Welcome to Tableau Desktop

This online help system from Tableau Software® contains the complete product documentation for using Tableau Desktop.

**Get Started** on page 32 Take a tutorial that tells a data story, or follow steps through opening Tableau, building and enhancing a view, and saving your work.

**Build-It-Yourself Exercises** on page 55 Create popular view types based on sample data sources that come with Tableau.

**The Tableau Environment** on page 122 Learn what elements of the Tableau UI are called.

**Tableau Concepts** on page 256 Dig into the ideas behind the terms and behaviors you see in Tableau.

**Connect to Your Data** on page 340 Connect to a wide variety of data sources, including files, SQL databases, web data, and cube (multidimensional) databases.

**Set Up Data Sources** on page 349 Configure and optimize your data source for analysis.

**Manage Data Sources** on page 428 Edit, refresh, replace, export, and upgrade data sources.

**Building Data Views** on page 436 Drag and drop fields to create views of your data, then refine the view.

**Work with Time** on page 570 Identify trends and make forecasts by working with date and time fields.

**Filter Data from Your Views** on page 630 Display only the data you choose.

**Build and Use Maps** on page 659 Assign geographic roles, build basic map views, explore data in maps, and more.

**Advanced Analysis** on page 746 Create custom fields, use the built-in statistical tools, and more.

**Optimize Workbook Performance** on page 942 Speed up your workbooks.

**Present your work** on page 958 Work with formatting, dashboards, and stories.

**Publish Data Sources and Workbooks** on page 1104 Share your work with others using Tableau Online, Tableau Server, the Tableau mobile app, or on Tableau Public.

**Save, Export, and Print** on page 1143 Make your work available to other applications.

**Reference** on page 1165 Upgrade Tableau Desktop, consult a Quick Start, look up Tableau functions, keyboard shortcuts, connectors, glossary definitions, and more.

Copyright Notices
What's New in Tableau Desktop

Browse summaries of new features in version 10.0 or in previous versions (9.0 through 9.3).

What's New in Tableau Desktop 10.0

- Retain connection details below
- New connectors on the next page
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- Display titles in worksheets on page 5
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Retain connection details

After you connect to a database, Tableau 10.0 stores every connection detail that you enter in the Connection dialog box except the password. The next time you connect to that database, the only thing you have to enter is the password. These settings are stored per user, so shared computers do not share connection settings.
New connectors

New Google Sheets connector
Use the Google Sheets connector to connect to a Google Sheets data source. For more information, see Google Sheets on page 1231.

New Presto connector
Use the Presto connector to connect to Presto 141t from Teradata. For more information, see Presto on page 1302.

New MemSQL connector
Use the MemSQL connector to connect to MemSQL data. MemSQL uses a MySQL driver, so if you already have a MySQL driver installed, you can connect to MemSQL. For more information, see MemSQL on page 1269.

New QuickBooks Online connector
Use the QuickBooks Online connector to connect to QuickBooks Online data. For more information, see QuickBooks Online on page 1308.

Size marks on an axis
For views where the mark type is Bar and there are continuous fields on both Rows and Columns, Tableau 10.0 adds options for sizing the bar marks on the axis where the bars are anchored.

- The bar marks in histograms are continuous by default (with no spaces between the marks), and are sized to match the size of the bins. See Build a Histogram on page 85 for an example.

- When there is a field on Size, you can determine the width of the bar marks on the axis where the bars are anchored using the field on Size. To do this, click the Size card and choose Fixed.

- When there is no field on Size, you can specify the width of the bar marks on the axis where the bars are anchored in axis units. To do this, click the Size card, choose Fixed, and then type a number in the Width in axis units field.

- When there is a continuous date field on the axis where the bars are anchored, the width of the marks is set to match the level of the date field. For example, if the level of the continuous date field is MONTH, the bars are exactly one month wide—that is, slightly wider for 31-day months than for 30-day months. You can configure the width of the bars by clicking the Size card, choosing Fixed, and then typing a number in the Width in
days field, but the resulting bar widths don’t take account of the varying lengths of time units, such as months and years.

**New table calculation experience**

Tableau 10.0 enhances the experience of creating table calculations:

- When you work in the Table Calculation dialog box to configure a calculation, the view updates in real time to show the results of your choices.
- **Highlighting** shows you the scope and direction of your calculation by setting off part of the view with a colored background. As you change the **Compute Using** option in the Table Calculation dialog box, the highlighting reflects your changes.

See [Transform Values with Table Calculations](#) on page 767 for details.

**Display titles in worksheets**

Titles are now turned on automatically in worksheets and appear as part of the view. You can create polished presentations using your worksheet without creating a separate dashboard. For more information, see [Titles](#) on page 225.

**Combine data with cross-database joins**

Combine data from different databases using a cross-database join. For example, you can combine related data from tables stored in an Excel workbook and a SQL Server database. For more information, see [Join Your Data](#) on page 349.

**Highlight data points in context**

The Highlighter is a new interactive exploration tool that you can use to quickly find and highlight specific data points while maintaining the context of the data. It is simple and powerful.

To use this new tool, do the following:

1. Select **Show Highlighter** from the context menu on a discrete field that is used in the view and that affects the level of detail in the view.
2. Search for the data you are interested in (a specific mark or group of marks) using a
keyword search, or select a mark from the drop-down list.

The marks are highlighted in the view.

You can also perform ad hoc comparisons with instant highlighting when you hover over items in the drop-down list.

**LOD expressions: Dimension expressions supported in dimensionality declaration**

You can now use any expression that evaluates as a dimension, including Date expressions, in the dimensionality declaration for a level of detail expression.

This example excludes a discrete date bin in the view:

```{EXCLUDE YEAR(Date) : SUM([Sales])}
```

This example excludes the `YEAR(Date)`, which is a discrete date bin in the view:

```{EXCLUDE DATEPART('year', Date) : SUM([Sales])}
```

This example excludes the `YEAR(Date)`, which is a continuous date field in the view:

```{EXCLUDE DATETRUNC('year', Date): SUM([Sales])}
```

For information about level of detail expression syntax, see **Overview: Level of Detail Expressions** on page 824.
Find clusters in data

You can now find meaningful clusters in your data by dragging **Cluster** from the **Analytics** pane and dropping it in the view. The result is a statistical object that Tableau places on **Color**. If there is already a field on **Color**, Tableau moves that field to **Label**.

Cluster analysis partitions marks in the view into clusters, where the data values within each cluster are more similar to one another than they are data values in other clusters.

You can drag a cluster from **Color** to the **Data** pane to make it a group dimension in which the individual members (Cluster 1, Cluster 2, etc.) contain the marks that the cluster algorithm has determined are more similar to each other than they are to other marks.

See **Find Clusters in Data** on page 845 for details.

Oracle support for table functions and for Kerberos

One way to simplify data access in Oracle is to create table functions, which return tables while hiding complex logic and exposing parameters. When you connect to Oracle, you can use table functions, which appear under **Stored Procedures** on the data source page.

Tableau supports Kerberos for Oracle. Enterprise environments that use Active Directory with Tableau can now have a seamless single sign-on experience with Oracle and Tableau.

For more information, see **Oracle** on page 1288.
**SQL Server support for contained databases**

Microsoft SQL Server and Azure SQL support a new feature called *contained databases*. When a database is *contained*, user information is stored in the database rather than in the database management system, which makes the database more portable. In Tableau 10.0, you can connect to contained databases by entering the database name in the connection dialog box. See Microsoft SQL Server on page 1276.

**Use JDBC to connect to SAP HANA on a Mac**

You can now connect to SAP HANA on a Mac using JDBC drivers. For more information, see SAP HANA on page 1319.

**Create device layouts for a dashboard**

After you’ve built a dashboard you can create layouts for it that are specific to particular devices.

When you publish the dashboard to Tableau Server or Tableau Online, people who interact with it experience a dashboard expressly designed for their screen display, whether it’s a phone, tablet, or desktop. For more information, see Try it: Create Dashboard Device Layouts on page 1052.
Format at the workbook level

You can quickly change how fonts and titles look in every view in a workbook by specifying format settings at the workbook level instead of at the worksheet level. See Change Formatting at the Workbook Level on page 977 for more information.
Create territories on a map

You can create territories on a map view by grouping existing locations (location points or polygons) together. For more information, see Create Territories on a Map on page 715.
Measure distance in metric or imperial (U.S.) units

You can now choose to measure in meters and kilometers or feet and miles when you measure distances on a map with the Radial tool. For more information, see Change the units of measurement on page 740.

Map data updates

Hong Kong districts; Singapore URA subzones, South Korea Sigungu (Metropolitan Areas); and Taiwan cities and districts are now automatically recognized by Tableau and can be geocoded with the County geographic role. For more information, see County-equivalents recognized by Tableau on page 698.

Postcodes for Argentina, Brazil, Costa Rica, India, Mexico, Singapore, and Taiwan are now automatically recognized by Tableau and can be geocoded with the Zip Code/Post Code geographic role. For more information, see ZIP codes and postcodes recognized by Tableau on page 699.

Update to the default map server address

When configuring Tableau Desktop and Tableau Server proxy settings, use maps.tableau.com to connect to the default map server. For more information, see Web Proxy and Firewall Settings in the Tableau Knowledge Base.
Filter data across multiple primary data sources

You can apply a filter across multiple primary data sources. For more information, see Filter Data Across Multiple Data Sources on page 646.

On-demand connections

When you load a workbook, Tableau connects only to the data sources that are required to display your data. This means that if there are multiple sheets in a workbook, Tableau only connects to the data sources for the current sheet so that you can view your data as soon as possible. For data sources that require authentication, now you only have to enter your credentials for the current sheet.

Added in version 9.3

- Desktop installer improvements below
- Stay connected to Tableau Server or Tableau Online on the next page
- Forecasting improvements on page 14
- New data source support for Tableau functions and aggregations on page 15
- Add color to sheets in sorter view on page 15
- Workbook updates to use published data source on page 15
- Union your data on page 15
- Data grid enhancements on page 16
- Zooming improvements for maps on page 16
- WMS Support for Web Mercator on page 16
- New default tool for maps on page 16
- View tools remain active on page 16
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- New Snowflake data connector on page 17
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- OAuth support for Salesforce in Tableau Desktop on page 18
- Initial SQL support added to more data sources on page 18
- Initial SQL parameter support on page 18

Desktop installer improvements

To streamline the install experience for Tableau Desktop for Windows, the four most common database drivers are now included as part of the setup process and are automatically installed by default. The following drivers are included:

- MySQL (version 5.3.6)
- Microsoft SQL Server (version 2008 R2 SP3)
- PostgreSQL (version 9.3.400)
- Amazon Redshift (version 1.2.1)

Note: Microsoft Visual C++ Redistributable is also automatically installed as a prerequisite for MySQL.

To view the list of drivers, or to clear the option to install these drivers, accept the license agreement on the installer page, and then click Customize.

You can clear the option to install the drivers in either the user interface or from the command line.

If you want to perform a quiet install for Tableau Desktop 9.3, use the installer (.exe) file. The installer package (.msi) is included as part of the installer file and can no longer be extracted separately.

For more information about how to perform a quiet install of Tableau Desktop, see Performing a Quiet Installation of Tableau desktop or Tableau Reader in the Tableau Knowledge Base.

**Stay connected to Tableau Server or Tableau Online**

When you connect to Tableau Server or Tableau Online, Tableau Desktop saves each connection from session to session if you don't sign out. Next time you launch Tableau
Desktop, you are signed in to your most recent server connection. You can also sign into different servers and easily switch between your available server and site connections.

For more information, see Quick Start: Stay Connected with Automatic Sign-In on page 1621.

**Forecasting improvements**

Forecasting in Tableau Desktop has been improved in the following ways:

- You can now forecast values ordered by an integer dimension. Formerly it was only possible to forecast measures that are ordered by time. For more information, see Forecasting When No Date is in the View on page 602.

- Automatic selection of the best season length for a forecast has been improved. For more information, see the **Seasonality** section in How Forecasting Works in Tableau on page 593.

- Tableau forecasting will now skip null or missing values when estimating model parameters. However, the nulls remain in the series so the indexes of the values remain the same. For example, for a daily time series that is missing weekend days, the algorithm computes the model, potentially with parameters for a weekly cycle, but without using the missing values. But because the missing values are in the series, the cycle length is still seven days.

Due to this change:

- Forecasting now supports irregular time series without zero fill. So no error will result if you do not select **Fill in missing values with zeros** in the Forecast Options dialog box.
The Fill in missing values with zeros option is no longer selected by default in the Forecast Options dialog box.

New data source support for Tableau functions and aggregations

For Tableau 9.3, more functions and aggregations are available for more data sources:

- The PERCENTILE function and aggregation are now available for Cloudera Hive, Hortonworks Hadoop Hive, and EXASolution data sources.
- The MEDIAN function and aggregation are now available for Cloudera Hive, Hortonworks Hadoop Hive, and EXASolution data sources.
- Regular expression functions (beginning with REGEXP_) are now available for HP Vertica, Pivotal Greenplum, and Teradata (version 14.1 and above) data sources. See Additional Functions on page 1409. In addition, REGEXP_MATCH is now supported for Impala 2.3.0 and higher in Cloudera Hadoop data sources.
- The SPLIT function is now supported for Impala 2.3.0 and higher in Cloudera Hadoop data sources. Split functionality in the Data source pane is also now supported for Impala 2.3.0 and higher in Cloudera Hadoop data sources. See Quick Start: Split a Field into Multiple Fields on page 1492.

Add color to sheets in sorter view

To make it easier to identify or group worksheets, you can now add color to the sheet tabs in the sheet sorter.

Workbook updates to use published data source

When you publish a data source to Tableau Server or Tableau Online, the workbook you're publishing it from is updated to connect to the published data source. At the same time the local data source is closed. To continue using the local data source, clear the Update workbook to use the published data source check box in the Publish data source to Tableau Server dialog box.

If you click Undo after publishing a data source, Tableau will revert to using the local data source, but it will not "un-publish" the data source.

Tableau does not replace the local data source when you publish a cube (multidimensional) data source.

For more information, see Publish a Data Source on page 1122.

Union your data

In your Tableau data source, you can now append rows of data from one table to another table thereby creating unions. If columns in the union do not align correctly, you can merge the
columns whose names don’t match. For more information, see **Union Your Data** on page 382.

**Data grid enhancements**

From the grid on the Data Source page, you can now do the following:

- See extract data and extract-only calculations, including data from the Web Data Connector
- Review data after applying extract filters and aggregating extracts
- Create groups and bins
- Join on pivot columns
- Join on merged columns
- See sheet and table name information for unioned tables

**Zooming improvements for maps**

Zooming in map views just got easier. You can now scroll to zoom in and out of a point on a map.

**WMS Support for Web Mercator**

Tableau now supports WMS servers that use Web Mercator. For more information, see **Supported Spatial Reference Systems** on page 727 in the Use WMS Servers topic.

**New default tool for maps**

When you click and drag in a map view, you can now automatically select marks with the rectangular tool. This is a change in behavior to Tableau Desktop version 9.2, where clicking and dragging in a map view would automatically allow you to pan across the view instead.

**View tools remain active**

When you select a tool from the view toolbar (the pan tool, zoom area tool, radial tool, rectangular tool, or lasso tool), it remains active until you select to use another tool. The same is true if you use keyboard shortcuts to switch between tools. This is a change in behavior to Tableau Desktop version 9.2, where a tool would revert back to the default after one use.

The last tool you select will be saved with the workbook and available when you reopen it or publish it to the web.

**Totals are no longer included in color encoding**

Totals are no longer color encoded by default when you add them to the view.
To include totals in color encoding, click **Color** on the Marks card and then select **Edit Colors**. In the Edit Colors dialog box, select **Include Totals**.

### Default

<table>
<thead>
<tr>
<th>Sub-Category</th>
<th>Central</th>
<th>East</th>
<th>South</th>
<th>West</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>$7,252</td>
<td>$11,196</td>
<td>$7,005</td>
<td>$2,936</td>
<td>$26,385</td>
</tr>
<tr>
<td>Appliances</td>
<td>$-2,639</td>
<td>$8,391</td>
<td>$4,124</td>
<td>$6,426</td>
<td>$13,680</td>
</tr>
<tr>
<td>Art</td>
<td>$1,195</td>
<td>$1,900</td>
<td>$1,059</td>
<td>$1,501</td>
<td>$6,655</td>
</tr>
<tr>
<td>Binders</td>
<td>$-1,044</td>
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<td>$3,001</td>
<td>$2,525</td>
<td>$15,849</td>
</tr>
<tr>
<td>Bookcases</td>
<td>$-1,998</td>
<td>$-1,168</td>
<td>$1,339</td>
<td>$1,647</td>
<td>$-3,473</td>
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<tr>
<td>Chairs</td>
<td>$6,593</td>
<td>$9,358</td>
<td>$6,612</td>
<td>$4,028</td>
<td>$26,609</td>
</tr>
<tr>
<td>Copiers</td>
<td>$15,609</td>
<td>$17,023</td>
<td>$3,659</td>
<td>$13,374</td>
<td>$55,618</td>
</tr>
<tr>
<td>Envelopes</td>
<td>$1,778</td>
<td>$1,812</td>
<td>$1,465</td>
<td>$1,909</td>
<td>$6,964</td>
</tr>
<tr>
<td>Fasteners</td>
<td>$237</td>
<td>$264</td>
<td>$174</td>
<td>$275</td>
<td>$950</td>
</tr>
<tr>
<td>Furnishings</td>
<td>$-3,906</td>
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<td>$13,059</td>
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<tr>
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<td>$12,119</td>
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</tr>
<tr>
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<td>$8,645</td>
<td>$21,279</td>
</tr>
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<td>Supplies</td>
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<td>$2</td>
<td>$626</td>
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<tr>
<td>Tables</td>
<td>$-3,560</td>
<td>$-11,025</td>
<td>$-4,623</td>
<td>$1,483</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td>$39,706</td>
<td>$91,523</td>
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### Totals included in color encoding

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### New Snowflake data connector

Use the Snowflake connector to connect to a Snowflake data warehouse. For more information, see **Snowflake** on page 1336.

### New Kognitio data connector

Starting in 9.3.1, use the Kognitio connector to connect to a Kognitio database. For more information, see **Kognitio** on page 1255.

### New Cisco Information Server data connector

Starting in 9.3.1, use the Cisco Information Server connector to connect to a Cisto Information Server virtual database. For more information, see **Cisco Information Server** on page 1201.
Data preview for Web Data Connectors

When you connect using a Web Data Connector, Tableau now opens on the Data Source page so that you can prepare your data (for example, change data types or hide columns) before you start your analysis.

Kerberos support for PostgreSQL and Teradata

Kerberos support has been added for PostgreSQL and Teradata connections. For more information, see PostgreSQL on page 1298 or Teradata on page 1343. For information about configuring Tableau Server for Kerberos, see Kerberos in the Tableau Server Help.

OAuth support for Salesforce in Tableau Desktop

You can now use OAuth when you connect to Salesforce in Tableau Desktop. After you provide your Salesforce credentials and allow Tableau access to the data, Salesforce.com creates an OAuth access token that is used to connect to the data. Instead of having to embed your credentials in data sources or workbooks, you can use the access token.

Initial SQL support added to more data sources

Oracle, Pivotal Greenplum, and Microsoft SQL Server now support initial SQL statements.

Initial SQL parameter support

For data source connections that support initial SQL, you can now perform parameter substitution for a set of useful parameters, such as ServerUser and WorkbookName. For more information, see Run Initial SQL on page 343.

Added in Version 9.2

- Google Analytics query enhancements on the next page
- Recent colors save to the application on the next page
- Data grid enhancements on the next page
- Data Interpreter enhancements on the next page
- Data pane enhancements on page 20
- Match mark label color to mark color on page 21
- Label most recent marks on page 22
- Fix one or both ends of an axis on page 22
- Move totals to the top or left of the view on page 23
- New Map Options dialog box on page 24
- Support for Mapbox maps on page 24
- SAP HANA column labels on page 24
- Query improvements on page 25
Show Quick Filter has changed to Show Filter on page 25

Google Analytics query enhancements

By default, Tableau returns all data in a Google Analytics query to avoid returning sampled data. See Quick Start: Query All Data from Google Analytics on page 1507.

Recent colors save to the application

From any Color drop-down control, you can select a recently used color. Up to eight recently used colors save to the application and are available in any workbook.

Data grid enhancements

The following functionality is now available from the grid on the Data Source page:

- Sort columns and rows
- Double-click the name of the column to rename the field
- Reset the name of a single column or select multiple columns to reset the column names at once
- Create calculations based on existing fields in the data source
- Copy values in the data source using Ctrl+C (Command-C on a Mac).

For more information, see Quick Start: Data Grid Enhancements on page 1467.

Data Interpreter enhancements

The Data Interpreter now detects subtables in your Excel data. For more information, see Excel on page 1167.
Data pane enhancements

The following functionality is now available in the Data pane:

- Click the icon to the left of a field in the Data pane to change the field’s data type or geographic role:

- Click a field and hold down the mouse button to rename the field:

- Enhanced Search options in the Data pane. Click the search icon at the top of the Data pane or press Ctrl + F (Command-F on a Mac) to initiate a search. As you type in the
search box, search now filters the contents of the Data pane to show all fields that contain the typed string. Search remains open until you click the search icon or press Ctrl + F again.

- The zones apportioned for Dimensions, Measures, Parameters, and Sets in the Data pane automatically size so that scroll bars are not shown unless there are more fields than can be displayed in the available space.

See Data Types on page 256, Rename Fields on page 303, and Find Fields on page 302.

**Match mark label color to mark color**

You can select to closely match the color of each label to the color of its mark. See Select label color. on page 516 in the Format Mark Labels topic.
Label most recent marks

When there is a date field in the view, you can select to label the most recent marks in the view. Labels are based on the level of detail of fields in the view. See Show and Hide Mark Labels on page 504.

Fix one or both ends of an axis

You can specify the values for the start or end of an axis. See Edit Axes on page 964 in the Edit Axes topic.
Move totals to the top or left of the view

You can select to show totals at the top or left of the view. See Move Totals on page 916.
New Map Options dialog box

Use the new Map Options dialog box to customize how your audience interacts with your map view. Use the Map Layers pane (previously the Map Options pane) to customize the appearance of your map. See Customize How People Interact with your Map on page 722.

Support for Mapbox maps

You can now connect to Mapbox maps in Tableau. See Use Mapbox Maps on page 730.

SAP HANA column labels

By default, the SAP HANA column names now display the column label, rather than the column name.
Query improvements

The following query improvements have been added for Tableau 9.2.

- **Filtering on categorical aggregates**
  You can now create a filter that aggregates a measure and use it as a domain filter.

- **Numerical bins and combined fields in level of detail expressions**
  You can now refer to a numerical bin or a combined field in a level of detail expression.

- **MIN and MAX supported for boolean data type**
  These aggregations can now be used with boolean fields.

- **Additional optimizations**
  Tableau can now detect “always false” predicates and avoid issuing queries for them. For known domains such as boolean, we short circuit to return \{true, false\} or \{true, false, null\}. Other rewrites include folding case expressions with constant results to IN SET or NOT IN set.

Show Quick Filter has changed to Show Filter

In Tableau 9.2, the option to Show Quick Filter for a field has changed to Show Filter. For more information, see Filter Data from Your Views on page 630

Added in Version 9.1

The following new features and enhancements have been added to Tableau Desktop for version 9.1.

- **Product Updates below**
  - Single Sign-On for SAP HANA on the next page
  - Web Data Connector on the next page
  - SAP Prompts on the next page
  - Bin Size Optimization on the next page
  - Auto-complete Availability on the next page
  - Confidence Intervals for Reference Lines on the next page
  - Measure Distance with the Radial Tool on the next page
  - Turn Off Pan and Zoom on page 27

Product Updates

To ensure that you always have the most up-to-date features, security resolutions, and corrected issues, Tableau Desktop includes a product update feature. See Turn Product Updates Off or On on page 1625.
Single Sign-On for SAP HANA

When SAP HANA is configured to support single sign-on (SSO), after you sign in to the SAP HANA server, you can access data, and publish data sources and workbooks to Tableau Server, without having to re-enter your user name and password. See Quick Start: SAP HANA Single Sign-On on page 1488. Note: Tableau Desktop requires SAP HANA driver version 1.00.85 and later to support SSO for SAP HANA.

Web Data Connector

You can use a web data connector to connect to data that is accessible over HTTP and that doesn’t already have a connector. You can create your own web data connector or use one that has been created by someone else. See Web Data Connector on page 1354.

SAP Prompts

With SAP HANA and SAP Netweaver Business Warehouse, you can prompt for a variable when a workbook is opened. See SAP HANA on page 1319 or SAP NetWeaver Business Warehouse on page 1325.

Bin Size Optimization

When you create discrete bins from a continuous measure, Tableau can compute an optimal bin size. See Create Bins from a Continuous Measure on page 554.

Auto-complete Availability

You can now take advantage of auto-completion for formulas in additional locations where you can create formulas—for example, when you add conditions or limits to filters, or when you create a set based on a condition. See (for example) Filter Data from Your Views on page 630.

Confidence Intervals for Reference Lines

You can now add and configure confidence intervals (bands) for a reference line. See Adding Reference Lines on page 878. You can no longer add confidence intervals for reference distributions.

Measure Distance with the Radial Tool

Use the Radial tool to measure approximate distances between your data and the locations or landmarks in a map view. For more information see, Measure Distances Between Data Points and Locations in a Map on page 737.
Turn Off Pan and Zoom

You can turn off pan and zoom to control how your audience interacts with your map view or background image. For more information see, Customize How People Interact with your Map on page 722.

Added in Version 9.0

The following new features and enhancements have been added to Tableau Desktop for version 9.0.

- New start page experience below
- Pivot below
- Split fields into multiple fields below
- Metadata area on the next page
- Data Interpreter on the next page
- New data sources and enhancements to existing data sources on the next page
- Analytics pane on page 29
- Recalculated lines on page 30
- New calculation features on page 30
- Story point formatting on page 31
- Advanced selection tools on page 31
- Map search on page 31
- Configurable tooltip behavior on page 31

New start page experience

The start page in Tableau Desktop is a central location from which you can connect to your data, access most recently used workbooks, and explore content produced by the Tableau community. For more information, see Start Page on page 122.

Pivot

Pivot your Microsoft Excel and text file data sources from crosstab format to columnar format. For more information, see Pivot Data from Columns to Rows on page 398.

Split fields into multiple fields

Split existing string fields into new fields. For more information, see Split a Field into Multiple Fields on page 403.

SPLIT is also available as a Tableau function, for use in calculated fields. For more information, see String Functions on page 1369.
**Metadata area**

Perform bulk management tasks, like hiding multiple fields at once, using the metadata area. For more information, see Data Source Page on page 126.

**Data Interpreter**

Detect and remove unique formatting and extraneous information in your Excel data sources. For more information, see Excel on page 1167.

**New data sources and enhancements to existing data sources**

**New: Amazon Aurora**

Use the Amazon Aurora connector to connect to an Amazon Aurora data source. For more information, see Amazon Aurora on page 1187.

**New: Spark on Azure HDInsight**

Use the Spark SQL connector to connect to a Spark on Azure HDInsight data source. For more information, see Spark SQL on page 1339.

**New: Microsoft Azure SQL Database**

Connect to Microsoft Azure SQL Database data using the Microsoft SQL Server connector. For more information, see Microsoft SQL Server on page 1276.

**New: Google Cloud SQL**

Use the Google Cloud SQL connector to connect to a Google Cloud SQL database instance. For more information, see Google Cloud SQL on page 1228.

**New: Microsoft Azure SQL Data Warehouse**

Connect to Microsoft Azure SQL Data Warehouse data using the Microsoft SQL Server connector. For more information, see Microsoft SQL Server on page 1276.

**New: Amazon EMR**

Use the Amazon EMR connector to connect to an Amazon Elastic MapReduce (EMR) database. For more information, see Amazon EMR on page 1191.
New: Spark SQL
Use the Spark SQL connector to connect to a Spark SQL cluster (requires Apache Spark 1.2.1 or later). For more information, see Spark SQL on page 1339.

New: Statistical File
Use the Statistical File connector to connect to SAS (*.sas7bdat), SPSS (*.sav), and R (*.rdata, *.rda) data files. For more information, see Statistical File on page 1174.

Enhanced: MapR Hadoop Hive
MapR Hadoop Hive now supports connectivity for the Mac.

Enhanced: MySQL
SSL encryption is supported. Mac drivers are now included in the TableauDrivers.dmg file. For more information, see MySQL on page 1283.

Enhanced: Salesforce
The Salesforce connector now supports more flexible joins. You can create joins on any string fields in addition to fields that are constrained references between tables. For more information, see Salesforce on page 1315.

Enhanced: SAP NetWeaver Business Warehouse (BW)
The SAP NetWeaver Business Warehouse connector has been updated to include support for variables. For more information, see SAP NetWeaver Business Warehouse on page 1325.

Tableau Data Extracts
Tableau Data Extracts are no longer listed on the Connect pane. Use Other Files to connect to a Tableau Data Extract. For more information, see Other Files on page 1177.

Windows Azure Marketplace
To connect to Windows Azure Marketplace, use the OData connector. Workbooks created in earlier versions of Tableau that used the Windows Azure Marketplace DataMarket connector will work as expected. For more information, see OData on page 1286.

Analytics pane
The Analytics pane, on the left side of the Tableau workspace, provides quick and easy access to common analytic objects in Tableau. You can drag reference lines, forecasts, trend lines, and other objects into your view from the Analytics pane.
For more information, see Analytics Pane on page 131.

**Recalculated lines**

Recalculated lines help you gain insight into how a subset of your data compares to the overall data in your view. For more information, see Marks and Data Analysis on page 518.

**New calculation features**

The following features were added to Tableau Desktop to enhance the experience of creating and using calculated fields.

**Non-modal calculation editor**

The calculation editor has been redesigned to provide interactive editing, intelligent formula-completion, and drag-and-drop support. The calculation editor is now also available when you're editing a view in Tableau Server or Tableau Online.

For more information, see Create or Edit a Calculated Field on page 746.

**Ad-hoc calculations**

Ad-hoc calculations are calculations that you can create and update on a shelf in the view. Ad-hoc calculations can be useful for testing a hunch, trying a what-if scenario, or debugging a complex calculation.

For more information, see Ad-Hoc Calculations on page 755.

**Auto-completion for formulas**

As you type a formula, either in the calculation editor or in an ad-hoc calculation, Tableau displays a list of options for completing the formula.

For more information, see Auto-Completion for Formulas on page 753.

**Level of detail expressions**

Level of detail expressions support aggregation using dimensions other than those in the view. With level of detail expressions, you can attach one or more dimensions to any aggregate expression.

For more information, see Level of Detail Expressions on page 824.

**Functions for regular expressions**

Four new functions have been added to the calculation language to support regular expressions.
For more information, see functions beginning with REGEXP in Additional Functions on page 1409.

**Functions for hexagonal binning**

Hexagonal binning is a technique for clustering data in a two-dimensional plane. Two new functions have been added to the calculation language to support hexagonal binning. These functions support binning data in a single dimension using histograms, or by a geographic level of detail in a map.

For more information, see functions beginning with HEXBIN in Number Functions on page 1361.

**Story point formatting**

You can now re-size the captions in your story, change the shading and font of the navigator, and select to fit a dashboard to the exact size of a story in your workbook. For more information, see Format a Story on page 1088.

**Advanced selection tools**

Use the Radial, Rectangular, and Lasso tools on the view toolbar to select multiple marks in the view. For more information, see View Toolbar on page 521.

**Map search**

Use map search to find locations on a map view so you can quickly explore and inspect data. For more information, see Search for Locations in Your Map on page 735.

**Configurable tooltip behavior**

Show tooltips instantly as you move the mouse over the marks in a view or configure tooltips to display only after resting the mouse on a mark. For more information, see Tooltip Properties on page 209.
Get Started

This section shows you how to get started using Tableau Desktop and walks you through some exercises that introduce such concepts as connecting to data, creating a view, developing that view, and then saving it.

It also shows how you can quickly create a view using Show Me. With Show Me, Tableau automatically evaluates the fields you have selected and then shows you which types of views are appropriate for those fields.

Tutorial: Get Started with Tableau Desktop

Tableau Desktop makes exploring your data and sharing your insights easy. If you're new to it, though, it can be difficult to get started.

If this is true for you, check out the Get Started with Tableau Desktop tutorial.

The Get Started with Tableau Desktop tutorial walks you through the features and functions of Tableau Desktop. You'll learn how to connect to data; build, present, and share some useful views; and apply key features along the way.

Open Tableau and Connect to Data

In this topic you'll start Tableau Desktop and connect to a Microsoft Excel sample data source that comes with Tableau, which is called Sample - Superstore.

Open Tableau

On a Windows computer, open Tableau by selecting All Programs > Tableau 10.0 on the Windows Start menu, or by double-clicking the desktop shortcut.

On a Mac computer, open Tableau by selecting the Tableau icon in the Applications folder in Finder, by typing Tableau into Spotlight, or by clicking the Dock shortcut.

Tableau opens to the start page.

The start page contains sample workbooks and data sources. After you've used Tableau to connect to data or create a view, your recently used workbooks and saved data connections appear on the start page as well.

You can always return to the start page after you have started working in the data source page, or in a workbook or worksheet, by clicking the Tableau logo in the upper-left corner.

Connect to Data

The first step in Tableau Desktop is to connect to the data you want to explore.

This example shows how to connect to Microsoft Excel data from the start page.
1. On the start page, under Connect, click Excel.

The Connect pane lists the different types of data you can connect to:

![Connect pane](image)

2. In the Open dialog box, navigate to the Sample - Superstore Excel file on your computer at /My Documents/My Tableau Repository/Datasources and open it.

After you have connected to the Excel data, the data source page shows the sheets in your data. You drag one or more sheets to the canvas. You can combine sheets on the canvas to form the data source from which you will build your view.
3. At the top of the data source page, select how you want to connect to the data. You can select from the following options:

- **Live** – Creates a direct connection to your data. The speed of your data source will determine performance.

- **Extract** – By default, this option imports the entire data source into Tableau fast data engine as an extract. The extract is saved with the workbook. If you prefer to import a subset of the data, click the **Edit** link. This option requires you specify what data you want to extract using filters.

4. At the bottom of the data source page, preview the data in your data source in the *grid*. You can make the following changes in the grid:

   - Hide or rename a column by clicking the column header drop-down arrow.
   - Change the data type by clicking the data type icon in the column header.

5. Click the sheet tab to go to the new worksheet and begin your analysis.

**Step-by-Step: Explore Data with Tableau**

You are now invited to follow along through a series of topics to see how a view can evolve in Tableau through the process of exploration. First you create a basic view that shows year-to-year profit. Then you diversify the view to include more data, filter the view to drill into the most important data, and finally add color to make the results stand out.
In the worksheet, the columns from your data source are shown as fields on the left side in the **Data** pane. The **Data** pane contains a variety of different kinds of fields; for now the most important ones are *dimensions* and *measures*.

Dimensions typically hold categorical data such as product types and dates, while measures hold numeric data such as sales and profit. (If you want to know more, see **Dimensions and Measures** on page 261.)

When you build a view, you add fields from the **Data** pane. You can do this in different ways. For example:

- You can drag fields from the **Data** pane and drop them onto the cards and shelves that are part of every Tableau worksheet.
- You can double-click one or more fields in the **Data** pane.
- You can select one or more fields in the **Data** pane and then choose a chart type from **Show Me**, which identifies the chart types that are appropriate for the fields you selected. For details, see **Show Me** on page 551.
- You can drop a field on the **Drop field here** grid, to start creating a view from a tabular
Proceed to **Step 1 - Create a Basic View** below to create a view to show year-by-year profit.

**Step 1 - Create a Basic View**

Here you build a basic view that shows year-by-year profit in the form of a line chart.

1. From the **Dimensions** area in the **Data** pane, drag the **Order Date** field to the **Columns** shelf.

   When you drag a field over a shelf, a plus sign indicates that the shelf can accept the field.
The resulting table has four columns and one row. Each column header represents a member of the Order Date field (2011, 2012, 2013, and 2014). Each cell contains an “Abc” label, which indicates that the current mark type for this view is text.

Notice that the field is colored blue, which indicates that it is discrete. Also, the field name changed to YEAR(Order Date) because year is the default date level for this field.

The default date level is determined by the highest level that contains more than one distinct value (for example, multiple years and multiple months). That means that if [Order Date] contained data for only one year but had multiple months, the default level
would be month. You can change the date level using the field menu.

2. From **Measures** in the **Data** pane, drag the **Profit** field to the **Rows** shelf.
The **Profit** field is colored green on the **Rows** shelf, indicating that it is continuous. Also, the field name changes to **SUM(Profit)**. That’s because measures are automatically aggregated when you add them to the view, and the default aggregation for this measure is SUM. For more information on what happens when you add a measure to a view—and why—see Dimensions and Measures on page 261.

Tableau transforms the table into a line chart and creates a vertical axis (along the left side) for the measure.

A line chart is a great way to compare data over time and identify trends effectively.

This line chart shows profit over time. Each point along the line shows the sum of profit for the corresponding year.
The next step is to drill a little deeper into the time dimension. See Step 2 - Create a Nested Table View below.

**Step 2 - Create a Nested Table View**

In this example you modify the view from Step 1 - Create a Basic View on page 36 to show quarters in addition to years.

You can show [Order Date] by quarters using either of the following methods:

- Click the plus button on the left side of the field YEAR(Order Date) field on **Columns**.

- Drag the Order Date field (again) from the **Data** pane and drop it on the **Columns** shelf to the right of Year(Order Date).

The new dimension divides the view into separate panes for each year. Each pane, in turn, has columns for quarters. This view is called a nested table because it displays multiple headers,
with quarters nested within years. The word "headers" might be a bit misleading because while the year headers remain at the "head" of the view (that is, the top), the quarter headers are at the foot (that is, the bottom). So it might be more accurate to call them footers.

Continue to refine the view in Step 3 - Create a Small Multiples View below.

**Step 3 - Create a Small Multiples View**

In this step you modify the view from Step 2 - Create a Nested Table View on the previous page to add customer segment.

Drag the Segment dimension from the Data pane and drop it just to the left of the Profit axis in the view.

The field is added to the Rows shelf and row headers are created. Each header represents a member of the Segment field.
You could achieve the same result by dropping Segment on the Rows shelf, to the left of SUM(Profit). Tableau typically supports multiple ways to drag-and-drop fields.

**Note:** Tableau does not allow you to place a dimension to the right of a measure on either the Rows or Columns shelves.

The new dimension divides the view into 12 panes, one for each combination of year and segment. This view is a more complex example of a nested table. Any view that contains this sort of grid of individual charts is referred to as a small multiples view.
At this point you probably don’t want to make the view any more granular; in fact, you may want to simplify the view by removing (that is, filtering) some data. See **Step 4 - Filter to Show a Subset of Data** below.

**Step 4 - Filter to Show a Subset of Data**

In this step you modify the view from **Step 3 - Create a Small Multiples View** on page 41 to show only data for orders in 2012 and 2013.
1. Drag the **Order Date** measure from the **Data** pane and drop it on the **Filters** shelf.

![Filter Field dialog box](image)

2. In the Filter Field dialog box, choose the date level you want to filter on—**Years**. Then click **Next**.

3. In the next pane, clear the years that you do not want to include in the view—2011 and 2014.

4. When you are finished, click **OK**.

The view updates to only show data rows where Order Date is 2012 or 2013. Tableau can now allocate more space to the data that interests you.
In **Step 5 - Color Marks by Region** below, you complete your data exploration by adding color to the view.

**Step 5 - Color Marks by Region**

In this step, you modify the view from **Step 4 - Filter to Show a Subset of Data** on page 43 to color the marks by region.

1. Drag the **Region** dimension from the **Data** pane and drop it on **Color**.

   Placing a dimension on **Color** separates the marks according to the members in the dimension, and assigns a unique color to each member. The color legend displays each member name and its associated color.
Each pane now has four lines, one for each region. This view now shows profit for each customer segment and region for 2012 and 2013.
Create a Scatter Plot with Show Me

In this example you use Show Me to build a scatter plot to show sales versus profit for each product and customer.

1. Select **Customer Name** and **Product Name** (from the Dimensions area in the Data pane) and **Profit** and **Sales** from the Measures area. To select multiple fields, hold down the Ctrl key (or the command key on a Mac) as you click fields.

2. Click **Show Me** on the toolbar.
3. Select the scatter plot chart type from Show Me.

Tableau creates a scatter plot using the fields you selected. You can drag fields to further refine the view.
Create a Line Chart with Show Me

In this example, you use **Show Me** to create a line chart that displays profit as a function of time.

1. Select [Order Date] and **Profit** in the **Data** pane. Hold down the Ctrl key (or the command key on a Mac) as you select the fields.
2. Click **Show Me** on the toolbar to display the **Show Me** card, if it isn’t already displayed.

3. In the **Show Me** pane, see what type of view Tableau suggests.
Because a date dimension and a measure are selected, Tableau suggests you build a line view (as indicated by the check mark). A line is often the optimal way to look at how measure values change over time.

The view below shows the resulting chart. Each point on the line represents the sum of profit for the corresponding year.
You can more easily see the points by clicking the **Mark Labels** button on the toolbar.
Save Your Work

After you have created a set of views, you should save the results in a Tableau Workbook. You can open the workbook later to continue working on your views, or share your workbook with other users, either by sending them the file or publishing the workbook to the web. Follow the steps below to save your workbook.

1. Select **File > Save** or press Ctrl + S on your keyboard.
   
   On a Mac, select **File > Save** or press Command-S on your keyboard.

2. Browse to a file location to save the workbook.

   By default, Tableau saves workbooks in the Workbooks folder in My Tableau Repository.

3. Specify a file name for the workbook.

4. Specify a file type. You can select from the following options:

   **Tableau Workbook (.twb)** – Saves the all the sheets and their connection information in a workbook file. The data is not included.

   **Tableau Packaged Workbook (.twbx)** – Saves all the sheets, their connection information and any local resources (e.g., local file data sources, background images,
custom geocoding, etc.).

5. When finished, click **Save**.
Build-It-Yourself Exercises

This section includes detailed exercises that guide you through the steps involved in building some common types of data views. All exercises use the Sample - Superstore data source, which is included with Tableau Desktop. This collection of exercises is just a sample of the many types of data views that you can create in Tableau.

Build a Bar Chart

Use bar charts to compare data across categories. You create a bar chart by placing a dimension on the Rows shelf and a measure on the Columns shelf, or vice versa.

A bar chart uses the Bar mark type. Tableau selects this mark type when the data view matches one of the two field arrangements shown below. You can add additional fields to these shelves.

For more information about the Bar mark type, see Bar Mark on page 169.

<table>
<thead>
<tr>
<th>Creates Vertical Bars</th>
<th>Creates Horizontal Bars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columns Category</td>
<td>Columns SUM(Profit)</td>
</tr>
<tr>
<td>Rows SUM(Profit)</td>
<td>Rows Category</td>
</tr>
</tbody>
</table>

To create a bar chart that displays total sales over a four-year period, follow these steps:

1. Connect to the Sample - Superstore data source.
2. Drag the Order Date dimension to Columns.
   The data is aggregated by year and column headers appear.
3. Drag the Sales measure to Rows.
   The measure is aggregated as a sum and an axis is created. The column headers move to the bottom of the view.
   Tableau uses Line as the mark type because you added the date dimension.
4. On the **Marks** card, select **Bar** from the drop-down list.

The view changes to a bar chart.
The marks (which are bars in this case) are vertical because the axis is vertical. The length of each mark represents the sum of the sales for that year. For example, the sum of the sales in 2014 is $733,947, which you can verify by hovering over that column.

7. Drag the **Ship Mode** dimension to **Color** on the **Marks** card.

   The view shows how different shipping modes have contributed to total sales over time. The ratios look consistent from year to year.
8. Drag the **Region** dimension to **Rows**, and drop it to the left of **Sales** to produce multiple axes for sales by region.
9. To view data in the West region only, you can filter out the other regions. To do this, drag the Region dimension again, this time from the Data pane to the Filters shelf.

10. In the Filter [Region] dialog box, clear the Central, East, and South check boxes, and then click OK.
This view gives you insight into your data—for example, how the ship mode changed in the West over the four-year period.

**Build a Text Table**

In Tableau, you typically create text tables (also called cross-tabs or pivot tables) by placing one dimension on the **Rows** shelf and another dimension on the **Columns** shelf. You then complete the view by dragging one or more measures to **Text** on the **Marks** card.

A text table uses the text mark type. Tableau uses this mark type automatically if the view is constructed using only dimensions (assuming the mark type is set to **Automatic**). For more information about the text mark type, see **Text Mark** on page 176.

To create a text table that shows sales totals by year and category, follow these steps:

1. Connect to the **Sample - Superstore** data source.
2. Drag the **Order Date** dimension to **Columns**.
   
   Tableau aggregates the date by year and creates column headers.
3. Drag the **Sub-Category** dimension to **Rows**.
   
   Tableau creates row headers. Columns with headers plus rows with headers means that a valid table structure now exists. Now you can add a measure to the view to see actual data.
4. Drag the **Sales** measure to **Text** on the **Marks** card.
Tableau aggregates the measure as a sum.

Tableau uses text as the mark type. Each cell in the table displays the sum of sales for a particular year and sub-category.

We can see that the chairs and phones sub-categories had the highest sales in every year.

5. Drag the **Region** dimension to **Rows** and drop it to the left of **Sub-Category**. A small triangle will appear to indicate that the new field will be inserted to the left of the existing field.

The view now breaks out sales by region, in addition to year and sub-category.
Regions are listed alphabetically. You can drop **Region** to the right of **Sub-Category** to organize the view first by sub-category, and then by region.
You can use a table calculation to show percentages of total instead of raw dollar values. First, you must determine how to frame the calculation.

In this case, there are three dimensions in the view: **Order Date**, **Sub-Category**, and **Region**.

You could show percentages of total for a single dimension, but that can be unwieldy. For example, if you show percentages just by region, the percentages would be calculated across the two remaining dimensions: **Sub-Category** (there are 17 sub-categories) and **Year(Order Date)** (there are 4 years). So you would be dividing the total $17 \times 4 = 68$ ways. That would make for some tiny percentages.

Instead, show percentages using two dimensions: **Year(Order Date)** and **Region**. Then the percentages are calculated on the remaining dimension, **Sub-Category**, that is, you calculate percent of total within each highlighted area shown below.
The dimensions that you use to frame your calculation are called the *addressing fields*, and the fields in which you run your calculation are the *partition fields*.

For more information about these concepts, see *Table Calculations: Addressing and Partitioning* on page 780.

6. To create a table calculation to show percentages, right-click (control-click on Mac) the *SUM(Sales)* field on the *Marks* card, and then select *Add Table Calculation*. 
7. In the Table Calculation dialog box, set Calculation Type to Percent of Total.

The options in the dialog box change depending on the type of calculation you choose.
For more information about using table calculations, see Transform Values with Table Calculations on page 767.

8. For the Calculation definition, select Pane (Down), and then close the Table Calculation dialog box.

Now we see percentages calculated within each sub-category, duplicated for each year within each region. The numbers within each highlighted area add up to 100%.
Pane (Down) is the appropriate choice because it specifies that the calculation should be performed from top to bottom within each pane of the table. The table has two vertical dimensions, so Table (Down) would have calculated the percent of total from top to bottom for the entire table, ignoring the Region dimension.

The pane is always the finest level of detail for the relevant direction (across or down). If you had three dimensions on the vertical axis, you might have had to use field names to define the calculation, because only the dimension furthest to the left on the Rows shelf (defined as Table) and the dimension furthest to the right (defined as Pane) could be captured with the structural options.

These concepts can be daunting. One solution is to use trial-and-error to see the results of different definitions for table calculations. But you should have a clear idea of what result you want, so that you can recognize it when you see it.

**Building Line Charts**

Line charts connect individual data points in a view. They provide a simple way to visualize a sequence of values and are useful when you want to see trends over time, or to forecast future values. For more information about the line mark type, see Line Mark on page 170.

To create a view that displays the sum of sales and the sum of profit for all years, and then uses forecasting to determine a trend, follow these steps:

1. Connect to the Sample - Superstore data source.
2. Drag the Order Date dimension to Columns.
   
   Tableau aggregates the date by year, and creates column headers.
3. Drag the Sales measure to Rows.
Tableau aggregates **Sales** as SUM and displays a simple line chart.

4. Drag the **Profit** measure to **Rows** and drop it to the right of the **Sales** measure.

Tableau creates separate axes along the left margin for **Sales** and **Profit**.

Notice that the scale of the two axes is different—the **Sales** axis scales from $0 to $700,000, whereas the **Profit** axis scales from $0 to $100,000. This can make it hard to see that sales values are much greater than profit values.

When you are displaying multiple measures in a line chart, you can align or merge axes to make it easier for users to compare values.
For more information about aligning the axes, see **Dual Axes on page 564**.

For more information about enforcing a single axis across multiple measures, see **Blended Axes on page 563**.

With either of these options, you can create a combination chart to change the mark type for one of your measures.

For more information, see **Combination Charts on page 567**.

5. Drag the SUM(Profit) field from **Rows** to the **Sales** axis to create a blended axis. The two pale green parallel bars indicate that **Profit** and **Sales** will use a blended axis when you release the mouse button.
The view updates to look like this:
The view is rather sparse because we are looking at a summation of values on a per-year basis.

6. Click the drop-down arrow in the **Year(Order Date)** field on the **Columns** shelf and select **Month** in the lower part of the context menu to see a continuous range of values over the four-year period.
The resulting view is a lot more detailed than the original view:
Notice that the values seem to go much higher just before the end of each year. A pattern like that is known as seasonality. If we turn on the forecasting feature in the view, we can see whether we should expect that the apparent seasonal trend will continue in the future.

7. To add a forecast, in the Analytics pane, drag the Forecast model to the view, and then drop it on Forecast.
We then see that, according to Tableau forecasting, the seasonal trend does continue into the future:

![Tableau Scatter Plot Example]

**Build a Scatter Plot**

Use scatter plots to visualize relationships between numerical variables.

In Tableau, you create a scatter plot by placing at least one measure on the Columns shelf and at least one measure on the Rows shelf. If these shelves contain both dimensions and measures, Tableau places the measures as the innermost fields, which means that measures are always to the right of any dimensions that you have also placed on these shelves. The word "innermost" in this case refers to the table structure.

**Creates Simple Scatter Plot**

**Creates Matrix of Scatter Plots**
A scatter plot can use several mark types. By default, Tableau uses the shape mark type. Depending on your data, you might want to use another mark type, such as a circle or a square. For more information, see Mark Types on page 164.

To use scatter plots and trend lines to compare sales to profit, follow these steps:

1. Open the Sample - Superstore data source.
2. Drag the Profit measure to Columns.
   Tableau aggregates the measure as a sum and creates a horizontal axis.
3. Drag the Sales measure to Rows.
   Tableau aggregates the measure as a sum and creates a vertical axis.

Measures contain continuous numerical data. When you plot one number against another, you are comparing two numbers; the resulting chart is analogous to a Cartesian chart, with x and y coordinates.

Now you have a one-mark scatter plot:

4. Drag the Category dimension to Color on the Marks card.
   This separates the data into three marks—one for each dimension member—and encodes the marks using color.
5. Drag the **Region** dimension to **Detail** on the **Marks** card.

Now there are many more marks in the view. The number of marks is equal to the number of distinct regions in the data source multiplied by the number of departments. (If you’re curious, use the **Undo** button on the toolbar to see what would have happened if you’d dropped the **Region** dimension on **Shape** instead of **Detail**.)
To add trend lines, from the **Analytics** pane, drag the **Trend Line** model to the view, and then drop it on the model type.

A trend line can provide a statistical definition of the relationship between two numerical values. To add trend lines to a view, both axes must contain a field that can be interpreted as a number—by definition, that is always the case with a scatter plot.

Tableau adds three linear trend lines—one for each color that you are using to distinguish the three categories. Tableau also shows the confidence bands for each trend line.

To declutter the view, remove the confidence bands: right-click (control-click on Mac) in the view and choose **Trend Lines > Edit Trend Lines**. In the Trend Line Options dialog
box, in the **Options** section, clear the **Show Confidence Bands** check box, and then click **OK**.

8. Hover the cursor over the trend lines to see statistical information about the model that was used to create the line:

For more information, see *Assessing Trend Line Significance* on page 621. You can also customize the trend line to use a different model type or to include confidence bands. For more information, see *Adding Trend Lines* on page 615.

**See Also**

*Example – Scatter Plots and Aggregation* on page 333

**Build a Heat Map**

Use heat maps to compare categorical data using color.
In Tableau, you create a heat map by placing one or more dimensions on the **Columns** shelf and one or more dimensions on the **Rows** shelf. You then select **Square** as the mark type and place a measure of interest on the **Color** shelf.

You can enhance this basic heat map by setting the size and shape of the table cells.

To create a heat map to explore how profit varies across regions, product sub-categories, and customer segments, follow these steps:

1. Connect to the **Sample - Superstore** data source.
2. Drag the **Segment** dimension to **Columns**.
   
   Tableau creates headers with labels derived from the dimension member names.
3. Drag the **Region** and **Sub-Category** dimensions to **Rows**, dropping **Sub-Category** to the right of **Region**.
   
   Now you have a nested table of categorical data (that is, the **Sub-Category** dimension is nested within the **Region** dimension).
4. Drag the **Profit** measure to **Color** on the **Marks** card.
   
   Tableau aggregates the measure as a sum. The color legend reflects the continuous data range.
5. Optimize the view format:
   
   - On the **Marks** card, select **Square** as the mark type.
   - Make the columns wider by pressing Ctrl + Right arrow (on a Mac, the combination is "z"). Hold down Ctrl (or "z") and continue pressing the Right arrow key until the headings for **Segment** are displayed in full:
   - Increase the mark size by pressing Ctrl + Shift + B (on a Mac: "zB"). Hold down Ctrl + Shift ("z") and continue to press B until the squares are large enough.
In this view, you can see data for only the Central region. Scroll down to see data for other regions.

In the Central region, copiers are shown to be the most profitable sub-category, and binders and appliances the least profitable.

6. Click **Color** on the **Marks** card to display configuration options. In the **Border** drop-down list, select a medium gray color for cell borders, as in the following image:
Now it's easier to see the individual cells in the view:

7. The default color palette is Orange-Blue Diverging. A Red-Green Diverging palette might
be more appropriate for profit. To change the color palette and to make the colors more distinct, do the following:

- Hover over the SUM(Profit) color legend, then click the drop-down arrow that appears and select Edit Colors.
- In the Edit Colors dialog box, in the Palette field, select Red-Green Diverging from the drop-down list.
- Select the Use Full Color Range check box and click Apply and then click OK.

When you select this option, Tableau assigns the starting number a full intensity and the ending number a full intensity. If the range is from -10 to 100, the color representing negative numbers changes in shade much more quickly than the color representing positive numbers.

When you do not select Use Full Color Range, Tableau assigns the color intensity as if the range was from -100 to 100, so that the change in shade is the same on both sides of zero. The effect is to make the color contrasts in your view much more distinct.
For more information about color options, see *Color Properties* on page 184.

8. Drag the **Sales** measure to **Size** on the **Marks** card to control the size of the boxes by the Sales measure. You can compare absolute sales numbers (by size of the boxes) and profit (by color).

Initially, the marks look like this:
9. To enlarge the marks, click **Size** on the **Marks** card to display a size slider:

10. Drag the slider to the right until the boxes in the view are the optimal size. Now your view is complete:
11. Use the scroll bar along the right side of the view to examine the data for different regions.

**Build a Histogram**

A histogram is a chart that displays the shape of a distribution. A histogram looks like a bar chart but groups values for a continuous measure into ranges, or bins.

In Tableau you can create a histogram using **Show Me**.

1. Connect to the **Sample - Superstore** data source.
2. Drag **Quantity** to **Columns**.
3. Click **Show Me** on the toolbar, then select the histogram chart type.
The histogram chart type is available in **Show Me** when the view contains a single measure and no dimensions.

Three things happen after you click the histogram icon in **Show Me**:

- The view changes to show vertical bars, with a continuous x-axis (1 – 14) and a continuous y-axis (0 – 5,000).

- The **Quantity** measure you placed on the **Columns** shelf, which had been aggregated as SUM, is replaced by a continuous **Quantity (bin)** dimension. (The green color of the field on the **Columns** shelf indicates that the field is continuous.)

- The **Quantity** measure moves to the **Rows** shelf and the aggregation changes from SUM to CNT (Count).
The **Quantity** measure captures the number of items in a particular order. The histogram shows that about 4,800 orders contained two items (the second bar), about 2,400 orders contained 4 items (the third bar), and so on.

Let's take this view one step further and add **Segment** to **Color** to see if we can detect a relationship between the customer segment (consumer, corporate, or home office) and the quantity of items per order.

4. Drag **Segment** to **Color**.
The colors don’t show a clear trend. Let’s show the percentage of each bar that belongs to each segment.

5. Hold down the Ctrl key and drag the CNT(Quantity) field from the Rows shelf to Label.
Holding down the Ctrl key copies the field to the new location without removing it from the original location.

6. Right-click (Control-click on a Mac) the CNT(Quantity) field on the Marks card and select Quick Table Calculation > Percent of Total.

Now each colored section of each bar shows its respective percentage of the total quantity:
But we want the percentages to be on a per-bar basis.

7. Right-click the CNT(Quantity) field on the Marks card again and select Edit Table Calculation.

8. In the Table Calculation dialog box, change the value of the Compute Using field to Cell.
Now we have the view that we want:
There is still no evidence that the percentages by customer segment show any trend as the number of items in an order increases.

For information on how to create a binned dimension from a continuous measure, see Create Bins from a Continuous Measure on page 554. If you create a binned dimension, place it on Columns, and then place the initial measure that you used as the basis for the binned dimension on Rows. Set the aggregation to Count (Distinct) to create a histogram.

**Build a Gantt Chart**

Use Gantt charts to show the duration of events or activities.

In a Gantt chart, each separate mark (usually a bar) shows a duration. For example, you might use a Gantt chart to display average delivery time for a range of products.

For more information about the Gantt bar mark type, see Gantt Bar Mark on page 182.

To create a Gantt chart that shows how many days elapse on average between order date and ship date, follow these steps:

1. Connect to the Sample - Superstore data source.
2. Drag the Order Date dimension to Columns.
Tableau aggregates the dates by year and creates column headers with labels for the years.

3. On the Columns shelf, click the Year (Order Date) drop-down arrow, and then select Week Number.

![Image of Tableau interface showing Year and Week Number options]

The column headers change. Individual weeks are indicated by tick marks because there are 208 weeks in a four-year span—to too many to show as labels in the view.

![Image of Tableau interface with week numbers highlighted]

4. Drag the Sub-Category and Ship Mode dimensions to the Rows shelf. Drop Ship Mode to the right of Sub-Category.

This builds a two-level nested hierarchy of dimensions along the left axis.
Next, we'll size the marks according to the length of the interval between the order date and the ship date. To do this, create a calculated field to capture that interval.

5. In the toolbar menu, click **Analysis > Create Calculated Field**. You can also right-click (Control-click on Mac) any field in the **Data** pane and select **Create > Calculated Field**.

6. In the calculation dialog box, name your calculated field **OrderUntilShip**.

7. Clear any content that’s in the **Formula** box by default.
8. In the **Formula** box, enter the following formula and then click **OK**:

   `DATEDIFF('day',[Order Date],[Ship Date])`

   The formula creates a custom measure that captures the difference between the **Order Date** and **Ship Date** values, in days.

9. Drag the **OrderUntilShip** measure to **Size** on the **Marks** card.

   The default aggregation for **OrderUntilShip** is **Sum**, but in this case it makes more sense to average the values.

10. Right-click (Control-click on Mac) the **SUM(OrderUntilShip)** field on the **Marks** card, and then select **Measure (Sum) > Average**.

    ![Screenshot of marks card with SUM(OrderUntilShip) field selected and average measure chosen]

   The view is coming along. But there are too many marks squeezed into the view.
We can make our data more readable by filtering down to a smaller time window.

11. Hold down the Ctrl key (Option key on the Mac) and drag the **Week(Order Date)** field from the **Columns** shelf to the **Filter** shelf.

By holding down the Ctrl key (or the Option key), you tell Tableau that you want to copy the field to the new location, with whatever customizations you have added, without removing it from the old location.

12. In the Filter Field dialog box, select **Range of Dates** and then click **Next**.
13. Set the range to a three-month time interval, such as 1/1/2013 to 3/31/2013, and then click OK.

It can be difficult to get the exact date using the sliders—it’s easier just to enter the numbers you want directly into the date boxes or use the calendar to select the dates.

14. Drag the **Ship Mode** dimension to **Color** on the **Marks** card.

Now your view shows you all sorts of information about the lag between order times and ship times.
For example, you can see which ship modes are more prone to longer lag times, whether lag times vary by category, and whether lag times are consistent over time.

Note: If you publish this view to Tableau Server, you can include filters that let users interact with the view by varying the time window, or filtering out various sub-categories or ship modes. For more information, see Publish Data Sources and Workbooks on page 1104.

Build a Pie Chart

Use pie charts to show proportions.

To create a pie chart view that shows how different product categories contribute to total sales, follow these steps:

1. Connect to the Sample - Superstore data source.
2. Drag the Sales measure to Columns.
   Tableau aggregates the measure as a sum.
3. Drag the Sub-Category dimension to Rows.
   The default chart type is a bar chart.

4. Click Show Me on the toolbar, then select the pie chart type.
The result is a rather small pie:

5. To make the chart bigger, hold down Ctrl + Shift (hold down ⌘ + ⌥ on a Mac) and press B several times.

6. To add labels, drag the **Sub-Category** dimension from the **Data** pane to **Label** on the
7. If you don't see labels, press Ctrl + Shift + B (press ⌘ + ⌘ + B on a Mac) to make sure most of the individual labels are visible.

You can make a pie chart interactive in a dashboard. For more information, see Actions and Dashboards on page 1039.

Note: Pie charts can also be used as a mark type in a visualization. For more information, see Pie Mark on page 181.

Build a Treemap

Use treemaps to display data in nested rectangles. You use dimensions to define the structure of the treemap, and measures to define the size or color of the individual rectangles. Treemaps are a relatively simple data visualization that can provide insight in a visually attractive format.

To create a treemap that shows aggregated sales totals across a range of product categories, follow the steps below.
1. Connect to the **Sample - Superstore** data source.

2. Drag the **Sub-Category** dimension to **Columns**.
   
   A horizontal axis appears, which shows product categories.

3. Drag the **Sales** measure to **Rows**.
   
   Tableau aggregates the measure as a sum and creates a vertical axis.

   Tableau displays a bar chart—the default chart type when there is a dimension on the **Columns** shelf and a measure on the **Rows** shelf.

4. Click **Show Me** on the toolbar, then select the treemap chart type.

Tableau displays the following treemap:
In this treemap, both the size of the rectangles and their color are determined by the value of **Sales**—the greater the sum of sales for each category, the darker and larger its box.

5. Drag the **Ship Mode** dimension to **Color** on the **Marks** card. In the resulting view, **Ship Mode** determines the color of the rectangles—and sorts them into four separate areas accordingly. **Sales** determines the size of the rectangles:

6. Try another option to modify the treemap: click the **Undo** button to remove **Ship Mode** from view.
7. Drag the **Profit** measure to **Color** on the **Marks** card. Now **Profit** determines the color of the rectangles, and **Sales** determines their size:

With treemaps, **Size** and **Color** are the crucial elements. You can place measures on **Size** and **Color**, but placing a measure anywhere else has no effect. Treemaps can accommodate any number of dimensions, including one or even two on **Color**. But beyond that, adding dimensions only breaks the map into an ever greater number of smaller rectangles. For information on how to place two dimensions on **Color** in a treemap, see **Example – Multiple Fields on Color** on page 194.

**Build a Box Plot**

Use box plots, also known as box-and-whisker plots, to show the distribution of values along an axis.

Boxes indicate the middle 50 percent of the data (that is, the middle two quartiles of the data's distribution).

You can configure lines, called **whiskers**, to display all points within 1.5 times the interquartile range (in other words, all points within 1.5 times the width of the adjoining box), or all points at the maximum extent of the data, as shown in the following image:
To create a box plot that shows discounts by region and customer segment, follow these steps:

1. Connect to the **Sample - Superstore** data source.

2. Drag the **Segment** dimension to **Columns**.
   
   The measure is aggregated as a sum and row headers appear, identifying three customer segments.

3. Drag the **Discount** measure to **Rows**.
   
   Tableau creates a vertical axis and displays a bar chart—the default chart type when there is a dimension on the **Columns** shelf and a measure on the **Rows** shelf.

4. Drag the **Region** dimension to **Columns**, and drop it to the right of **Segment**.
   
   Now you have a two-level hierarchy of dimensions from left to right in the view, with regions (listed along the bottom) nested within segments (listed across the top).

5. Click **Show Me** in the toolbar, then select the box-and-whisker plot chart type.
Tableau displays the following box plot:
Notice that there are only a few marks in each box plot. Also, Tableau reassigned Region from the Columns shelf to the Marks card. When you changed the chart type to a box plot, Tableau determined what the individual marks in the plot should represent. It determined that the marks should represent regions. We'll change that.

6. Drag Region from the Marks card back to Columns, to the right of Segment.
The horizontal lines are flattened box plots, which is what happens when box plots are based on a single mark.

Box plots are intended to show a distribution of data, and that can be difficult when data is aggregated, as in the current view.

7. To disaggregate data, select **Analysis > Aggregate Measures**.

This command turns aggregation on or off, and because data is aggregated by default in Tableau, the first time you select this command, it disaggregates the data.

For more information, see **Disaggregating Data on page 332**.

Now, instead of a single mark for each column in the view, you see a range of marks, one for each row in your data source.
The view now shows the information we want to see. The remaining steps make the view more readable and appealing.

8. Click the Swap button to swap the axes:

The box plots now flow from left-to-right:

9. Right-click (control-click on Mac) the bottom axis and select Edit Reference Line.

10. In Edit Reference Line, Band, or Box dialog box, in the Fill drop-down list, select an interesting color scheme.
For more on these options, see Adding Box Plots on page 895.

Now your view is complete:

You can see that the discount was the same for all segments in the West. You can also see that the interquartile range (from the 25th percentile to the 75th percentile) for discount was greatest in the Central region for the consumer and corporate segments.

For more information about box plots, see Reference Lines, Bands, Distributions, and Boxes on page 873.
Build a Packed Bubble Chart

Use packed bubble charts to display data in a cluster of circles. Dimensions define the individual bubbles, and measures define the size and color of the individual circles.

To create a basic packed bubble chart that shows sales and profit information for different product categories, follow these steps:

1. Connect to the Sample - Superstore data source.
2. Drag the Category dimension to Columns.
   A horizontal axis displays product categories.
3. Drag the Sales measure to Rows.
   The measure is aggregated as a sum and a vertical axis appears.
   Tableau displays a bar chart—the default chart type when there is a dimension on the Columns shelf and a measure on the Rows shelf.
4. Click Show Me on the toolbar, then select the packed bubbles chart type.
Tableau displays the following packed bubble chart:

5. Drag **Region** to **Detail** on the **Marks** card to include more bubbles in the view.
Next we'll add another layer of information to the view.

6. Drag **Profit** to **Color** on the **Marks** card:
7. Drag **Region** to **Label** on the **Marks** card to clarify what each bubble represents.
The size of the bubbles shows the sales for different combinations of region and category. The color of the bubbles shows the profit (the darker the green, the greater the profit).

For information about formatting mark labels, see Show and Hide Mark Labels on page 504.

To further develop this view, you might edit the colors for Profit to show negative profit in a different color, or create a calculated field to shows profit divided by sales (that is, profit margin) and then drop that on Color instead of absolute profit. For more information, see Color Properties on page 184.

**Build a Map View**

Use map views to display and analyze geographic data. To create map views, add geographic fields to the view, and then add measures or continuous dimensions to the Marks card.

The first exercise in this topic shows you how to create a map view and customize your map appearance. The second exercise in this topic shows you how to create a map view with pie marks.

**Build a map view**

This exercise demonstrates how to create a custom map view that shows the amount of sales
by U.S. city.

1. Connect to the **Sample – Superstore** data source.

2. In the **Data** pane, double-click the **City** dimension. Tableau adds **Country**, **State**, and **City** to **Detail** on the **Marks** card and creates a map view.

   Because Tableau assigns the **Country**, **State**, **City**, and **Postcode** dimensions a geographic role, a map view is created when you double-click one of these dimensions:

   Tableau looks for geographic fields in any data source. For more information on how Tableau interprets geographic data in data sources, see **Prepare Your Geographic Fields** on page 693.

3. From **Measures**, drag **Sales** to **Color** on the **Marks** card. The marks in the view color according to the amount of sales in each city.

4. From **Measures**, drag **Sales** to **Size** on the **Marks** card. The marks in the view resize according to sales in each city.
5. To adjust the size of the marks in the view, click **Size** on the **Marks** card, and then drag the slider to the right.

The marks in the view are now larger and easier to inspect, though they overlap. Overlapping marks make it difficult to see a difference in the size of some marks.

To make the map view easier to analyze, you can add a border to the marks in the view.

6. To add a border to the marks in the view, on the **Marks** card, click **Color**, and then click the **Border** drop-down list to select a color.
The marks in the view update to display the selected border:

After you plot your data on a map view, you can configure the background map style, map layers, and data layers using the **Map Layers** pane.

7. To open the **Map Layers** pane, select **Map > Map Layers**. In the **Map Layers** pane, click the **Style** drop-down list, and then select **Dark**.

The background map changes from light to dark.
You can now add or subtract map layers to provide context to your data, or to simplify the view.

8. In the Map Layers pane, clear the Country/Region Names and State/Province Names map layers to simplify the map view.

The country/region and state/province names are removed from the view.

Your view is now complete. Your map view shows total sales for each city in your data source across the United States. The size and the color of each mark corresponds to the total sales for that city.
For more information about creating map views, see Build and Use Maps on page 659.

**Build a map with pie marks**

In this exercise, you will create a map with a pie mark on each state. The overall size of the mark represents sales, and the size of each section represents the sales for each ship mode (First Class, Same Day, Second Class, Standard Class).

1. Connect to the Sample - Superstore data source.
2. In the Data pane, double-click the State dimension.
   
   Tableau adds Country and State to Detail on the Marks card.
3. From Measures, drag Sales to Size on the Marks card.
   
   The marks in the view resize according to sales in each city.
4. On the Marks card, click the Mark Type drop-down list, and then select Pie.
5. From Dimensions, drag Ship Mode to Color on the Marks card.

6. To make the marks in the view larger, on the Marks card, click Size, and then drag the slider to the right.

Your view is now complete. Your map view shows pie chart marks for each state. The size of each pie corresponds to the total sales for that state, and the slices of the pie show what proportions of the total were provided by each of the four available ship modes.
The Tableau Environment

This section provides information on the various panes, shelves, pages, icons, and other elements that comprise the Tableau Desktop environment.

Start Page

The start page in Tableau Desktop is a central location from which you can do the following:

- Connect to your data
- Open your most recently used workbooks, and
- Discover and explore content produced by the Tableau community.

The start page consists of three panes: Connect, Open, and Discover.

Connect

Connect to data and open saved data sources.
On the **Connect** pane, you can do the following:

- **Connect to data**: Under **To a File**, connect to data stored in Microsoft Excel files, text files, Access files, Tableau data extract files, and statistical files, such as SAS, SPSS, and R. Under **To a Server**, connect to data stored in databases like Microsoft SQL Server or Oracle. The server names listed in this section change based on which servers you connect to and how often.

- **Open saved data sources**: Quickly open data sources that you have previously saved to your My Tableau Repository directory. Also, Tableau provides sample saved data sources that you can use to explore Tableau Desktop functionality. To follow along with examples in the Tableau Desktop documentation, you'll usually use the **Sample – Superstore** data source.

**Open**

Open recent workbooks, pin workbooks to the start page, and explore sample workbooks.
On the **Open** pane, you can do the following:

- **Open recently opened workbooks:** When you open Tableau Desktop for the first time, this pane is empty. As you create and save new workbooks, the most recently opened workbooks appear here. Click the workbook thumbnail to open a workbook, or if you don't see a workbook thumbnail, click the **Open a Workbook** link to find other workbooks that are saved to your computer.

- **Pin workbooks:** You can pin workbooks to the start page by clicking the pin icon that appears in the top-left corner of the workbook thumbnail. Pinned workbooks always appear on the start page, even if they weren't opened recently. To remove a recently opened or pinned workbook, hover over the workbook thumbnail, and then click the "x" that appears. The workbook thumbnail is removed immediately but will show again with your most recently used workbooks the next time you open Tableau Desktop.

- **Explore sample workbooks:** Open and explore sample workbooks.
Discover

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Navigating back to the start page

When Tableau Desktop is already open, you can navigate back to the start page by clicking the Tableau icon in the upper-left corner of the Tableau Desktop workspace.

Data Source Page

Before or during your analysis, you may want to make changes to the Tableau data source. You can do that on the data source page. Tableau takes you to the data source page after you establish the initial connection to your data. You can also access the data source page by clicking the Data Source tab from any location in the workbook.

Although the look of the page and the options available vary depending on the type of data that you are connected to, the data source page generally consists of four main areas: left pane, canvas, data grid, and metadata grid.
Left pane

The left pane of the data source page displays details about your data, that is the data that Tableau Desktop is connected to. For file-based data, the left pane might display the file name and the worksheets in the file. For relational-based data, the left pane might display the server, the database or schema, and the tables in the database.

You can also use the left pane to add more connections to the data source to create cross-database joins.

The left pane does not display for cube (multidimensional) data.

Canvas

When connected to most relational and file-based data, you can drag one or more tables to the canvas area to set up your Tableau data source.

When connected to cube data, the top of the data source page displays the available catalog or queries and cubes to select from to set up your Tableau data source.

Data grid

Use the data grid to review the fields and the first 1,000 rows of the data contained in the Tableau data source. You can also use the data grid to make general modifications to the Tableau data source like sorting or hiding fields; renaming fields or resetting field names; creating calculations; changing the column or row sort; or adding aliases. For the Web Data
Connector, file- and relational-based data sources in Extract mode, you can see extract data in the grid, including extract only calculations.

To select multiple fields in the grid, click a column, and then drag the mouse to select more columns. To select all fields, click the area in the upper-left corner of the grid like in the example, below.

<table>
<thead>
<tr>
<th>#</th>
<th>Abc</th>
<th>Order ID</th>
<th>Order Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CA-2013-152156</td>
<td>11/9/2013</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>CA-2013-152156</td>
<td>11/9/2013</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The grid does not display for cube (multidimensional) data.

**Metadata grid**

Depending on the type of data that you are connected to, click the metadata grid button to navigate to the metadata grid. The metadata grid displays the fields in your data source as rows so that you can quickly examine the structure of your Tableau data source and perform routine management tasks, such as renaming fields or hiding multiple fields at once.

When connected to cube or some extract only data, the metadata grid displays by default.

**The Tableau Workspace**

The Tableau workspace consists of menus, a toolbar, the Data pane, cards and shelves, and one or more sheets. Sheets can be worksheets, dashboards, or stories.

Worksheets contain shelves and cards that you can drag and drop data fields on to build views.
A. Workbook name.

B. Cards and shelves - Drag fields to the cards and shelves in the workspace to add data to your view.

C. Toolbar - Use the toolbar to access commands and analysis and navigation tools.

D. View - This is the workspace where you create your data visualizations.

E. Go to the start page. For more information, see Start Page on page 122.

F. Side Bar. The side bar provides two panes: the Data pane and the Analytics pane. For more information, see The Side Bar below.

G. Go to the data source page. For more information, see Data Source Page on page 126.

H. Status bar - Displays information about the current view.

I. Sheet tabs - Tabs represent each sheet in your workbook. This can include worksheets, dashboards and stories. For more information, see Sheets on page 233.

**The Side Bar**

The Side Bar provides two panes: the Data pane and the Analytics pane.

You can hide and show the Side Bar by clicking the icon \( \square \) in the upper right corner.

To open the Side Bar again, look for that same icon in the lower left corner of the Tableau window:
Data Pane

Tableau displays your data fields in the Data pane on the left side of the workspace. You can toggle between the Data and Analytics panes:

Current data sources appear at the top of the Data pane.

Below the data sources in the Data pane are the fields that are available in the currently selected data source.

Perform common tasks in the Data pane

To view all the data sources used in the workbook, click the drop-down arrow next to the data source that is displayed.

To view a context menu for the data source, click Data in the top menu and then click on the data source in the menu list. For more information, see Edit Data Sources on page 428.

To search for fields in the Data pane, click the magnifying class icon and then type in the text box.

To see the underlying data, click the View Data icon at the top of the Data pane. For more information, see View Data on page 529.

To convert a measure to a dimension, drag the measure and drop it into the Dimensions area in the Data pane.
How the Data pane is organized

The **Data** pane is organized into several areas:

- **Dimensions** - fields that contain data like text or dates. This is called *category data*.
- **Measures** - fields that contain numbers. *Numerical data* can be aggregated. For more information, see **Dimensions and Measures** on page 261.
- **Sets** - subsets of data that you define, for example if you want to create a report that shows only data you specify. For more information, see **Sets** on page 473.
- **Parameters** - dynamic placeholders that can replace constant values in calculated fields and filters so that view designers can give data consumers choices about what they see. For more information, see **Parameters** on page 917.

By default, Tableau treats all relational fields containing numbers as measures. However, you might decide that some of these fields should be treated as dimensions. For example, a field containing ages might be categorized as a measure by default in Tableau because it contains numeric data. However, if you want to look at each individual age rather than an axis, you can convert the **Age** field to a dimension.

Drag the **Age** measure and drop it into the Dimensions area in the Data pane. When you drag the **Age** field to the **Rows** or **Columns** shelf, it creates column headers (1, 2, 3, etc.) instead of a continuous axis.

For information on converting measures to dimensions—or dimensions to measures—see **Dimensions and Measures** on page 261.

**Analytics Pane**

The **Analytics pane** provides quick and easy access to common analytic features in Tableau.

You can drag reference lines, box plots, trend lines forecasts, and other items into your view from the **Analytics pane**, which appears on the left side of the workspace. Toggle between the **Data pane** and the **Analytics pane** by clicking one of the tabs at the top of the Side Bar:
There isn't anything you can add to a view from the Analytics pane that you couldn't add by some other means—for example, reference lines and bands are available when you edit an axis, and trend lines and forecasts are available from the Analysis menu. The Analytics pane just makes the process easier by offering drag-and-drop access for the various options.

**Add Analytics Pane Item**

To add an item from the Analytics pane, drag it into the view. When you drag an item from the Analytics pane, Tableau shows the possible destinations for that item in a drop target area in the upper left section of the view—drop the item somewhere in this area. The range of choices varies depending on the type of item and the current view.

In a simple case, the drop target area would offer these three options:
The terms **Table**, **Pane** and **Cell** define the scope for the item:

For a more complicated view—for example, if the view contained a line chart with multiple or dual axes—Tableau would show you a drop target area that looked like this:
If you dropped the item in one of the three larger boxes in the header at the top of the drop target area—for example, the Table box—a separate median with quartiles would be added for each axis:

But if you drop the item in any of the six lower boxes aligned with a specific measure, the median with quartiles would only be added on the corresponding axis, with the specified scope.

**Delete Analytics Pane Item**

You can delete an item you just added from the Analytics pane by clicking Undo. You can also drag items off the view to delete them.

You can also click on an item and choose **Remove** from the tooltip.

---

**Note:** Some Analytics pane items (Median with Quartiles and Average with 95% CI) actually add both a reference line and a reference distribution. Unless you are using Undo, you would need to delete these items separately.

**Edit Analytics Pane Item**

To edit an item you have added from the Analytics pane, click on the item and choose **Edit** from the tooltip. For additional editing options, see the section for a particular item type under Analytics Pane Item Definitions, below.

**Analytics Pane Items**

The following items can be dragged from the Analytics pane and dropped in the view.

**Constant Line**

Adds one or more constant lines to the view. You can add a constant line for a specific
measure, for all measures, or for date dimensions. When you add a constant line, Tableau displays a Value prompt where you specify the value for the constant:

For a date value, the Value prompt is a calendar control:

You can click on a resulting constant line and choose Edit, Format, or Remove. Choosing Edit opens the Edit Reference Line dialog box. For details, see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. Another way to edit a line is to right-click (control-click on Mac) the relevant axis and choose Edit Reference Line.

**Average Line**

Adds one or more average lines to the view. You can add an average line for a specific measure or for all measures.

You can click on a resulting average line and choose Edit, Format, or Remove. Choosing Edit opens the Edit Reference Line dialog box. For details, see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. Another way to edit a line is to right-click (control-click on Mac) the relevant axis and choose Edit Reference Line.

**Median with Quartiles**

Adds one or more sets of median lines and distribution bands to the view. You can add a median with quartiles for a specific measure or for all measures.

The distribution bands are computed as quartiles; the middle two quartiles are shaded.

You can click on a resulting median line or distribution and choose Edit, Format, or Remove. Median lines and distributions must be edited, formatted, or removed separately. Choosing Edit opens the Edit Reference Line dialog box. You must click on the outer edge of a distribution band to see the options--clicking in the middle of the band has no effect. For details,
see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. Another way to edit a line or distribution is to right-click (control-click on Mac) the relevant axis and choose Edit Reference Line. A submenu will offer you two choices: Quartiles and Median.

For information on distribution types, including quartiles, see Basic Reference Distributions on page 888.

**Box Plot**

Adds one or more box plots to the view. You can add box plots for a specific measure or for all measures. The scope for a box plot is always Cell (and never Table or Pane).

Click or hover over any of the horizontal lines in the box plot to see statistical information about the whiskers, quartiles, and median.

You can also choose Edit, Format, or Remove when you click on a line. Choosing Edit opens the Edit Reference Line dialog box. Another way to edit a box plot is to right-click (control-click on Mac) the relevant axis and choose Edit Reference Line.

**Note:** Box Plot appears twice in the Analytics pane. For the Box Plot option in the Summarize section, Tableau will automatically add a box plot for the specified target. For the Box Plot option in the Custom section, Tableau will open the Edit Reference Line, Band, or Box dialog box after you specify a target.

**Totals**

Adds totals to the view. When you add totals, the drop options are Subtotals, Column Grand Totals, and Row Grand Totals.

For details, see Totals on page 902.

To remove totals, click the relevant column or row header and choose Remove.

You can also click on a totals column or row header after adding totals and set the aggregation for that row or column from the tooltip:

**Average with 95% CI**
Adds one or more sets of average lines with distribution bands; the distribution bands are configured at a 95% confidence interval. You can add these items for a specific measure or for all measures.

The confidence interval distribution bands shade the region in which the population average will fall 95% of the time.

You can click on a resulting average line or distribution and choose Edit, Format, or Remove. Choosing Edit opens the Edit Reference Line dialog box. The average lines and distributions must be edited, formatted, or removed separately. You must click on the outer edge of a distribution band to see the options--clicking in the middle of the band has no effect. For details, see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. Another way to edit a line or distribution is to right-click (control-click on Mac) the relevant axis and choose Edit Reference Line. A submenu will offer you two choices: Average and 95% Confidence Interval.

You can also remove lines and bands by dragging them off the view.

**Median with 95% CI**

Adds one or more sets of median lines with distribution bands; the distribution bands are configured at a 95% confidence interval. You can add these items for a specific measure or for all measures.

The confidence interval distribution bands shade the region in which the population median will fall 95% of the time.

You can click on a resulting median line or distribution and choose Edit, Format, or Remove. Choosing Edit opens the Edit Reference Line dialog box. The median lines and distributions must be edited, formatted, or removed separately. You must click on the outer edge of a distribution band to see the options--clicking in the middle of the band has no effect. For details, see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. Another way to edit a line or distribution is to right-click (control-click on Mac) the relevant axis and choose Edit Reference Line. A submenu will offer you two choices: Median and 95% Confidence Interval.

You can also remove lines and bands by dragging them off the view.

**Trend Line**

Adds one or more trend lines to the view. When you add trend lines, the drop options identify the trend line model types available in Tableau: Linear, Logarithmic, Exponential, and Polynomial. For some views, only a subset of these options is available.

For details, see Trend Line Model Types on page 617.

Click on a trend line to remove or edit it, or to see a statistical definition. You can also remove a trend line by dragging it off the view.

**Forecast**

Adds a forecast to the view. Forecasting is only possible when there is at least one date and
one measure in the view.

Forecasting is not supported for views based on multidimensional data sources. In addition, the view cannot contain any of the following:

- Table calculations
- Disaggregated measures
- Percent calculations
- Grand Totals or Subtotals
- Date values with aggregation set to Exact Date

A time series containing null values also imposes constraints.

For details, see Forecasting on page 592.

To remove, edit, or read a description of the current forecast, go to the Analysis menu and choose Forecast.

**Reference Line**

You can add reference lines for a specific measure or for all measures.

After you drag a reference line from the Analytics pane and drop it on a target, Tableau automatically opens Edit Reference Line dialog box. For details, see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. To return to this dialog box later, right-click (control-click on Mac) the relevant axis and choose Edit Reference Line. You can also click on the line and choose Edit, Format, or Remove.

**Reference Band**

You can add reference bands for a specific measure or for all measures.

After you drag a reference band from the Analytics pane and drop it on a target, Tableau automatically opens Edit Reference Line dialog box. For details, see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. To return to this dialog box later, right-click (control-click on Mac) the relevant axis and choose Edit Reference Line. You can also click on the band and choose Edit, Format, or Remove. You must click on the outer edge of a reference band to see the options--clicking in the middle of the band has no effect.

**Distribution Band**

You can add reference distributions for a specific measure or for all measures.

After you drag a reference distribution from the Analytics pane and drop it on a target, Tableau automatically opens Edit Reference Line dialog box. For details, see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. To return to this dialog box later, right-click (control-click on Mac) the relevant axis and choose Edit Reference Line. You can also click on the distribution and choose Edit, Format, or Remove. You must click on the outer edge of a distribution band to see the options--clicking in the middle of the band has no effect.
**Box Plot**

You can add box plots for a specific measure or for all measures.

After you drag a box plot from the Custom section of the Analytics pane and drop it on a target, Tableau automatically opens Edit Reference Line dialog box. For details, see Editing Reference Lines, Bands, Distributions, or Boxes on page 900. The scope for a box plot is always **Cell** (and never **Table** or **Pane**).

Click any of the horizontal lines in the box plot to see statistical information about the whiskers, quartiles, and median.

You can click on a resulting box plots and choose **Edit**, **Format**, or **Remove**. Choosing **Edit** opens the Edit Reference Line dialog box. Another way to edit a box plot is to right-click (control-click on Mac) the relevant axis and choose **Edit Reference Line**.

**Shelves and Cards**

Every worksheet in Tableau contains shelves and cards. By placing fields on shelves or cards, you can create the rows and columns of a data view, exclude data from the view, create pages, and control mark properties. You should experiment placing fields on different shelves and cards to find the optimal way to look at your data.

Tableau can also help you determine the best way to display your data using Show Me. See Create a Line Chart with Show Me on page 49 and Create a Scatter Plot with Show Me on page 47.

**Columns and Rows Shelves**

The **Columns** shelf creates the columns of a table, while the **Rows** shelf creates the rows of a table. You can place any number of fields on these shelves.

When you place a dimension on the **Rows** or **Columns** shelves, headers for the members of that dimension are created. When you place a measure on the **Rows** or **Columns** shelf, quantitative axes for that measure are created. As you add more fields to the view, additional headers and axes are included in the table and you get an increasingly detailed picture of your data.

In the view shown below, the members of the **Segment** dimension are displayed as column headers, while the **Profit** measure is displayed as a vertical axis.
Tableau displays data using marks, where every mark corresponds to a row (or a group of rows) in your data source. The inner fields on the Rows and Columns shelves determine the default mark type. For example, if the inner fields are a measure and a dimension, the default mark type is a bar. You can manually select a different mark type using the Marks card drop-down menu. For more information, see Mark Types on page 164.

Adding more fields to the Rows and Columns shelves adds more rows, columns, and panes to the table.
Hide Rows and Columns

Generally you will add dimensions and measures to create the rows and columns of the table and you’ll either include all data or add filters to only show a subset. However, when you filter data it is also excluded from calculations and other computations performed on the summarized data in the table. Instead of filtering the data, you can hide the row or column so it doesn’t display in the view but it is still included in calculations.

Hiding columns is especially useful when using table calculations that compare to previous or next. In that case, there is always a row or column that doesn’t show data because there is no data to compare to. You can simply hide the empty column without modifying the table calculation. For example, when calculating year-over-year growth, the first year doesn’t have a previous year to compare to, so the column is left blank. Filtering the first year will remove it from the view but it will also remove it from the calculation so now the second year doesn’t have a previous year to compare to and is left blank. Instead of filtering, you can hide the column that you don’t want to show without changing the calculation.

To hide a row or column:

Right-click (control-click on Mac) the row or column you want to hide, and then select Hide.
To show hidden data:

Open the field menu for a field that has hidden columns or rows and select **Show Hidden Data**.
Pages Shelf

The Pages shelf lets you break a view into a series of pages so you can better analyze how a specific field affects the rest of the data in a view. When you place a dimension on the Pages shelf you are adding a new row for each member in the dimension. When you place a measure on the Pages shelf, Tableau automatically converts the measure into a discrete measure.

The Pages shelf creates a set of pages, with a different view on each page. Each view is based on a member of the field you placed on the Pages shelf. You can easily flip through the views and compare them on a common axis, using the controls that get added to the view when you move a field to the Pages shelf. For example, the view below shows the Profit vs. Sales by Region for each day throughout the month. The image below shows days 1, 2, 3, and 4. You would have to scroll down to see other days in the month.
To make this view more user-friendly, move DAY(Order Date) to the Pages shelf and use the associated control to flip through the pages (one for each day). You can quickly discover hidden insights. In this example, it is interesting that the 19th is an especially big day in terms of sales and profit in the Western region.
When you add a field to the **Pages** shelf, a page control is automatically added to the right of your view.

Use this control to navigate through the pages. There are three ways to navigate through the pages in a view:

- **Jump to a specific page**
- Manually advance through the pages
- Automatically advance through pages

**Jump to a specific page**

Select the member or value you want to view from the drop-down list to display a specific page.
Manually Advance through the pages

You can manually advance through the sequence of pages by doing any of the following:

- Use the forward and back buttons on either side of the drop-down list to navigate through the pages one at a time.
- Use the Page Slider to quickly scroll forward and backward in the sequence of pages.
- Use any of the following keyboard shortcuts to scroll forward and backward in the sequence of pages.

<table>
<thead>
<tr>
<th>Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Starts and stops forward playback</td>
</tr>
<tr>
<td>SHIFT + F4</td>
<td>Starts and stops backward playback</td>
</tr>
<tr>
<td>CTRL + .</td>
<td>Skip forward one page</td>
</tr>
<tr>
<td>CTRL + ,</td>
<td>Skip backward one page</td>
</tr>
</tbody>
</table>

On a Mac, these are the equivalent keyboard shortcuts.

<table>
<thead>
<tr>
<th>Shortcut</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4</td>
<td>Starts and stops forward playback</td>
</tr>
</tbody>
</table>
Automatically Advance through the pages

Use the playback controls to watch a slide show of the pages in the view. You can play forward or backward, and stop the playback at any time. You can control the speed of playback with the speed controls in the bottom right corner of the control. The smallest bar indicates the slowest playback speed.

Page History

Show page history using the Show History check box. With page history, marks from previous pages are shown on the current page. Open the drop-down control for history to specify what marks to show and when to show them.
The history drop-down control has the following options:

- **Marks to show history for** – select whether you want to show history for just selected marks, highlighted marks, marks that you’ve manually selected to show history for, or all marks. To manually show history for marks, right-click (control-click on Mac) the mark in the view and select an option on the Page History menu.

- **Length** – select the number of pages to show in the history.

- **Show** – specify whether to show the historical marks, a line tracing through the previous values (trails), or both.

- **Marks** – format the historical marks including the color and how much to fade them if the color is set to automatic, the marks will either use the default mark color or the color encoding on the Color shelf.

- **Trails** – format the lines that are drawn through the historical marks. This option is only available if Trails is selected in the Show options.

Page trails may not display if there are multiple marks per color on a page. Make sure that the level of detail for the view is less than or equal to the level of detail on the Pages shelf and on the Color target. Also, trails are only supported for discrete mark types such as squares, circles, or shapes. They are not supported when the mark type is Automatic.
Pages on Dashboards

When a dashboard contains multiple views that use the same field on the Pages shelf, you can control all of the views with a single page control by selecting the Synchronized option. This option is only available on the page control shown on a dashboard.

Filters Shelf

The Filters shelf allows you to specify which data to include and exclude. For example, you might want to analyze the profit for each customer segment, but only for certain shipping containers and delivery times. By placing fields on the Filters shelf, you can create such a view.

Note: This section presents a brief overview of filtering. For more information on filtering, see Filter Data from Your Views on page 630.

You can filter data using measures, dimensions, or both at the same time. Additionally, you can filter data based on the fields that make up the columns and rows of the table. This is called an internal filter. You can also filter data using fields that don’t contribute headers or axes to the table. This is called an external filter. All filtered fields display on the Filters shelf.

To illustrate the basic concepts of filtering, consider the following view.
Suppose you are not interested in the Home Office data. You can remove this column from the view by filtering the Segment dimension. To do so, select Filter on the field menu or drag the Segment dimension to the Filters shelf. The Filter dialog box opens. By default all members are selected. Clear the check box for Home Office to exclude it from the view. All selected members will be included.
As shown below, the view updates and the Home Office column is removed. The filter is indicated by the **Segment** field on the **Filters** shelf.
Suppose you want to only view profit for a category of the products. Even though the Category field is not used on the Rows and Columns shelves or on the Marks card, you can still add a filter. Drag the Category dimension to the Filters shelf. This is an example of an external filter because Category is not part of the view.

The Filter dialog box automatically opens. By default, none of the members are selected. Select the members you want to keep as part of the view. All cleared members are excluded. In this example, Office Supplies is selected.

The modified data view is shown below. The mark label shows that the sum of the profit for the Consumer segment has decreased to $56,330. This number is derived by summing all the rows in the data source that are associated with the Corporate market and are part of the Office Supplies category.
The order of fields placed on the Filters shelf does not affect the data view because the filters are independent. In other words, the result of filtering by customer segment, and then by container is the same as filtering by container and then by customer segment. For more information about the filtering order of operations, see Filter Data from Your Views on page 630.

**Marks Card**

The Marks card is where you drag fields to control mark properties such as type, color, size, shape, and so on. The fields on the Marks card are listed at the bottom of the card. Each field has an icon next to it to identify the mark property it is setting. For example, the Marks card shown below has three fields: Segment is on Color, Region is on Shape, and Quantity is on Size. For more information, see Marks on page 163, Mark Types on page 164, and Mark Properties on page 184.
After a field has been added to the Marks card, you can click the icon next to the field to change the property it is controlling.

Many properties can have multiple fields. For example, you can add multiple fields to Label, Detail, Tooltip, and Color. Size and Shape can only have one field at a time.

**Note:** By default, dragging a new field to **Color** replaces the existing fields. To add a new field to color without replacing the existing field, hold the SHIFT key on your keyboard while dragging a new field to **Color** on the Marks card.
Additional Shelves, Legends, Cards, and Controls

Some shelves, legends, cards, or controls are only displayed as a result of things that you do as you work with views. For example, the Color legend is only displayed when there is a field on Color.

Tableau provides controls for moving or otherwise customizing these elements of the view.

The following list describes each such shelf, legend, card, or control.

- **Measure Values Shelf**—Measure Values is a special field that always appears at the bottom of the Measures area of the Data pane and contains all the measures of your data collected into one field. Tableau automatically adds Measure Values to the view when multiple measures are sharing the same axis. When Measure Values is in the view, Tableau displays a Measure Values shelf that shows which measures are being included. You can add measures to or remove measures from this card. See [Measure Values and Measure Names](#) on page 295.

- **Color Legend**—Shows how colors are allocated when there is a field on Color. For more information, see [Color Properties](#) on page 184.

- **Shape Legend**—Shows how shapes are allocated when there is a field on Shape. For more information, see [Shape Properties](#) on page 211.

- **Size Legend**—Shows how sizes are allocated when there is a field on Size. For more information, see [Size Properties](#) on page 198.

- **Map Legend**—Shows the legend for the symbols and patterns on a map. The map legend is not available for all map providers.

- **Parameter Controls**—A separate parameter control is available for every parameter in the workbook. For more information, see [Parameter Controls](#) on page 923.

- **Title**—A title is displayed by default for every view. The default title is the sheet name. Double-click a title (Control-click on a Mac) to edit it.

- **Caption**—Choose Show caption from the Worksheet menu to display a caption for the view. For more information, see [Captions](#) on page 227.

- **Summary Card**—Choose Show summary from the Worksheet menu to display a summary card for the view. For more information, see [Summary Card](#) on page 528.
- Page Control – Provides options for navigating through pages when there is a field on the Pages shelf. For more information, see Pages Shelf on page 143.

Parts of the View

This section describes the basic components of the views you can create in Tableau. The parts of a view can be categorized as either table components, which are part of every view, or optional components, which can be turned on or off.

Table Components

Data views are displayed in a table on every worksheet. A table is a collection of rows and columns, and consists of the following components: Headers, Axes, Panes, Cells, and Marks. In addition to these, you can choose to show Titles, Captions, Field Labels, and Legends.

A. Field label - The label of a discrete field added to the row or column shelf that describes the members of that field. For example, Category is a discrete field that contains three members; Furniture, Office Supplies and Technology.

B. Title - The name that you give your worksheet, dashboard, or story. Titles display automatically for worksheets and stories and you can turn them on to display them in your dashboards.

C. Marks - The data that represents the intersection of the fields (dimensions and measures) included in your view. Marks can be represented using lines, bars, shapes, maps and so on.

D. Legend - A key that describes how the data is encoded in your view. For example if you use shapes or colors in your view, the legend describes what each shape or color represents.
E. Axis - Created when you add a measure (fields that contain quantitative, numerical information) to the view. By default, Tableau generates a continuous axis for this data.

F. Headers - The members of a field.

G. Caption - Text that describes the data in the view. Captions can be automatically generated and can be toggled on and off.

Headers

Headers are created when you place a dimension or discrete field on the **Rows** shelf or the **Columns** shelves. The headers show the member names of each field on the shelves. For example, in the view below the column headers show the members of the **Order Date** field and the row headers show the members of the **Sub-Category** field.

<table>
<thead>
<tr>
<th>Sub-Category</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessories</td>
<td>$25,014</td>
<td>$40,524</td>
<td>$41,896</td>
<td>$59,946</td>
</tr>
<tr>
<td>Appliances</td>
<td>$15,314</td>
<td>$23,241</td>
<td>$26,050</td>
<td>$42,927</td>
</tr>
<tr>
<td>Art</td>
<td>$6,058</td>
<td>$6,237</td>
<td>$5,910</td>
<td>$8,914</td>
</tr>
<tr>
<td>Binders</td>
<td>$43,488</td>
<td>$37,453</td>
<td>$49,485</td>
<td>$72,986</td>
</tr>
<tr>
<td>Bookcases</td>
<td>$20,037</td>
<td>$38,544</td>
<td>$26,275</td>
<td>$30,024</td>
</tr>
<tr>
<td>Chairs</td>
<td>$77,242</td>
<td>$71,735</td>
<td>$83,919</td>
<td>$95,554</td>
</tr>
<tr>
<td>Copiers</td>
<td>$10,850</td>
<td>$26,179</td>
<td>$49,599</td>
<td>$62,899</td>
</tr>
<tr>
<td>Envelopes</td>
<td>$3,856</td>
<td>$4,512</td>
<td>$4,730</td>
<td>$3,379</td>
</tr>
<tr>
<td>Fasteners</td>
<td>$661</td>
<td>$545</td>
<td>$960</td>
<td>$658</td>
</tr>
<tr>
<td>Furnishings</td>
<td>$13,826</td>
<td>$21,090</td>
<td>$27,874</td>
<td>$28,915</td>
</tr>
<tr>
<td>Labels</td>
<td>$2,841</td>
<td>$2,956</td>
<td>$2,827</td>
<td>$3,861</td>
</tr>
<tr>
<td>Machines</td>
<td>$62,023</td>
<td>$27,764</td>
<td>$55,907</td>
<td>$43,545</td>
</tr>
<tr>
<td>Paper</td>
<td>$14,835</td>
<td>$15,288</td>
<td>$20,638</td>
<td>$27,718</td>
</tr>
<tr>
<td>Phones</td>
<td>$77,391</td>
<td>$68,314</td>
<td>$78,660</td>
<td>$105,643</td>
</tr>
<tr>
<td>Storage</td>
<td>$50,329</td>
<td>$45,048</td>
<td>$58,632</td>
<td>$69,834</td>
</tr>
<tr>
<td>Supplies</td>
<td>$14,394</td>
<td>$1,952</td>
<td>$14,278</td>
<td>$16,049</td>
</tr>
<tr>
<td>Tables</td>
<td>$46,088</td>
<td>$39,150</td>
<td>$60,833</td>
<td>$60,894</td>
</tr>
</tbody>
</table>

You can show and hide row and column headers at anytime.

**To hide headers:**
Right-click (control-click on Mac) the headers in the view and select **Show Header**.

To show headers:

- Select the field in the view whose headers you want to show and select **Show Header** on the field menu.
Hiding headers can be useful when you are working with multiple measures. For example, the view below shows both the sales and profit for each region along a single axis. You can see the view looks cluttered with the Measure Names headers showing. Because Measure Names is also indicated by the mark color, you can hide the excess headers to clean up the view.
Axes

Axes are created when you place a measure or continuous field on the **Rows** or **Columns** shelves. By default, the values of the measure field are displayed along a continuous axis.

You can show and hide axes at any time.
To hide axes:

- Right-click (control-click on Mac) the axis in the view and select Show Header to clear the check mark next to this option.

To show axes:

- Right-click (control-click on Mac) the measure in the view whose axis you want to show and select Show Header on the field menu.
**Panes**

Panes are created by the intersection of rows and columns in a table. An example of a pane is highlighted in the view below.
**Note:** Tableau can display up to 1 million panes. If your view contains more than 1 million panes, you will need to filter your data so there are fewer panes in the view. For more information on filtering, see Filter Data from Your Views on page 630.

**Cells**

Cells are the basic components of any table you can create in Tableau. For a text table, the cell is the intersection of a row and a column, and is where the text is displayed. For example, one of the 68 cells is highlighted in the view below.

For other view types such as bar charts and scatter plots, identifying the cell is not always possible or useful.

**Marks**

When you drag fields to the view, the data are displayed using marks. Each mark represents the intersection of all of the dimensions in the view. For example, in a view with Region and Year dimensions, there is a mark for every combination of those two dimensions (East 2011, East 2012, West 2011, West 2012, etc.).
Marks can be displayed in many different ways including lines, shapes, bars, maps, and so on. You can show additional information about the data using mark properties such as color, size, shape, labels, etc. The type of mark you use and the mark properties are controlled by the Marks card. Drag fields to the Marks card to show more data. For example, the same view above is shown again below but this time with Profit on Color. With this additional information, it is clear that the West region had the highest profit in 2014.

Control the marks in the view using the Marks card. Use the drop-down menu to specify the type of mark to show. Drag fields to the Marks card and use the drop-down controls to add more information to the view and control the color, shape, size, labels, and number of marks in the view.

For information about how to move marks in a view, see Move Marks on page 219.

Mark Types

Mark types are available from the Marks card drop-down menu at the top of the Marks card. After selecting a mark type, you can further modify the marks by adding fields to Color, Size, Shape, and so on. The available mark properties are dependent on the type of mark you select.
Automatic Mark

When the Marks card drop-down menu is set to **Automatic**, Tableau automatically selects the best mark type for your data view. The mark type that is automatically selected is determined by the inner fields on the **Rows** and **Columns** shelves. The icon in the Marks card drop-down menu indicates which type of mark was automatically selected. The mark types below are automatically selected for the following scenarios.

**Text**

The **Text** mark type is automatically selected when there are dimensions as inner fields on both the **Rows** and **Columns** shelves.
**Shape**

The Shape mark type is selected when there are measures as inner fields on both the **Rows** and **Columns** shelves.
Bar

The Bar mark type is selected when there is a dimension and a measure as inner fields on Rows and Columns shelves.
Line

The Line mark type is selected when there is a date field and a measure as the inner fields on the Rows and Columns shelves.
Note: You can override the default selection and use any mark type that provides insight into your data. However, you should exercise some caution when manually selecting a mark type because the resulting view might hide important information about your data.

Bar Mark

The Bar mark type is useful when you want to compare measures across categories, or when you want to break data down into stacked bars. Tableau displays your data using bars when:

- The Marks card drop-down menu is set to Automatic, and you place a dimension and a measure as the inner fields on the Rows and Columns shelves. If the dimension is a date dimension, the Line mark is used instead.
- You select Bar from the Marks card drop-down menu.

Marks are automatically stacked.

Note: For views where the mark type is Bar and there are continuous (green) fields on both Rows and Columns, Tableau supports additional options and defaults for sizing the bar marks on the axis where the bars are anchored. See the Continuous axis mark sizing section in Size Properties on page 198 for details.
The data view shown below displays a dimension as the columns of the table, and a measure as the rows of the table. It is also color-encoded by a dimension (Category). Because the Marks card drop-down menu is set to Automatic, data is displayed using bars.

To try some hands-on exercises for building bar charts, see Build a Bar Chart on page 55.

Line Mark

The line mark type is useful when you want to see trends in data over time, your data are ordered, or interpolation makes sense. Tableau displays data using lines when:

- The Marks card drop-down menu is set to Automatic, and you place one or more measures on either the Columns shelf or the Rows shelf, and then plot the measures against a date dimension or a continuous dimension.
- You select Line from the Marks card drop-down menu.

The data view shown below displays a date dimension as the columns of the table and a measure as the rows of the table.
As the density of data increases, trends are often easier to see when using lines. This view shows 93 data points.

To try some hands-on exercises for building line charts, see Building Line Charts on page 67.
Area Mark

The Area mark type is useful when you have a view where the marks are stacked and do not overlap. For more information about stacked marks, see Stack Marks on page 221. In an area chart, the space between each line and the next line is filled with a color. This type of chart is not the best way to show specific values along the line but it can clearly show the total values so you can get an idea of how a dimension is contributing to an overall trend. Tableau displays your data using areas when:

- The Marks card drop-down menu is set to Automatic and one or more measures is plotted against a date dimension or continuous dimension. The Analysis > Stack Marks option must also be selected.

The view below shows a date dimension on the Columns shelf and a measure on the Rows shelf. Each line represents the sales for a product category. The lines have been stacked so that they do not overlap.

Note: You can add labels, edit the color legend, and highlight areas. In addition, you can turn on color effects, such as mark borders. For more information, see Mark Properties on page 184.
Square Mark

The square mark type is useful when you want to clearly see individual data points. When you select Square from the Marks card drop-down menu, Tableau displays your data using squares.

The view shown below displays several dimensions on both the rows and columns shelves. By default, the data is displayed using text. However, when you place a measure on Color, Tableau converts the marks to squares and creates a heat map. To try some hands-on exercises for building heat maps, see Build a Heat Map on page 78.

When you add additional levels of detail by placing a dimension on Detail, Color, Shape, Size, or Label on the Marks card, the squares are displayed side-by-side and wrap to fill the cell. If the window is too small to show all of the squares, an ellipses indicates that there are more values than you can see.

You can also use the square mark to create treemaps. A treemap displays hierarchical data as a set of nested rectangles. To try a hands-on exercise for building a treemap, see Build a Treemap on page 100.
Circle Mark

When you select **Circle** from the Marks card drop-down menu, Tableau displays your data using filled circles.

If the mark type was set to **Automatic**, Tableau would display the data using a shape (that is, an open circle).

Shape Mark

The shape mark type is useful when you want to clearly see individual data points while also viewing categories associated with those points. Tableau displays your data using a shape when:

- The Marks card drop-down menu is set to **Automatic**, and you place one or more measures on both the **Rows** and the **Columns** shelves.
- You select **Shape** from the Marks card drop-down menu.

The view shown below displays the data from two measures. Because the Marks card drop-down menu is set to **Automatic**, the data are displayed using a shape.
By default, the shape used is an open circle. To select a different shape, click **Shape** on the Marks card. Twenty unique shapes are available:

To add more data to the view, you can place a field on **Shape** on the Marks card. Tableau separates the marks according to the values in the field. If the field is a dimension, each member is assigned a unique shape. If the field is a measure, the measure is automatically
binned into distinct buckets and each bucket is assigned a unique shape. The shape legend displays how shapes are distributed.

As shown below, the Ship Mode dimension is placed on Shape on the Marks card to encode each mark with information about how the order was shipped.

Text Mark

The Text mark type is useful when you want to display the numbers associated with one or more dimension members. This type of view is often called a text table, a cross-tab, or a pivot table. Tableau displays your data using text when:

- The Marks card drop-down menu is set to Automatic, and you place one or more dimensions as the inner fields on both the Rows and the Columns shelves.
- You select Text from the Marks card drop-down menu.

Initially, the data is displayed as Abc.
To complete the view, you must place a field (typically a measure) on Text on the Marks card. In the view below, the Sales measure, which is aggregated as a sum, is used to complete the table.
Note: To create a cross-tab of any data view, select Worksheet > Duplicate as Crosstab.

When you add additional levels of detail by placing a dimension on Detail, Color, Shape, Size, or Text on the Marks card, the values are shown side-by-side and wrap to fill the cell. Allowing the text to stack up makes it possible to create word cloud visualizations like the one shown below.
If the application window is too small to fill all of the text, the cell displays an ellipses to indicate that there are more values than can fit.

To try some hands-on exercises for building text tables, see Build a Text Table on page 60.

**Filled Map Mark**

The Filled Map mark type uses geocoding to fill a polygon with a color based on data. The primary use of the filled map mark type is for creating choropleth maps (also known as thematic maps or data maps). The area to be filled is defined by the geographic fields used in the view. Tableau displays data using a filled map when:
A geographic dimension is on **Detail** on the Marks card, along with **Latitude** and **Longitude** on the **Rows** and **Columns** shelves. A measure or continuous dimension is added to **Color** on the Marks card.

You select **Filled Map** from the Marks card drop-down menu.

The data view below shows a map with the **State** geographic dimension on **Detail** on the Marks card. The **Profit** measure is on **Color** on the Marks card.

The polygon for each state is filled with a color based on the profit for that state. The profit in Texas is low (in fact, negative) while the profit in California is high.

You can also use the Filled Map mark type when you are plotting two measures against each other. By default, placing measures on both the **Rows** and **Columns** shelves creates a scatter plot. However, adding a geographic dimension allows you to change the mark type to Filled Map. Each mark becomes the area defined by the geographic field. For example, the view below shows **Sales** versus **Profit** for a selection of states. Rather than showing a round mark with a label for each state, the view uses the Filled Map mark type to draw the outline of each state. While this works well for recognizable areas, it is not the best choice for areas that are similar in shape or difficult to recognize.
Pie Mark

You can use the Pie mark to show proportions. Although generally this type of information can be better shown using stacked bar charts, there are cases where pie marks can be very effective—for example, when trying to convey the percentage allocation of marketing expenses by state where the spending of geographically close states are very relevant.

Tableau will never use the Pie mark as an automatic mark type, but you can select Pie from the Marks card drop-down menu.

When you select the Pie mark type, an additional target named Angle is displayed on the Marks card. The Angle target determines the angular measure of the pie wedges. For example, if you place a measure such as Sales on Angle on the Marks card, the 360 degrees of the pie corresponds to the total sum of sales, and each wedge is divided by the values of the field on Color on the Marks card.

The view below shows the time it took to ship products by various ship modes. The data overlays a map and shows data by state. We can see that standard class shipping takes the longest in most areas.
To try some hands-on exercises for pie charts, see Build a Pie Chart on page 98 and Build a Map View on page 114.

**Gantt Bar Mark**

The Gantt Bar mark type is useful for viewing dates, project plans, or the relationships between different quantitative variables. Tableau displays your data using Gantt bars when:

- The Marks card drop-down menu is set to **Automatic** and you place one or more dimensions on either the **Columns** shelf or the **Rows** shelf, and then plot the dimensions against a continuous quantity.
- You select **Gantt Bar** from the Marks card drop-down menu.

The distinguishing characteristic of Gantt Bars is that the length of every mark is proportional to the measure placed on **Size** on the Marks card.

The view below displays a dimension as a function of a continuous date. If the Marks card drop-down menu is set to **Automatic**, the data would be displayed using bars. Selecting **Gantt Bar** and adding additional fields will display a view like the following.
In particular, placing the **Days to Ship** measure on **Size** on the Marks card causes every bar in the view to be drawn with a length that indicates the delivery time of an order. Additionally, placing the **Ship Mode** dimension on **Color** on the Marks card causes each bar to be colored according to the ship mode.

To try a hands-on exercise for building a Gantt Bar chart, see [Build a Gantt Chart on page 92](#).

**Polygon Mark**

Polygons are points connected by lines enclosing an area. The polygon mark type is useful when you want to connect points to create data areas. Tableau displays data using polygons when you select Polygon from the **Mark** menu.

The polygon mark is not commonly used and often requires a specially constructed data source.

The view shown below comes from a specially constructed data source that holds geographic and election data. It displays the 48 contiguous US states as a function of latitude and longitude and color-encodes each state by the 2000 presidential election results.

If **Mark** is set to Automatic, the data will be displayed using a shape. Manually selecting Polygon and adding additional fields to the view causes a different view to be created.
Every state is considered to be a polygon in the data source. The PolygonID field on the Detail target is distinct for each US state. You can remove states from the view by filtering this field.

Additionally, you can specify the drawing order of the lines that constitute each polygon by placing a field on the Path target. In this example, the PointOrder measure is used to draw each state.

Mark Properties

You can control the mark properties using the Marks card. For example, you can control the colors, size, shape, etc. of the marks in the view. Drag fields to each property to encode the marks using your data. Click each property on the marks card to open a drop-down control where you can further tune the mark properties.

Color Properties

All marks have a default color, even when there are no fields on Color on the Marks card. For most marks, blue is the default color; for text, black is the default color.

When you drop a field on Color on the Marks card, Tableau applies different colors to marks, based on the field’s values. The effect of color-encoding your data view depends on whether the field you drop on Color is discrete, as indicated by a blue background:

- **Category**, or continuous, as indicated by a green background:

  - **SUM(Sales)**. Typically, dimensions are discrete and measures are continuous. For discrete fields, Tableau assigns a categorical palette, and for continuous fields, a quantitative palette.
You can also use the **Color** drop-down control on the Marks card to specify other color properties such as transparency, borders, and halos. For more information, see Configure color effects on page 189.

**Note:** Color selections for a field are shared across multiple worksheets that use the same data source. For example, if you assign the color orange to the West value for the **Region** field in one worksheet, West will automatically be orange in all other worksheets in the workbook. To set the default color for a field, right-click (control-click on Mac) the field in the **Data** pane, and then select **Default Properties > Color**.

**Categorical palettes**

When you drop a field with discrete values (typically a dimension) on **Color** on the **Marks** card, Tableau uses a categorical palette and assigns a color to each value of the field. Categorical palettes contain distinct colors that are appropriate for fields with values that have no inherent order, such as departments or shipping methods.

To change colors for values of a field, click in the upper-right corner of the color legend to open a context menu, and then select **Edit Colors** to open the Edit Colors dialog box.

![Edit Colors dialog box](image)

**Change the color for a value**

1. Click a value on the left, under **Select Data Item**.
2. Click a new color in the palette on the right. You can hover over a swatch to identify the color.
3. Repeat for as many values that you want to change.
4. Click **OK** to exit the Edit Colors dialog box.
Select a different palette

The Select Color Palette drop-down list in the Edit Colors dialog box provides color palettes that you can use for discrete fields. The list contains both categorical and ordinal palettes.

At the top of the list are categorical palettes, such as Tableau 10. As noted above, categorical palettes are appropriate for discrete fields with no inherent order.

At the bottom of the list are ordinal palettes such as Orange. Ordinal palettes contain a range of related colors and are appropriate for fields that have an associated order, such as dates or numbers.

After you select a palette, click Assign Palette to automatically assign the new palette colors to the members in the field.

To return to the Automatic palette and the default color assignments, click Reset in the Edit Colors dialog box.

Quantitative palettes

When you drop a field with continuous values on the Marks card (typically a measure), Tableau displays a quantitative legend with a continuous range of colors.

![Quantitative Legend Example]

You can modify the colors used in the range, the distribution of color, and other properties. To edit colors, click in the upper right of the color legend to open a context menu, and select Edit Colors to open the Edit Colors dialog box.

When there are both negative and positive values for the field, then the default range of values will use two color ranges and the Edit Colors dialog box for the field has a square color box on either end of the range. This is known as a diverging palette.
Edit Colors dialog box for a diverging palette

When all values are positive, then the default range of values will use a single color range and the Edit Colors dialog box for the field has a square color box only at the right end of the range. This is known as a sequential palette.

Edit Colors dialog box for a sequential palette

You can specify whether Tableau uses a diverging or a sequential palette for a continuous field on Color, and also configure the range of colors for the field’s values.

The Palette drop-down list provides a range of color palettes from which you can choose. There are two types of quantitative palettes available for continuous fields:
• All palettes with *Diverging* in the name are diverging quantitative palettes—for example, *Orange-Blue Diverging*. You can choose a diverging palette for any continuous field—it isn’t necessary for the range of values to contain both positive and negative numbers. To change the colors for a diverging palette, click one of the square color boxes at either end of the palette spectrum to open a color configuration dialog box, which is part of your computer’s operating system.

• All other palettes are sequential quantitative palettes. To change the colors for a sequential palette, click the square color box at the right end of the palette spectrum to open the color configuration dialog box, which is part of your computer’s operating system.

**Options for quantitative palettes**

The following options are available in the Edit Colors dialog box for a continuous field.

**Stepped Color**

Click **Stepped Color** to group values into uniform bins, where each bin is associated with a color. Use the spin control to specify how many steps (bins) to create. For example, for a range of values from 0 to 100 you could specify five steps, to sort values into five bins (0-20, 20-40, etc.).

If a diverging color palette is selected, the point where the palette transitions between colors is shown on the color ramp with a small black tick mark. When the number of steps is odd, the mark is placed in the middle of the transitional step. When the number of steps is even, the mark is placed at the boundary between the steps where the color changes.
Reversed

Click **Reversed** to invert the order of colors in the range. For example, if you want lower values to have a darker intensity in a sequential palette, reverse the palette. For a diverging palette, reversing the color palette means swapping the two colors in the palette, in addition to inverting the shades within each color range.

Use Full Color Range

With a diverging (two-color) palette, you can select to **Use Full Color Range**. Tableau assigns both the starting number and the ending number a full intensity for both color ranges. So if the range is from -10 to 100, the color representing negative numbers will be adjusted to change in shade much more quickly than the color representing positive numbers. If you do not select **Use Full Color Range**, Tableau assigns the color intensity as if the range of values was from -100 to 100, so that the change in shade is the same on both sides of zero. This means there will be much less change on the negative side, where actual values only range from -10 to 0, than on the positive side, where values range from 0 to 100.

The image on the left below shows a red-green diverging color palette for values from -858 to 72,986. Without using the full color range, -858 (associated with the small box at the lower right of the chart) shows as gray, because -858 is only about 1% as far to the negative side as 72,986 is to the positive side. When the full color range is used, as in the image on the right, -858 shows as a dark red, equal in intensity to the maximum positive value.

Limit the color range

When you click **Advanced** in the Edit Colors dialog box, you can choose to specify the start, end, and center RGB values for the range by selecting the check box and typing a new value into the field. The **Start** value is the lower limit in the range, the **End** value is the upper limit, and the **Center** value is where the neutral color is located on a diverging color palette.

Reset the color range

To return to the Automatic palette and the default color assignments, click **Reset** in the Edit Colors dialog box.

Configure color effects

Click the **Color** drop down on the **Marks** card to configure additional **Color** settings not related
to the actual colors shown.

Transparency

Modify the transparency of marks by moving the slider.

Adjusting transparency is especially useful in dense scatter plots or when you are looking at data overlaying a map or background image. As you slide the slider toward the left, marks become more transparent.

Mark borders

By default, Tableau displays all marks without a border. You can turn on mark borders for all mark types except text, line, and shape. On the Color drop-down control, select a mark border color.
Borders can be useful for visually separating closely spaced marks. For example, the views below show a scatterplot with mark borders turned on (left) and turned off (right). When borders are turned on, marks are easier to distinguish in areas where they are tightly clustered.

**Note:** You can also use transparency to show the density of marks.

When you are viewing a large number of color-encoded small marks, it is usually better to leave mark borders off. Otherwise borders can dominate the view, making it difficult to see the color encoding.

For example, the views below show bars that are segmented by a large number of color-encoded dimension members. With mark borders turned on (right), some of the narrower marks are difficult to identify by color. With borders turned off (left), the marks are easy to distinguish.
Mark halos

To make marks more visible against a background image or map, surround each mark with a solid contrasting color called a halo. Mark halos are available when you have a background image or a background map. On the Color drop-down control, select a mark halo color.
Markers

When you are using the Line mark type, you can add a marker effect to show or hide points along the line. You can show selected points, all points, or no points. On the Color drop-down control, select a marker in the Effects section.
Example - Multiple Fields on Color

If you drop one field on Color and then drop a different field on Color, the second field replaces the first field. However, depending on the chart type, for example treemaps and bullet graphs, you can put multiple fields on color. You can use one field to set the hue, and the other to show gradations within that hue.

Follow these steps, using the Sample - Superstore data source, to build a treemap with two fields on Color.

1. Drag **Category** and **Sub-Category** to **Columns**.
2. Drag **Sales** to **Size** on the **Marks** card.
3. Click **Show Me** in the toolbar, then select the Treemap chart type.

Tableau moves all fields to the **Marks** card, putting **SUM(Sales)** on both **Size** and **Color**, and **Category** and **Sub-Category** on **Label**.
4. Click the label icon to the left of Category on the Marks card and select Color:

Category replaces SUM(Sales) on Color. The marks are still sized by the sum of Sales, but now they are colored by Category:
5. Click the label icon to the left of **Sub-Category** on the Marks card and select **Color**. Tableau uses distinct, categorical colors for the first field, **Category**, and a range of sequential shades to distinguish values for the second field, **Sub-Category**.
The size of the individual rectangles is still determined by **Sales**, per **Category** and **Sub-Category**.

The two fields on **Color (Category** and **Sub-Category**) are related within a hierarchy, so if you swap their positions on the **Marks** card, moving **Sub-Category** to be above **Category**, the effect is the same as if you had removed **Category** from the view altogether. The treemap changes to show a uniquely colored rectangle for each **Sub-Category**:

When the two fields on Color are not related within a hierarchy, you can switch the order of the fields on the Marks card so that the field that was used for categorical colors was used for sequential shades, and vice versa.

If you aren’t satisfied with the colors that Tableau used, double-click the color legend to change them.

6. Make the view more readable by adding **Category**, **Sub-Category**, and **Sales** to **Label**. Users can hover to see tooltips for any rectangle that is too small to show text by default.
Size Properties

The **Size** property allows you to encode data by assigning different sizes to the marks in a data view. Depending on whether you use a discrete or continuous field, you will add either categorical or quantitative size encodings.

You can change the size of the marks using the slider on the **Size** drop-down control on the **Marks** card.
The Size slider affects different marks in different ways, as described in the following table.

<table>
<thead>
<tr>
<th>Mark Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circle, Square, Shape, Text</td>
<td>Makes the mark bigger or smaller.</td>
</tr>
<tr>
<td>Bar, Gantt Bar</td>
<td>Makes bars wider or narrower.</td>
</tr>
<tr>
<td>Line</td>
<td>Makes lines thicker or thinner.</td>
</tr>
<tr>
<td>Polygon</td>
<td>You cannot change the size of a polygon.</td>
</tr>
<tr>
<td>Pie</td>
<td>Makes the overall size of the pie bigger and smaller.</td>
</tr>
</tbody>
</table>

The size of your data view is not modified when you change marks using the Size slider. However, if you change the view size, the mark size might change to accommodate the new formatting. For example, if you make the table bigger, the marks might become bigger as well.

**Categorical sizes**

When you place a discrete field on Size on the Marks card, Tableau separates the marks according to the members in the dimension, and assigns a unique size to each member. Because size has an inherent order (small to big), categorical sizes work best for ordered data like years or quarters.

Size-encoding data with a discrete field separates the marks in the same way as the Detail property does, and then provides additional information (a size) for each mark. For more information about the Detail property, see **Detail Properties on page 207**. When you add categorical size encoding to a view, Tableau displays a legend showing the sizes assigned to each member in the field on the Size target. You can modify how these sizes are distributed using the Edit Sizes dialog box.

**Edit categorical sizes:**

- 199 -
1. Click the drop-down arrow in the right-hand corner of the Size legend and select **Edit Sizes** from the legend menu. For more information about legends, see **Legends** on page 230.

2. In the Edit Sizes dialog box, drag the slider to adjust the sizes assigned to each member.

   In the Edit Sizes dialog box, sizes are displayed on the left and a size range slider is shown on the right. The sizes assigned to each member are distributed across the specified range.

   You can also select **Reversed** to assign the largest mark to the smallest value and the smallest mark to the largest value.

   ![Edit Sizes dialog box](image)

3. Click **OK** to save your changes.

   The view below shows profit and order quantity broken out by region and order date. The discount customers received with each order is indicated by the size of the mark.
Quantitative sizes

When you place a continuous field on Size on the Marks card, Tableau draws each mark with a different size using a continuous range. The smallest value is assigned the smallest sized mark and the largest value is represented by the largest mark.

When you add quantitative size encoding to the view, Tableau displays a legend showing the range of values over which sizes are assigned. You can modify how these sizes are distributed using the Edit Sizes dialog box.

Edit quantitative sizes:

1. Click the drop-down arrow in the right-hand corner of the Size legend and select Edit Size from the legend menu.
2. In the Edit Sizes dialog box, in the Sizes vary drop-down box, select one of the following options to vary the sizes:
   - Automatically - Selects the mapping that best fits your data. If the data is numeric and does not cross zero (all positive or all negative), the From zero mapping is used. Otherwise, the By range mapping is used.
   - By range - Uses the minimum and maximum values in the data to determine the distribution of sizes. For example, if a field has values from 14 to 25, the sizes are distributed across this range.
- From zero - Sizes are interpolated from zero, assigning the maximum mark size to the absolute value of the data value that is farthest from zero.

3. Use the range slider to adjust the distribution of sizes. When the From zero mapping is selected from the Sizes vary drop-down menu, the lower slider is disabled because it is always set to zero.

4. Select Reversed to assign the largest mark to the smallest value and the smallest mark to the largest value. This option is not available if you are mapping sizes from zero because the smallest mark is always assigned to zero.

5. To modify the distribution of sizes, select the Start value in legend and End value for range check boxes and type beginning and end values for the range.

6. Click OK to save your changes.

The view below analyzes the time it takes to ship products based on their ship mode, order date, and the size of order. The size of each mark represents the order quantity while the color represents the ship mode. You can see that most products ship within one or four days. However, larger orders tend to take approximately four to six days and are shipped Standard Class. Curiously, there are a couple of small Same Day orders that were not delivered same day.
Continuous axis mark sizing

For views where the mark type is **Bar** and there are continuous (green) fields on both **Rows** and **Columns**, Tableau supports additional options and defaults for sizing the bar marks on the axis where the bars are anchored.

- The bar marks in histograms are continuous by default (with no spaces between the marks), and are sized to match the size of the bins. See [Build a Histogram](#) on page 85 for an example.

- When there is a field on **Size**, you can determine the width of the bar marks on the axis where the bars are anchored by using the field on **Size**. To do this, click the **Size** card and select **Fixed**.
- When there is no field on Size, you can specify the width of the bar marks on the axis where the bars are anchored in axis units. To do this, click the Size card, choose Fixed, and then type a number in the Width in axis units field.
When there is a continuous date field on the axis where the bars are anchored, the width of the marks is set to match the level of the date field. For example, if the level of the continuous date field is MONTH, the bars are exactly one month wide—that is, slightly wider for 31-day months than for 30-day months. You can configure the width of the bars by clicking the **Size** card, choosing **Fixed**, and then typing a number in the **Width in days** field, but the resulting bar widths don’t take into account the varying lengths of time units such as months and years.

**Label/Text Properties**

The Label property allows you to encode data by assigning text labels to the marks. When working with a text table, this property is called Text, which allows you to view the numbers associated with a data view. The effect of text-encoding your data view depends on whether you use a dimension or a measure.

- **Dimension** – When you place a dimension on **Label** or **Text** on the Marks card, Tableau separates the marks according to the members in the dimension. The text labels are driven by the dimension member names.

- **Measure** – When you place a measure on **Label** or **Text** on the Marks card, the text labels are driven by the measure values. The measure can be either aggregated or disaggregated. However, dis-aggregating the measure is generally not useful because it often results in overlapping text.
Text is the default mark type when dimensions are the inner fields for both the **Rows** shelf and the **Columns** shelf. This type of view is called a text table, which is also referred to as cross-tab or a PivotTable.

Note: You can display text labels with other mark types by dragging a field to the Label target on the Marks card. For more information on showing and hiding marks, see Mark Labels on page 504.

In the view below, the heights of the bars are driven by the **Sales** measure and the labels show the aggregation (SUM) of the **Profit** measure.
Whenever you place a dimension on the **Rows** or **Columns** shelf, Tableau uses the categorical members of the dimension to create table headers. The headers show how Tableau is sorting the underlying row data into specific categories. For example, the **Segment** dimension separates the data source rows into four levels of detail: Consumer, Corporate, and Home Office.
Drop a dimension on **Detail** on the Marks card to separate the marks in a data view according to the members of a dimension. Unlike dropping a dimension on the **Rows** or **Columns** shelf, dropping it on **Detail** on the Marks card is a way to show more data without changing the table structure.

In the view below, the bars are separated into segments according to the members of the **Sub-Category** dimension. The size of each segment reflects the contribution to the profit for a particular member. For example, the Accessories sub-category in the Consumer market has a profit of $20,736.

You can place any number of dimensions on **Detail** on the Marks card. In fact, placing all dimensions on this shelf is one way to display all the rows of your data source.

**Note:** The Detail property works only if the measures that contribute axes to the table are aggregated. If the measures are disaggregated, then it isn't possible to separate the marks into additional levels of detail because all levels of detail are already shown.
Placing a measure on **Detail** has no effect because measures do not contain members. However, you can place measures on this shelf if you want to export their values to Microsoft Access, copy their values to the Clipboard, or use the values in actions.

**Tooltip Properties**

Tooltips are details that appear when you hover over one or more marks in the view. Tooltips are also convenient for quickly filtering or removing a selection, or viewing underlying data. You can edit a tooltip to include both static and dynamic text. You can also modify which fields are included in a tooltip.

**Add a tooltip**

1. Drag a field to **Tooltip** on the **Marks** card.
2. Click **Tooltip** on the **Marks** card to open the Edit Tooltip dialog box, where you can add text, rearrange the tooltip contents, and insert more fields.

![Marks card with fields and schema](image)

**Note:** Dimensions are added to the tooltip using the ATTR aggregation, which means the tooltip may sometimes display as an asterisk. The asterisk indicates that there are multiple dimension members that apply to the mark you are pointing at. For example, a mark may represent the aggregated sales for all regions. Adding the Region field to the tooltip results in an asterisk because the mark represents more than one region. To avoid showing an asterisk, add the dimension to **Detail** on the Marks card or use it elsewhere in the view to ensure the marks are at the same level of detail.
**Tooltip options**

After you open the Edit Tooltip dialog box, there are several options that you can choose from to format the tooltips in your view and configure their behavior. You can choose from the options below.

- **Format tooltips**: Tooltips are specified on a per-sheet basis and can be formatted using the tools on the top of the Edit Tooltip dialog box.

- **Adding dynamic text**: Use the **Insert** menu at the top of the dialog box to add dynamic text such as field values, sheet properties, and more. The **All Fields** command on the **Insert** menu adds all field names and values that are used in the view to the tooltip for any mark in the view.

- **Show tooltips**: Tooltips are shown by default. If you prefer to hide automatic tooltips, clear the **Show Tooltips** check box.

- **Configure tooltip behavior**: Configure how tooltips behave by selecting one of the following options in the drop-down list next to the **Show Tooltips** check box:
  - **Responsive**: Select this option to show tooltips instantly as you move the cursor over the marks in the view. This is the default for all views.

    With this option, tooltips appear without command buttons. You must click a mark in the view first to see the command buttons.
- On Hover: Select this option to show tooltips only after you rest the cursor on a mark. However, with this option, command buttons appear on the tooltip without any further action from you (unless you specify otherwise in the Edit Tooltips dialog box).

- Show commands: Select the Include command buttons check box to add Keep Only, Exclude, Group Members, Create Set and View Data buttons at the top of the tooltip. These command buttons are available both in Tableau Desktop and when the view is published to the web or viewed on a mobile device.

  For more information about grouping members, see Groups on page 458. For more information about creating sets, see Sets on page 473.

- Add or remove fields: To add and remove fields when using the automatic tooltip, right-click (control-click on Mac) the field on one of the shelves in the view and select Include in Tooltip.

Note: The Include in Tooltip option is only available if you have not customized the tooltip. If you have customized the tooltip, you can return to the automatic tooltip by clicking Tooltip on the Marks card and then clicking Reset in the Edit Tooltip dialog box.

Shape Properties

The Shape property allows you to encode data by assigning different shapes to the marks in a data view.

When you place a dimension on Shape on the Marks card, Tableau separates the marks according to the members in the dimension, and assigns a unique shape to each member. Tableau also displays a shape legend, which shows each member name and its associated
shape. When you place a measure on **Shape** on the **Marks** card, the measure is converted to a discrete measure.

Shape-encoding data separates the marks in the same way as the Detail property does, and then provides additional information (a shape) for each mark. Shape is the default mark type when measures are the inner most fields for both the **Rows** shelf and the **Columns** shelf.

In the view below, the marks are separated into different shapes according to the members of the **Customer Segment** dimension. Each shape reflects the customer segment’s contribution to profit and sales.

![Graph showing marks separated into different shapes based on customer segments.](image)

**Editing shapes**

By default, ten unique shapes are used to encode dimensions. If you have more than 10 members, the shapes repeat. In addition to the default palette, you can choose from a variety of shape palettes, including filled shapes, arrows, and even weather symbols.

1. Click **Shape** on the **Marks** card, or select **Edit Shape** on the legend’s card menu.
2. In the Edit Shape dialog box, select a member on the left and then select the new shape in the palette on the right. You can also click **Assign Palette** to quickly assign the
shapes to the members of the field.

Select a different shape palette using the drop-down menu in the upper right.

**Note:** Shape encodings are shared across multiple worksheets that use the same data source. For example, if you define Furniture products to be represented by a square, they will automatically be squares in all other views in the workbook. To set the default shape encodings for a field, right-click (control-click on Mac) the field in the Data pane and select **Default Properties > Shape.**

**Custom shapes**

You can add custom shapes to a workbook by copying shape image files to the Shapes folder in your Tableau Repository, which is located in your Documents folder. When you use custom shapes, they are saved with the workbook. That way the workbook can be shared with others.

1. Create your shape image files. Each shape should be saved as its own file and can be in any of several image formats including bitmap (.bmp), portable network graphic (.png), .jpg, and graphics interchange format (.gif).

2. Copy the shape files to a new folder in the My Tableau Repository\Shapes folder in your Documents folder. The name of the folder will be used as the name of the palette in Tableau. In the example below, two new palettes are created: Maps and My Custom
Shapes.

3. In Tableau, click the drop-down arrow on the shape legend, and select **Edit Shape**.

4. Select the new custom palette in the drop-down list. If you modified the shapes while Tableau was running, you may need to click **Reload Shapes**.
5. You can either assign members shapes one at a time, or click Assign Palette to automatically assign the shapes to the members.
**Note:** You can return to the default palette by clicking the **Reset** button. If you open a workbook that uses custom shapes that you don’t have, the workbook will show the custom shapes because the shapes are saved as part of the workbook. However, you can click **Reload Shapes** in the Edit Shapes dialog box to use the ones in your repository instead.

Below are some examples of views that use both the default and custom shape palettes.
Tips for creating custom shapes

When you create custom shapes there are a few things that you can do to improve how your shapes look and function in the view. If you are creating your own shapes, we recommend following general guidelines for making icons or clip art.

- **Suggested size** - Unless you plan on using Size to make the shapes really large, you should try to make your original shape size close to 32 pixels by 32 pixels. However, the original size depends on the range of sizes you want available in Tableau. You can resize the shapes in Tableau by clicking Size on the Marks card, or by using the cell size options on the Format menu.

- **Adding color encoding** - If you plan to also use Color to encode shapes, you should use a transparent background. Otherwise, the entire square of the image will be colored rather than just the symbol. GIF and PNG file formats both support transparency. GIF files support transparency for a single color that is 100% transparent, while PNG files support alpha channels with a range of transparency levels available on every pixel in the image. When Tableau color encodes a symbol, the amount of transparency for each pixel won't be modified, so you can maintain smooth edges.

- **File formats** - Tableau doesn't support symbols that are in the Enhanced Meta File format (.emf). The shape image files can be in one of the following formats: .png, .gif, .jpg, .bmp, and .tiff.
Path Properties

The Path property allows you to encode data by connecting marks using a particular drawing order. You can path-encode your data using either a dimension or a measure.

- Dimension – When you place a dimension on Path on the Marks card, Tableau connects the marks according to the members in the dimension. If the dimension is a date, the drawing order is driven by the date order. If the dimension includes words such as customer names or product types, the drawing order is driven by the order of the members in the data source. You can change the order that data points are connected by changing the sort order of the members. For more information, see Sorting.

- Measure – When you place a measure on Path on the Marks card, Tableau connects the marks according to the values of the measure. The measure can be aggregated or disaggregated.

The Path property is available only when you select the Line or Polygon mark type from the Marks card drop-down menu. For more information, see Mark Types on page 164.

To create a useful path-encoded view, your data table should contain at least one measure. You can’t create a path that connects only categorical data (dimensions).

The view below was created using storm data from the Atlantic basin in 2010. The view uses line marks with the path determined by the date of the storm. This lets you see the path of the storm. By placing the continuous date on Path on the Marks card, this tells Tableau to draw the lines in chronological order.
Move Marks

In a dual-axis view that contains many marks, some marks can become hidden behind others, making it difficult to see details in your view. Tableau provides a Move Marks option to move selected marks forward or backward, depending on the axis that you select.

To move marks forward or backward, right-click on one of your axes and select one of the following options:

- Move Marks to Front
- Move marks to Back

Example - Move marks forward

In this example, suppose you have a view that uses the Circle mark type on a dual axis and shows department Sales and Profit for each Category.

The shape of each mark represents Sales and Profit, while Category is encoded as Color. The right axis represents the Sales mark, while the left represents the Profit mark.

Because the profit marks are in front, it is difficult to see the Sales marks in the Office Supplies category.

To move the Sales marks in front of the Profit marks, do the following:
1. Right-click on the Sales axis.

2. Select *Move marks to front* from the context menu.

By moving the Sales mark to the front, you can now see that rubber bands are below $100,000 in sales, whereas they were nearly invisible before.
Stack Marks

Stacking marks is relevant when your data view includes numeric axes. That is, at least one measure has been placed on the **Rows** or **Columns** shelves. When marks are stacked, they are drawn cumulatively along an axis. When marks are not stacked, they are drawn independently along an axis. That is, they are overlapping.

Stacking marks is particularly useful for bar charts which is why Tableau automatically stacks bars. You might find that stacking marks is useful for other marks such as lines as well.

You can control whether marks are stacked or overlapping in any given view by selecting the **Analysis** > **Stack Marks** menu item.

You can either allow Tableau to automatically select whether the marks are stacked or you can specify **On** or **Off**. The default setting is **Automatic**. When you are in automatic mode, the Stack Marks menu shows whether stacked marks is on or off.

Selecting **On** or **Off** on the **Stack Marks** menu, switches into manual mode. Your selection remains throughout any changes you make to the view.

The following examples illustrate stacking marks.

**Example – Stacking Bars**

Consider the stacked bars view shown below. It was created by placing a dimension on the **Columns** shelf, placing a measure on the **Rows** shelf, and color-encoding the data by a dimension (that is, dropping a dimension on **Color** on the Marks card).
Because the mark type is a bar, Tableau automatically stacks the marks. This means that the marks are drawn cumulatively and the height of each stacked segment within each bar represents the value for that segment, with each segment listed alphabetically. For example, the sum of the profit for products shipped with Same Day shipping (orange bar segment) in the Consumer market is $9,874.

If you turn off Stack Marks (under the Analysis menu), the marks start from the horizontal axis. As shown below, you can still view the individual bar segments. Be aware, however, because un-stacked marks overlap, it is possible to create a view where bar segments are not visible. For example, in the view below, Same Day shipping (orange bar segment) is no longer visible in the view for any market.
Example – Stacking Lines

Consider the data view shown below. It was created by placing a date dimension on the **Columns** shelf, placing a measure on the **Rows** shelf, and color-encoding the data by a dimension (that is, dropping a dimension on **Color** on the Marks card). Because the mark type is Line, the marks are not automatically stacked. Instead, they are drawn independently from the horizontal axis.
Interpret any data point by reading the associated values from the horizontal and vertical axes. For example, in the year 2014, the Corporate (orange) profit totaled $30,940. That is, the space between that data point and the horizontal axis is equal to the sum of the profit for the Corporate market.

Now, stack the marks by selecting the Analysis > Stack Marks > On menu item. Tableau automatically switches to the Area mark type.
In this view, the lines are no longer independent of each other. Instead, they are drawn cumulatively. The stacking order is driven by the order of the dimension members in the data source. This order is reflected in the color legend, from bottom to top.

Therefore, the stacked Home Office (red) area is the same as its un-stacked version because it’s at the bottom of the stacking list. The stacked Corporate (orange) area is derived by adding its un-stacked values to the un-stacked Home Office values. The stacked Consumer (blue) area is derived by adding its un-stacked values to the stacked Corporate data.

The vertical axis gives the new scale for the stacked marks. Interpret the filled area as the sum of the profit.

For example, notice that the label for the 2014 Corporate data still shows the profit as $30,940. The interpretation is that the space between the Corporate data and the Home Office data yields the sum of the profit for the Corporate market.

**Titles**

You can show titles on any worksheet, dashboard, or story. For worksheets and stories, a title is displayed by default, but you can remove it. For dashboards, you can add a title. By default, the title is the name of the sheet, but you can edit the title to change the text and include dynamic values such as page number and sheet name. For more information about how to format titles, see Format Titles, Captions, Tooltips and Legends on page 998.
Show and hide titles

To show and hide titles for worksheets, dashboards, and stories, review the following sections.

Worksheets

Titles are shown by default for worksheets and are included as part of the worksheet, shown at the top of the view. You can move the title to the sides or the bottom of the view. However, when you move the title from the top of the view, it becomes a Title card and displays like any other card in the view.

Note: If you move a title from the top position and then hide it; when you show the title again, it appears back at the top of the worksheet in its default position.

To show and hide titles in a worksheet, do one of the following:

- From the toolbar menu, click Worksheet > Show Title.
- On the toolbar, click the drop-down arrow on the Show/Hide Cards button and select Title from the context menu.
  
  Toggle the check mark on or off to show or hide the title.

Dashboards

You can turn on titles for dashboards. The title appears as part of the dashboard.

To show or hide titles on a dashboard, from the toolbar menu, select Dashboard > Show Title.
When you add worksheets to the dashboard, the title of the worksheet automatically shows, even if you turned off the title on the worksheet itself. To turn off the title for the worksheet on the dashboard, do the following steps:

1. In the dashboard, select the worksheet to highlight it.
2. In the top right corner of the highlighted worksheet, click the drop-down arrow and select Title in the context menu to clear the check mark.

Stories

Story titles are displayed by default. To toggle story titles on or off, in the top menu, select Story > Show Title to add or remove the check mark.

Captions

All views can have a caption that is either automatically generated or manually created. The caption is displayed on the Caption card. To show the caption, select it on the Show/Hide Cards toolbar menu or select Worksheet > Show Caption.

Caption

Sum of Sales for each Category. Color shows details about Region. The view is filtered on Region, which keeps Central, East and South.
The caption is automatically generated by default. However, you can edit the caption by double clicking the Caption card. In the Edit Caption dialog box, you can use change the font, size, color, and alignment and style.

![Edit Caption dialog box](image)

Use the Insert menu to add automatic text such as page number, sheet name, and field and parameter values.

The caption can optionally be included when printing, printing to PDF, and publishing to Tableau Server. When you export the view as an image to another application like Microsoft PowerPoint, you can optionally include the caption.

**Field Labels**

Placing discrete fields on the rows and column shelves creates headers in the view that display the members of the field. For example, if you place a field containing products on the rows shelf, each product name is shown as row headers. In addition to showing these headers, you can show field labels, which are labels for the headers. In this example, the rows are labeled **Category**, thus indicating that the discrete category names are members of the **Category** field.
Field labels apply only to discrete fields. When you add continuous fields to the view, Tableau creates an axis. The axis is labeled with a header.

By default, field labels are shown. You can hide or show field labels at anytime by selecting Analysis > Table Layout > Show Field Labels for Rows or Show Field Labels for Columns.

You can format the fonts, alignment, shading, and separators for field labels.
**Legends**

When you add fields to Color, Size, and Shape on the Marks card, a legend displays to indicate how the view is encoded with relation to your data.

**Color Legend**

<table>
<thead>
<tr>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
</tr>
<tr>
<td>East</td>
</tr>
<tr>
<td>South</td>
</tr>
<tr>
<td>West</td>
</tr>
</tbody>
</table>

**Size Legend**

<table>
<thead>
<tr>
<th>SUM(Sales)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$503</td>
</tr>
<tr>
<td>$20,000</td>
</tr>
<tr>
<td>$40,000</td>
</tr>
<tr>
<td>$60,000</td>
</tr>
<tr>
<td>$80,000</td>
</tr>
<tr>
<td>$101,781</td>
</tr>
</tbody>
</table>

**Shape Legend**

<table>
<thead>
<tr>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furniture</td>
</tr>
<tr>
<td>Office Supplies</td>
</tr>
<tr>
<td>Technology</td>
</tr>
</tbody>
</table>

Not only do legends help you understand encodings, you can also use legends to sort, filter, and highlight specific sets of data. For more information, see **Legend Highlighting** on page 1025.

**Workbooks and Sheets**

Tableau uses a workbook and sheet file structure, much like Microsoft Excel. A workbook contains sheets, which can be a worksheet, a dashboard, or a story.

A worksheet contains a single view along with shelves, legends, and the Data pane.
A dashboard is a collection of views from multiple worksheets.

A story contains a sequence of worksheets or dashboards that work together to convey information.

Within a workbook, you can create new sheets, clear an entire worksheet, duplicate sheets, hide or show a worksheet, and delete a sheet. Tableau has several ways to view and organize the sheets in your workbook.

**Sharing workbooks between Tableau Desktop on Windows and on the Mac**

When working in Tableau Desktop on the Mac, all sheets and workbooks will be fully functional for viewing and editing when opened in Tableau Desktop for Windows. The reverse is also true for workbooks created in Tableau Desktop on Windows.

However, Tableau Desktop on Windows is able to connect to additional data sources that may not be compatible when opened in Tableau Desktop on the Mac.

For more information about opening a Windows workbook that contains data sources that are not supported in Tableau Desktop on the Mac, see [Open an existing Windows workbook on a Mac on the next page](#) in the Workbooks topic.

**Creating and Opening Workbooks**

Tableau workbook files are much like Microsoft Excel workbooks.

A workbook contains one or more sheets, which can be worksheets, dashboards, or stories. You can use workbooks to organize, save, and share your results.

When you open Tableau, a new, blank workbook opens automatically.

**To create a new workbook**, select **File > New**.

**To open an existing workbook**, click the thumbnail image of the workbook on the start page.

When you open a workbook, the workbook name appears in the title bar.
You can open multiple workbooks simultaneously. Each workbook appears in its own window.

When you open multiple workbooks in Tableau Desktop on the Mac, multiple instances of the application are created, each with its own icon in the Dock. This differs from typical Mac application behavior, where one instance of the application handles all open documents.

Open an existing Windows workbook on a Mac

When working in Tableau Desktop on the Mac, you might need to open a Windows workbook that contains data sources that are not supported in Tableau Desktop on the Mac. To do so, follow the steps below:

1. In Tableau Desktop on Windows, save the workbook as an extract. To create and save an extract, on the Data menu, select a data source, and then select Extract Data.

2. Open the Tableau Extract (.tde file) you saved in Tableau Desktop on your Mac.

**Note:** When opening a workbook with Microsoft Excel or text files from Tableau version 9.2 or earlier, you will be prompted to upgrade the workbook. If the workbook is unable to upgrade, create an extract of the workbook in Windows, then open the extract on your Mac.

**Tip:** You can also open new workbooks in Windows using one of the following methods:

- Select **File > Open** and navigate to the location of your workbook using the Open dialog box. Tableau workbooks have a .twb or .twbx file extension.
• Double-click on any workbook file in the Windows explorer. On a Mac, click on any workbook file in Finder.

• In Windows, you can also drag any workbook file onto the Tableau desktop icon or onto the running application.

Sheets
Each workbook can contain different types of sheets: views (also known as worksheets), dashboards, and stories. A worksheet is where you build views of your data by dragging and dropping fields onto shelves. A dashboard is a combination of several views that you can arrange for presentation or to monitor. A story is a sequence of views or dashboards that work together to convey information. The sheets display along the bottom of the workbook as tabs. In this section you'll learn how to create, open, duplicate, hide, and delete sheets. You'll also learn how to organize sheets in a workbook.

Creating New Worksheets, Dashboards, and Stories
There are several ways to create new sheets in a workbook, dashboard, or a story. You can create as many sheets in a workbook as you want.

To create a new worksheet, dashboard, or story, click the New Worksheet, New Dashboard, or New Story button at the bottom of the workbook.

More ways to create new worksheets
Create a new worksheet by doing one of the following:

• Select Worksheet > New Worksheet.

• Right-click any open tab in the workbook, and select New Worksheet from the menu.

• On the toolbar, click the drop-down arrow on the New Worksheet button and then select New Worksheet.

• Press Ctrl + M on your keyboard (Command-M on a Mac).

More ways to create new dashboards
Create a new dashboard by doing one of the following:
- Select Dashboard > New Dashboard.
- Click the New Dashboard button at the bottom of the workbook.

- Right-click on any open tab in the workbook, and select New Dashboard from the menu.

- On the toolbar, click the drop-down arrow on the New Worksheet button and then select New Dashboard.

More ways to create new stories

Create a new story by doing one of the following:

- Select Story > New Story.
- Click the New Story button at the bottom of the workbook.

- Right-click on any open tab in the workbook, and select New Story from the menu.

- On the toolbar, click the drop-down arrow on the New Worksheet button and then select New Story.

Undo, Redo, and Clear Sheets

Every Tableau workbook contains a history of steps you have performed on the worksheets, dashboards, and stories in that workbook.

To move backward through the history, click Undo on the toolbar or press Ctrl + Z on your keyboard (Command-Z on a Mac).

To move forward through the history, click Redo on the toolbar or press Ctrl + Y (Command-Y on a Mac) on your keyboard.

To remove all fields, formatting, sizing, axis ranges, filters, sorts, and context filters in the sheet, click Clear Sheet on the toolbar.
To clear specific aspects of the view, use the Clear Sheet drop-down menu.

**Note:** Using the clear commands on the toolbar does not clear the history. If you decide that you didn’t want to clear the sheet, click the **Undo** button.

**Duplicating Sheets**

Duplicating a sheet allows you to easily make a copy of a worksheet, dashboard, or story. You can then modify the sheet without losing the original version. To duplicate the active sheet, right-click the sheet tab (control-click on Mac) and select **Duplicate Sheet**.

A crosstab (sometimes referred to as a Pivot Table) is a table that summarizes data in rows and columns of text. It is a convenient way to display the numbers associated with the data view.

To quickly create a cross-tab from a view, right-click the sheet tab (control-click on Mac) and select **Duplicate as Crosstab**. You can also select **Worksheet > Duplicate as Crosstab**. This command inserts a new worksheet into your workbook and populates the sheet with a cross-tab view of the data from the original worksheet. (Dashboards and stories cannot be duplicated as crosstabs.)

There are other ways to see the numbers behind the data views. For example, you can mouse-over any mark to display the associated numbers in a tooltip. Click the **View Data** command at the bottom of the tooltip to view underlying data. You can copy and paste the data into Excel or another application.

**Hide and Show Worksheets in Dashboards or Stories**

You can hide or show worksheets in a dashboard or story, for example, if you want to share a story with others but not clutter the view with all the supporting worksheets.

To hide a worksheet, right-click the worksheet tab (control-click on Mac) and select **Hide Sheet**.

**Dashboards**

To show a hidden sheet from a dashboard that uses it, in the **Dashboard** pane, right-click the worksheet that was hidden and select **Hide Sheet** to clear the selection and show the worksheet.
To show a sheet until you switch to another sheet, select the dashboard section that references the hidden worksheet, click the drop-down arrow in the top right corner, and then select Go to Sheet.

**Stories**

To view a hidden dashboard or worksheet, hover over the icon to the right of the sheet name and click to go to the underlying dashboard or sheet.

Though you can see the sheet, it is still hidden, so it won’t show when you publish the workbook or after you close and reopen it.

To unhide a sheet or dashboard, right-click it (Ctrl-click on Mac) and choose Unhide Sheet.

**Note:** If a story uses a hidden dashboard that in turn uses a hidden worksheet, to see that hidden worksheet you first go to the hidden dashboard from the story, and then to the hidden worksheet from the dashboard.
Deleting Sheets

Deleting a sheet removes it from the workbook. To delete the active sheet, right-click (control-click on Mac) the sheet in the sheet tab along the bottom of the workbook and select **Delete Sheet**. Worksheets used in a dashboard or story cannot be deleted, but they can be hidden. For more information, see **Hide and Show Worksheets in Dashboards or Stories** on page 235.

There must always be at least one worksheet in a workbook.

Organizing Sheets

You can navigate between sheets in a workbook, and you can reorder, create, or duplicate or delete sheets.

There are three ways to navigate and view the sheets in a workbook:

- Tabs at the bottom of the workbook
- In the filmstrip view
- In the sheet sorter view

The tabs are useful when you want to quickly navigate between a small number of sheets. If your workbook has a large number of sheets, you can use the sheet sorter to easily navigate them all.

You can also drag and drop to do the following:

- Reorder the sheets
- Create new sheets
- Duplicate or delete existing sheets from any of the views

**Navigate with sheet tabs**

Each sheet is represented as a tab along the bottom of the workbook. Select any tab to open the corresponding worksheet.

In the bottom right corner of the application window, there are several controls that you can use to advance through each sheet or quickly jump to the first or last sheet in the workbook. These
controls are only available when there are too many sheet tabs to show across the bottom of the application window.

You can also navigate between sheets using the window menu or move through the multiple worksheets by pressing the left or right arrow keys on your keyboard.

To navigate through multiple worksheets, select a worksheet tab at the bottom of the workbook first.

**Note:** Navigating within a story is a different matter—there, you use the Navigator to move between story points. See Updating a Story on page 1094.

### Show thumbnails with the filmstrip

Similar to the sheet tabs, the filmstrip displays along the bottom of the workbook. However, instead of just sheet names, the filmstrip also shows a thumbnail image of each sheet. The filmstrip is useful when you are using Tableau to present your analysis and works well when you are working in Presentation mode.

Open the filmstrip by clicking the Filmstrip button on the status bar (bottom right corner) of the workbook. Just like with the tabs, select the thumbnail image for the sheet you want to open. You can right-click the images to specify commands that apply to each sheet.

**Note:** When viewed from a Retina display, workbooks that are created on a standard resolution device will show only the first thumbnail in the filmstrip in high resolution. To display all thumbnails in the filmstrip in high resolution, resave the workbook on a computer with Retina display.

### Manage many sheets with sheet sorter

The sheet sorter shows all sheets in a workbook as thumbnail images on a single page. The sheet sorter is useful when you have a large number of sheets in a workbook. Open the sheet sorter by clicking the sheet sorter button on the status bar (bottom right corner of the
Right-click a sheet (Control-click on the Mac) to see these commands. You can also right-click (Control-click on the Mac) to refresh the thumbnail image of a particular sheet or Refresh All Thumbnails at once. If you have a large number of sheets, refreshing your view can take some time.

**Sheet commands**

Use sheet commands to manage and organize your worksheets. For example you can create new sheets, duplicate sheets, copy formatting, apply color, or delete the sheet entirely.

You can access sheet commands on the right-click menu (Control-click on a Mac) in the worksheet, sheet sorter, or the filmstrip view. To apply commands to multiple sheets at once, press the Ctrl key (Shift key on a Mac), and then select the sheets.

To make it easier to identify and group sheets, you can assign a color to sheets. You can select from seven different colors. Selecting None clears the color.

To assign a color to sheets, select one or more sheets, right-click the sheets (Control-click on the Mac), select **Color**, and then pick a color.
The color strip appears on the bottom of the tab or sheet.

**Files and Folders**

You can save your work using several different Tableau specific file types: workbooks, bookmarks, packaged data files, data extracts, and data connection files. Each of these file types are described below.

- **Workbooks (.twb)** – Tableau workbook files have the .twb file extension. Workbooks hold one or more worksheets, plus zero or more dashboards and stories.

- **Bookmarks (.tbm)** – Tableau bookmark files have the .tbm file extension. Bookmarks
contain a single worksheet and are an easy way to quickly share your work. For more information, see Bookmarks on page 1145.

- **Packaged Workbooks (.twbx)** – Tableau packaged workbooks have the .twbx file extension. A packaged workbook is a single zip file that contains a workbook along with any supporting local file data and background images. This format is the best way to package your work for sharing with others who don’t have access to the original data. For more information, see Packaged Workbooks on page 1144.

- **Data Extract (.tde)** – Tableau data extract files have the .tde file extension. Extract files are a local copy of a subset or entire data that you can use to share data, work offline, and improve database performance.

- **Data Source (.tds)** – Tableau data source files have the .tds file extension. Data source files are shortcuts for quickly connecting to the original data that you use often. Data source files do not contain the actual data but rather the information necessary to connect to the actual data as well as any modifications you’ve made on top of the actual data such as changing default properties, creating calculated fields, adding groups, and so on. For more information, see Export Data Sources on page 431.

- **Packaged Data Source (.tdsx)** – Tableau packaged data source files have the .tdsx file extension. A packaged data source is a zip file that contains the data source file (.tds) described above as well as any local file data such as Extract files (.tde), text files, Excel files, Access files, and local cube files. Use this format to create a single file that you can then share with others who may not have access to the original data stored locally on your computer. For more information, see Export Data Sources on page 431.

These files can be saved in the associated folders in the My Tableau Repository directory, which is automatically created in your My Documents folder when you install Tableau. Your work files can also be saved in other locations, such as your desktop or a network directory.

**Changing the Repository Location**

You can specify a new location for the Tableau repository if you are not using the default location in your Documents folder. For instance, if you are required to have your data on a network server instead of on your local machine, you can point Tableau at the remote repository.

1. Select **File > Repository Location**.
2. Select a new folder that will act as the new repository location in the Select a Repository dialog box.
3. Restart Tableau so that it uses the new repository.

Changing the repository location does not move the files contained in the original repository. Instead, Tableau creates a new repository where you can store your files.
Status Bar

The status bar is located at the bottom of the Tableau workspace. It displays descriptions of menu items as well as information about the current view. For example, the status bar below shows that the view has 143 marks shown in 3 rows and 12 columns. It also shows that the SUM(Sales) for all the marks in the view is $2,297,201.

You can hide the status bar by selecting **Window > Show Status Bar**.

Occasionally, Tableau will display warning icons in the bottom right corner of the status bar to indicate errors or warnings. Below are the possible warning icons and what they mean.

<table>
<thead>
<tr>
<th>Warning Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Warning Icon" /></td>
<td>Cancel query indicator: When you cancel multiple queries, an indicator appears to show you how many queries are still running on the database and using resources. See <a href="#">Abandoned Queries</a> on page 1629</td>
</tr>
<tr>
<td>Warning Icon</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td>![Warning Icon]</td>
<td>for more information about managing these queries.</td>
</tr>
<tr>
<td>![Precision warning icon]</td>
<td><strong>Precision warning:</strong> Some fields are more precise in the database than Tableau can model. When you add these fields to the view a precision warning is displayed in the status bar. See <a href="#">Precision Warnings on page 1630</a> for more information about this warning.</td>
</tr>
<tr>
<td>![Special values indicator]</td>
<td><strong>Special values indicator:</strong> If your data contains null</td>
</tr>
<tr>
<td>Warning Icon</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>values, unknown geographic locations, or negative or zero values on a logarithmic axis; the values are shown with an indicator in the lower right corner of the view. Click the indicator for options for handling these values. See <strong>Special Values</strong> on page 319 to learn more about this indicator and how to handle these values.</td>
</tr>
</tbody>
</table>

**Tooltips**

Tooltips are additional data details that display when you rest the pointer over one or more marks in the view. Tooltips also offer convenient tools to quickly filter marks, view underlying data, group data, and create sets. Tooltips consist of a body, action links, and commands.
Body

The body of a tooltip contains details about a specific mark or a selection of multiple marks. For example, in a bar chart showing sales by region, the tooltip body may include the actual sales amount and the region name. The default tooltip is based on the fields used in the view. You can customize what is shown in the tooltip by dragging fields to Tooltip on the marks card. Click Tooltip on the marks card to further customize the tooltip including how the text is formatted. Alternatively, you can select Worksheet > Tooltip. See Format Titles, Captions, Tooltips and Legends on page 998 to learn more about formatting the body of the tooltips.

Action links

If the sheet has any actions, the action links are listed below the body of the tooltip. An action adds context and interactivity to your data through filters, highlighting, and links to external resources. See Actions on page 1018 to learn more about adding actions to your workbook.

Commands

The top of the tooltip lists commands to quickly filter data and view the underlying data. For example, you can use the tooltip to quickly remove an outlier in a scatter plot. Each of the commands are described below.

- **Keep Only** - creates a filter that removes all other data. See Select to keep or exclude data points in your view on page 631 to learn more.

- **Exclude** - creates a filter that removes the selected data. See Select to keep or exclude data points in your view on page 631 to learn more.

- **Group Members** - creates a group based on the selection. If the selection contains multiple dimensions, you can group on one dimension or all dimensions. See Groups on page 458 to learn more.
- Create Set - creates a new set containing the selected members. You can create a new set or add members to an existing set. See Sets on page 473 to learn more.

- View Data - opens a window displaying the data. You can view the summarized data or the underlying data. See View Data on page 529 to learn more.

These commands are visible by default. You can disable the commands in the Edit Tooltip dialog box.

Disable tooltip commands

1. Click Tooltip on the Marks card or select Worksheet > Tooltip.
2. In the Edit Tooltip dialog box, clear the Include command buttons check box in the bottom left corner.

Tooltip settings apply to the active worksheet and can be different for each sheet in the workbook.

Reorganizing the Workspace

Every worksheet contains a variety of cards, shelves, legends, and so on. You can reorganize the workspace by rearranging cards, hiding and showing specific parts of the workspace, and hiding everything but the view using Presentation Mode.

Rearranging Cards

A worksheet contains several cards that contain shelves, legends, and other controls. Each card can be rearranged to create a custom workspace. To move a card, point the cursor at the title area of the card you want to move. When the cursor becomes the move symbol, click and drag the card to a new position. As you drag the card around the worksheet, the possible positions for it are highlighted with a black bar.
You can restore the worksheet windows to their default state by selecting Reset Cards on the Show/Hide Cards toolbar control.

**Showing and Hiding Parts of the Workspace**

Just about everything in the workspace can be turned on and off so you can avoid cluttering the worksheet with unnecessary cards, shelves, etc.

- To show and hide the toolbar or status bar, select **Window** and then select what you want to hide.

- To show and hide the window on the left side, which is either the Data pane (for worksheets), the Dashboard pane (for dashboards), or the Dashboards and Sheets pane (for stories); click the Minimize button in the upper right corner of the pane. The pane is minimized to the bottom left corner of the workbook. Click the same button again to restore the pane.

- To show or hide a card click **Show/Hide Cards** on the toolbar and then select the card you want to show or hide.
You can restore the worksheet windows to their default state by selecting **Reset Cards** on the **Show/Hide Cards** toolbar control.

### Presentation Mode

Sometimes you may want to use Tableau to present your findings. Rather than hiding each card or shelf one at a time, you can switch to presentation mode. Presentation mode hides everything on the sheet except for the view and its associated legends, filter cards, parameter controls, and worksheet tabs.

- To switch in and out of presentation mode, click the Presentation Mode button on the toolbar or select **Window > Presentation Mode**.

Use the presentation mode controls in the bottom right corner to move between sheets and more. Each presentation mode control is described below.

<table>
<thead>
<tr>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Filmstrip" /></td>
<td><strong>Show Filmstrip</strong> - shows the sheets as thumbnails at the bottom of the workspace.</td>
</tr>
<tr>
<td><img src="image" alt="Tabs" /></td>
<td><strong>Show Tabs</strong> - shows the sheet tabs at the bottom of the workspace.</td>
</tr>
<tr>
<td><img src="image" alt="Prev/Next" /></td>
<td><strong>Previous/Next Sheet</strong> - advances forward or backward through the sheets in a workbook.</td>
</tr>
<tr>
<td><img src="image" alt="FullScreen" /></td>
<td><strong>Enter/Exit Full Screen</strong> - switches between expanding the workbook to fill the entire screen and showing it in a window.</td>
</tr>
<tr>
<td><img src="image" alt="Exit" /></td>
<td><strong>Exit Presentation Mode</strong> - returns the workbook to showing the entire workspace including the menus, toolbar, and the Data pane.</td>
</tr>
</tbody>
</table>

### Language and Locale

Tableau Desktop is localized into several languages.

When you first run Tableau, it recognizes your computer locale and uses the appropriate language if it is supported. If you are using an unsupported language, the application defaults to English.

You can configure Tableau to display the user interface (menus, messages, etc.) by choosing **Help > Choose Language**. After you change this setting, you’ll need to restart the application for the changes to take effect. You do not need to change this setting for every workbook.
To configure date and number formatting, choose **File > Workbook Locale**. By default, the locale is set to **Automatic**, which means the locale will match the locale when the workbook is opened. This can be useful if you are authoring a workbook that will be viewed in many different languages and you want the dates and numbers to update accordingly. When you select a specific locale, the workbook will not change regardless of who opens it.

Tableau checks the following, in order, to determine the workbook locale:

- Workbook Locale (explicit setting)
- Windows Locale or Mac language
- Tableau Language

If none of the above is set, then the workbook locale defaults to English.

**Day of the Week Sorting**

If you are working in a language for which Tableau does not provide a local version, set your workbook locale to ensure that Tableau can sort the days of the week in the correct chronological order. Otherwise, Tableau will sort the names of the days alphabetically. If none of the supported locales is appropriate, you can sort the days of the week manually. See **Manual Sorting** on page 456.

**Visual Cues and Icons in Tableau Desktop**

Tableau provides many visual cues to help you evaluate the type of data that’s displayed in the Data pane and the state of a data view.

**Data sources in the Data pane**

The following table explains each of the icons used to describe the type of data sources in the Data pane. Each icon in the table can be modified by one of two indicators.

- A blue check mark indicates that the data source is the primary data source in the workbook.
- An orange check mark indicates that the data source is the secondary data source in the workbook.
<table>
<thead>
<tr>
<th>Visual Cue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![icon]</td>
<td>The workbook is directly connected to a relational data source or file.</td>
</tr>
<tr>
<td>![icon]</td>
<td>The workbook is connected to a cube (multidimensional) data source. In Tableau, cube data sources are supported only in Windows.</td>
</tr>
<tr>
<td>![icon]</td>
<td>The workbook is connected to an extract that still references the underlying data.</td>
</tr>
<tr>
<td>![icon]</td>
<td>The workbook is connected to a data source that has been published to Tableau Server.</td>
</tr>
</tbody>
</table>

**Fields in the Data Pane**

The following table explains each of the icons displayed in the Data pane. Each icon in the table can be modified by one of four indicators.

- Blue icons indicate that the field is discrete. $^\text{Abc}$
- Green icons indicate that the field is continuous. $^\#$
- Icons preceded by the equal sign (=) indicate that the field is a user-defined calculation or a copy of another field. $^\text{Abc}$
<table>
<thead>
<tr>
<th>Visual Cue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abc</td>
<td>The field contains text values.</td>
</tr>
<tr>
<td># Abc</td>
<td>The field contains numeric values.</td>
</tr>
<tr>
<td># #</td>
<td>The field is a calculation defined on the server.</td>
</tr>
<tr>
<td>[●]</td>
<td>The field contains only date values.</td>
</tr>
<tr>
<td>[●] [●]</td>
<td>The field contains both date and time values.</td>
</tr>
<tr>
<td>[●] [●] [●]</td>
<td>The field contains geographical data and has been assigned a geographic role. Use these fields when building map views. See Build and Use Maps on page 659.</td>
</tr>
<tr>
<td>[●] [●] [●]</td>
<td>The field contains geographical data from an active custom geocoding file. See Custom Geocode Your Data on page 676.</td>
</tr>
<tr>
<td>[●] [●] [●]</td>
<td>The field contains boolean (true or false) values.</td>
</tr>
<tr>
<td>[●] [●] [●]</td>
<td>The field is a calculation that is defined in the database by an administrator. These fields are marked with a cylinder icon and are not available for all data sources.</td>
</tr>
<tr>
<td>[●]</td>
<td>The field is a user-defined set. See Sets on page 473.</td>
</tr>
</tbody>
</table>
### Visual Cue Description

<table>
<thead>
<tr>
<th>Visual Cue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>![icon1]</td>
<td>The field is a server named set.</td>
</tr>
<tr>
<td>![icon2]</td>
<td>The field is a set that was automatically created as a result of an action.</td>
</tr>
<tr>
<td>![icon3]</td>
<td>The field is a user filter, used when publishing to the web. See Control Who Can See What in a Published View on page 1109.</td>
</tr>
<tr>
<td>![icon4]</td>
<td>The field is a numeric bin. See Create Bins from a Continuous Measure on page 554.</td>
</tr>
<tr>
<td>![icon5]</td>
<td>The field is a group. See Groups on page 458.</td>
</tr>
<tr>
<td>![icon6]</td>
<td>The field is a relational hierarchy. See Hierarchies (For Relational Databases) on page 292.</td>
</tr>
<tr>
<td>![icon7]</td>
<td>A folder that contains one or more fields. Folders are used to organize fields in the Data pane. See Organize the Data Pane on page 298.</td>
</tr>
<tr>
<td>![icon8]</td>
<td>The field is an attribute of a cube (multidimensional) data source. In Tableau, cube data sources are supported only in Windows.</td>
</tr>
<tr>
<td>![icon9]</td>
<td>The field is a varying attribute of a cube (multidimensional) data source.</td>
</tr>
<tr>
<td>![icon10]</td>
<td>The field is a level in a multidimensional hierarchy. Levels greater than five are shown without numbers.</td>
</tr>
<tr>
<td>![icon11]</td>
<td>The field is blended with a field from another data source. See Primary and secondary data sources on page 365</td>
</tr>
<tr>
<td>![icon12]</td>
<td>The field is not blended with a field from another data source. See Primary and secondary data sources on page 365</td>
</tr>
</tbody>
</table>

### Fields on Shelves

Fields placed on shelves use a combination of icons, colors, and text styles as visual cues.
<table>
<thead>
<tr>
<th>Visual Cue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Region</td>
<td>A blue field on a shelf indicates a discrete field. In most cases, adding a dimension to a shelf results in a blue field. Blue fields are discrete—they contain a finite number of values. Adding a blue field to a shelf creates headers. See Headers on page 157.</td>
</tr>
<tr>
<td>SUM(Sales)</td>
<td>A green field on a shelf indicates a continuous field. In most cases, adding a measure to a shelf results in a green field. Green fields are continuous—they contain an infinite number of values. Adding a green field to a shelf creates an axis. See Axes on page 160.</td>
</tr>
<tr>
<td>Company</td>
<td>The Sort icon indicates a field that has either a computed or manual sort order applied. See Computed Sorting on page 444.</td>
</tr>
<tr>
<td>∑ Date.Fiscal</td>
<td>The sigma icon indicates a slicing filter in a multidimensional (cube) data source. See Create Slicing Filters on page 656.</td>
</tr>
<tr>
<td>Core Product Gro..</td>
<td>The Venn diagram icon indicates a set. See Sets on page 473.</td>
</tr>
<tr>
<td>Core Product ..</td>
<td>A field name shown in italics indicates a filtered set.</td>
</tr>
<tr>
<td>Segment: Corporate</td>
<td>A gray field on the Filters shelf indicates a context filter. See Improve View Performance with Context Filters on page 652.</td>
</tr>
<tr>
<td>AVG(Close)</td>
<td>The delta icon indicates that the field is a table calculation. See Transform Values with Table Calculations on page 767.</td>
</tr>
<tr>
<td>Country, State</td>
<td>The plus and minus controls appear when the field is part of a hierarchy that you can traverse.</td>
</tr>
<tr>
<td>Visual Cue</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SUM(Sales)</td>
<td>The arrow icon indicates that a forecast is being displayed for the field. This icon is also used on the Forecast Indicator field, which is an automatic field used to distinguish between actual and forecast values. See Forecasting on page 592.</td>
</tr>
<tr>
<td>SUM(Sales ..)</td>
<td>The field is from a secondary data source. See Blend Your Data on page 363.</td>
</tr>
<tr>
<td>Last Sale Price</td>
<td>The field is assigned to a specific worksheet.</td>
</tr>
<tr>
<td>Segment</td>
<td>The field is assigned to all worksheets with the same data source.</td>
</tr>
<tr>
<td>Internet Sales Amount</td>
<td>The field is incompatible with one or more other fields in the view.</td>
</tr>
</tbody>
</table>

**Fields on the Marks card**

Fields placed on the Marks card use specific icons to describe how they appear in the view. See Mark Properties on page 184.

<table>
<thead>
<tr>
<th>Visual Cue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment</td>
<td>The field is applied to Color on the Marks card.</td>
</tr>
<tr>
<td>SUM(Profit)</td>
<td>The field is applied to Size on the Marks card.</td>
</tr>
<tr>
<td>AVG(Discount)</td>
<td>The field is applied to Label on the Marks card.</td>
</tr>
</tbody>
</table>
### Visual Cue Description

<table>
<thead>
<tr>
<th>Visual Cue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>🥦 Sub-Category</td>
<td>The field is applied to Shape on the Marks card.</td>
</tr>
<tr>
<td>⬤ SUM(True Average)</td>
<td>The field is applied to Detail on the Marks card.</td>
</tr>
<tr>
<td>⬤ AVG(Math)</td>
<td>The field is applied to Tooltip on the Marks card.</td>
</tr>
<tr>
<td>⬤ YEAR(Date)</td>
<td>The field is applied to Path on the Marks card. Path is only available when the Line or Polygon mark type is selected from the Marks drop-down menu. See Path Properties on page 218.</td>
</tr>
</tbody>
</table>

### Sheets in the Dashboards and Worksheets pane

The following table explains each of the icons used to describe the type of sheet that can be placed in a story. A blue check mark indicates that a sheet is being used in one or more story points.

<table>
<thead>
<tr>
<th>Visual Cue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>📑</td>
<td>The sheet is a worksheet.</td>
</tr>
<tr>
<td>📑</td>
<td>The sheet is a dashboard.</td>
</tr>
</tbody>
</table>
Tableau Concepts

Why are some fields dimensions and others measures?
What effect will adding a filter have on my view?
Why is the background color blue for some fields, and green for others?
The topics in this section attempt to clarify these and other questions about what you can see and experience as you use Tableau Desktop.

If you’re new to Tableau Desktop, also consider working through the **Build-It-Yourself Exercises** on page 55, and check out the **Free Training Videos** on the Tableau website.

**Data Types**

All fields in a data source have a data type. The data type reflects the kind of information stored in that field, for example integers (410), dates (1/23/2015) and strings (“Wisconsin”). The data type of a field is identified in the Data pane by one of the icons shown below.

**Data type icons in Tableau**

<table>
<thead>
<tr>
<th>Icon</th>
<th>Data type</th>
</tr>
</thead>
<tbody>
<tr>
<td>🍔️</td>
<td>Text (string) values</td>
</tr>
<tr>
<td>🕒</td>
<td>Date values</td>
</tr>
<tr>
<td>🕒⏰</td>
<td>Date &amp; Time values</td>
</tr>
<tr>
<td>🎯</td>
<td>Numerical values</td>
</tr>
<tr>
<td>🎯</td>
<td>Boolean values (relational only)</td>
</tr>
<tr>
<td>🌍</td>
<td>Geographic values (used with maps)</td>
</tr>
</tbody>
</table>

You can change the data type for a field either on the **Data Source** page or in the **Data** pane.
Change the data type for a field in the Data Source page

Sometimes Tableau incorrectly interprets the data type of a field. For example, Tableau might interpret a field that contains dates as an integer data type, rather than a date data type.

You can change the data type for a field that was part of the original data source (as opposed to a calculated field created in Tableau) on the Data Source page.

1. Click the field type icon for the field (as shown in the table above).
2. Choose a new data type from the drop-down list:

   ![Field Type Icon](image)

   Tip: Be sure to change data types before you create an extract. Otherwise, your data may not be accurate. For example, if a floating-point field in the original data source is interpreted as an integer by Tableau, and you create your extract before you change the field’s data type, the resulting floating-point field in Tableau will have some of its precision truncated.

For information on changing data types on the Data Source page, see Data Source Page on page 126.

Change the data type for a field in the Data pane

To change the data type of a field in the Data pane, click the icon to the left of the field name, and then choose a new data type from the drop-down list.
**Change the data type for a field in the view**

To change a field's data type in a view, right-click (control-click on a Mac) the field in the Data pane, choose **Change Data Type**, and then select the appropriate data type from the drop-down list.
**Note:** Sometimes the data in your database is more precise than Tableau can model. When you add these values to the view, a precision warning appears in the right corner of the status bar. See **Precision Warnings** on page 1630.

### Mixed data types in data from files

Most columns in a Microsoft Excel, Microsoft Access, or CSV (comma-separated value) file contain values that are all of the same data type (Booleans, dates, numbers, or text). When you connect to the file, Tableau creates a field in the appropriate area of the **Data** pane for each column. Dates and text values are dimensions, and numbers are measures.

However, files that you connect to might include columns that have a mixture of data types, such as numbers and text, or numbers and dates. When you connect to the file, the mixed-value column is mapped to a field with a single data type in Tableau. Therefore, a column that contains numbers and dates might be mapped as a number data type (making it a measure) or it might be mapped as a date data type (in which case Tableau treats it as a dimension.)

Tableau determines how to map mixed-value columns to data types by the data types of the first 10,000 rows in an Excel data source, and the first 1,024 rows in a CSV data source. For example, if most of the first 10,000 rows are text values, the entire column is mapped to use the text data type.

**Note:** Empty cells also create mixed-value columns because their formatting is different from text, dates, or numbers.

When Tableau determines a data type for each field, if the values in a field don’t match that data type, Tableau handles the field in one of several different ways, depending on the data type. For example, sometimes Tableau populates those fields with Null values, as shown in the following table:

<table>
<thead>
<tr>
<th>Mapped data type</th>
<th>Treatment of other data types in the field.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text</td>
<td>Dates and numbers are treated as text. Nulls are not created.</td>
</tr>
<tr>
<td>Dates</td>
<td>Text is treated as Null. A number is treated as the day in numeric order from 1/1/1900.</td>
</tr>
<tr>
<td>Numbers</td>
<td>Text is treated as Null. A date is treated as the number of days since 1/1/1900.</td>
</tr>
<tr>
<td>Boolean</td>
<td>Text, dates, and numbers are treated as Null.</td>
</tr>
</tbody>
</table>

If using fields that are based on mixed-value columns introduces difficulties when analyzing your data, you can do one of the following:
• Format empty cells in your underlying data source so that they match the data type of the column.
• Create a new column that does not contain the mixed values.

Field Types

When you connect to a new data source, Tableau assigns each field in the data source to either the Dimensions area or the Measures area of the Data pane, depending on the type of data the field contains. If a field contains categorical data (such as names, dates, or geographical data), Tableau assigns it to the Dimensions area. If a field contains numbers, Tableau assigns it to the Measures section.

So is it correct to say that a dimension is a field that contains categorical data, such as names, dates, or geographical data, and that measure is a field that contains numbers? Those assertions are accurate enough as a starting point, but as you work in Tableau, remember that you control the definition of a field in the view. Most fields can be used as either a dimension or as a measure, and can be either continuous or discrete, according to the requirements of the user.

Tableau’s initial assignment of fields to either the Dimensions area or the Measures area establishes a default. When you click and drag a field from the Data pane to a view, Tableau continues to provide a default definition for the field. If you are dragging a field from the Dimensions area, the resulting field in the view will be discrete (with a blue background). If you are dragging a field from the Measures area, the resulting field will be continuous (with a green background).

**Note:** If you want to be able to tell Tableau how to categorize a view you drag to the view, so as to override the default, right-click it (Control-click on a Mac) before you drag it to the view and Tableau will prompt you to specify how you want the field to be used in the view when you drop it.

By default, dimensions are discrete and measures are continuous, but in fact all four combinations are possible:

<table>
<thead>
<tr>
<th>discrete dimensions</th>
<th>Product Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>continuous dimensions (possible only with Date dimensions)</td>
<td>QUARTER(Order Date)</td>
</tr>
<tr>
<td>discrete measures</td>
<td>SUM(Profit)</td>
</tr>
</tbody>
</table>
**Note:** With a cube (multidimensional) data source (supported only on Windows), the options for changing data roles are limited. You can change some measures from continuous to discrete, but in general, you cannot change data roles for fields in cube data sources.

**Dimensions and Measures**

When you connect to a data source, Tableau assigns each field in the data source as playing one of two possible data roles: dimension or measure. What effect do these assignment have when you start working with data in Tableau?

**Dimensions**

When you first connect to a data source, Tableau assigns any fields that contain discrete categorical information (for example, fields where the values are strings or Boolean values) to the **Dimensions** area in the **Data** pane.

When you click and drag a field from the **Dimensions** area to **Rows** or **Columns**, Tableau creates column or row headers.

Any field you drag from the **Dimension** area will initially be discrete when you add it to a view, with a blue background. For this reason, it might be easy to assume (incorrectly, as it turns out) that a field's background color indicates whether it is a dimension or a measure. But Date
dimensions and numeric dimensions can be either discrete or continuous, and all measures can be discrete or continuous. A field's background color indicates whether it is discrete (blue) or continuous (green).

After you drag a dimension to Rows or Columns, you can change the field to a measure just by clicking the field and choosing Measure. Now the view will contain a continuous axis instead of column or row headers, and the field's background will become green:

If you want to make a dimension continuous (without first converting it into a measure), your options are limited. This is only possible with Date dimensions, which can be discrete or continuous but are always dimensions, and with numeric dimensions. You cannot convert dimensions containing strings or Boolean values.

Tableau does not aggregate dimensions. If you want a field's values to be aggregated, that field must be a measure. When you convert a dimension into a measure, Tableau will always prompt you to assign it an aggregation (Count, Average, etc.). Aggregation means collecting multiple values (individual numbers) into a single number by, for example, counting the number of individual values, averaging them, or displaying the smallest individual value for any row in the data source. For a discussion of the different types of aggregation Tableau can perform, see Aggregations on page 322.

In Tableau queries, dimensions in the view are expressed in SQL as "Group By" clauses.

**Measures**

When you first connect to a data source, Tableau assigns any fields that contain quantitative, numerical information (that is, fields where the values are numbers) to the Measures area in the Data pane.

When you drag a field from the Measures area to Rows or Columns, Tableau creates a continuous axis.
Any field that you drag from the Measures area will initially be continuous when you add it to the view, and so its background will be green. But if you then click the field and choose **Discrete**, the values become column headers.

Tableau continues to aggregate values for the field, because even though the field is now discrete, it is still a measure, and Tableau will always aggregate measures. You can take the process one step further and convert the measure to a dimension if you like. Only then will Tableau stop aggregating its values. See [Convert a Measure to a Dimension](#) on the next page for an example of this process.
**Visual identification of dimensions and measures in a view**

If you are looking at a view in Tableau Desktop and you’re not sure whether a field is a measure or a dimension, a quick visual cue is that measures are aggregated: "SUM(Quantity)"

and dimensions are not: "Region".

But there are exceptions:

- If the entire view is disaggregated, then by definition no field in the view is aggregated. See Disaggregating Data on page 332.
- If you are using a multidimensional data source, fields are aggregated in the data source and measures fields in the view do not show that aggregation.

**Convert a Measure to a Dimension**

You can convert a field in a view from a measure to a dimension.

Or, if you want the change to affect all future uses of the field in the workbook, you can convert a field in the Data pane from a measure to a dimension.

**Convert a measure in the view into a discrete dimension**

You can drag a field from the Measures area in the Data pane but then use it as a dimension in the view. For example, suppose you want to know the aggregated sales totals for each possible discount rate. The view you are aiming for looks like this:
The **Discount** field contains numeric data, so when you connect to the data source, Tableau assigns it to the **Measures** area in the **Data** pane. In the **Sample - Superstore** data source, which is included with Tableau Desktop, the values for **Discount** range from 0% to 80%.

Here are the steps to create the view shown above:

1. Drag **Sales** to **Rows** and **Discount** to **Columns**. Tableau shows you a scatter plot—this is the default chart type when you put one measure on **Rows** and another on **Columns**.

![Chart showing sales and discount relationship](image-url)
Tableau aggregates **Discount** as AVG, and **Sales** as SUM. The fields are both continuous, so along the bottom and left side of the view Tableau displays axes (and not column or row headers).

2. To treat **Discount** as a dimension, click the drop-down arrow on the field (on the **Columns** shelf) and select **Dimension** from the context menu. Tableau no longer aggregates the values for **Discount**, so what you see now is a line. But the values for **Discount** are still continuous, so Tableau still shows continuous axes for both fields:
3. To complete the process, click the drop-down arrow on the **Discount** again and select **Discrete** from the context menu. The transformation of **Discount** is now complete. You now see the bar chart as in the initial image at the beginning of this topic. Across the bottom, you now see column headers (0%, 10%, 20%, etc.) instead of an axis.

Let’s review how we got to this point:

<table>
<thead>
<tr>
<th>Action</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert <strong>Discount</strong> from a measure to a dimension...</td>
<td>Sales values are no longer aggregated according to discount rate, resulting in a line chart instead of a scatter plot.</td>
</tr>
<tr>
<td>Convert <strong>Discount</strong> from continuous to discrete...</td>
<td>Tableau shows headers at the bottom of the view, instead of a continuous axis.</td>
</tr>
</tbody>
</table>

The only thing left to do is to drag **Sales** to Label and then format the labels for readability.

The resulting chart is somewhat useful because there are only 12 unique values for **Discount** in the data source. Had there been a unique value for each row, which would not have been unusual for a numeric field, the number of individual bars in the resulting view would have been equal to the number of rows in the data source, which would probably not result in a useful visualization.

**Converting a measure in the Data pane into a dimension**

When you first connect to a data source, Tableau assigns most fields that contain quantitative,
numerical information (that is, fields where the values are numbers) to the Measures area in the Data pane. The exception is for fields where the name suggests the data type, such as Year or Month (which Tableau would identify as Date dimensions) or fields containing words like “ID” and “Key,” which Tableau would categorize as dimensions, even when they are numeric.

However, you might decide that some of these fields that Tableau has categorized as measures should actually be dimensions. Postal codes are a classic example—they often consist entirely of numbers, but the information is categorical and not continuous—you would never want to aggregate postal codes by adding or averaging them. Similarly, a field containing individuals’ ages may be categorized as a measure by default in Tableau because it contains numeric data. In some cases you may want to add or average ages, but you might also want to look at each individual age as a bin or category, in which case you want Tableau to create headers for this field rather than an axis. If this is how you want to use age in your view, you can convert the field to a dimension.

To convert a measure to a dimension in the Data pane, do either of the following.

- Click and drag the field from the measures area of the Data pane and drop it into the dimensions area.
Right-click (control-click on a Mac) the measure in the Data pane and select **Convert to Dimension**.

If you place a field that you converted from a measure to a dimension on a shelf, it now produces headers instead of an axis.
### Dimensions and the Level of Detail

As you add dimensions to **Rows** or **Columns**, the number of marks in the view increases. To understand why adding dimensions increases the number of marks in the view, do the following:

1. Drag **Segment** to **Columns**.
   
   The status bar at the bottom of the Tableau window shows you that there are now three marks in the view:

   ![Status Bar Screenshot](image)

   Those marks just contain placeholder text, *Abc*, because you are only building the view's structure at this point.

2. Drag **Region** to **Columns**.
   
   Now there are 12 marks. Three values in **Segment** multiplied by four values in **Region** is 12.

3. Drag **[Ship Date]** to **Rows**.
The total is now 57 marks (three segments by four regions by five years is 60, but there are three combinations of the dimensions in the view for which there is no data in the data source).

We could continue adding dimensions to **Rows** and **Columns** and observe as the number of total marks continues to increase. Dragging a dimension to a location on the Marks card such as Color or Size will also increase the number of marks, though it will not increase the number of headings in the view. The process of adding dimensions to the view to increase the number of marks is known as setting the *level of detail.*

Adding a dimension to any of the following locations in Tableau affects the level of detail:

4. The view now contains 57 separate instances of *Abc*—the view is all structure and no content. Rectify this by dragging **Sales** to Text. The view can now be considered complete:
Notes

- In some cases, adding a measure to the view can increase the number of marks in the view. For example, if you dropped Sales on Rows in the view above, the number of marks would be 57. But if you then also dropped Profit on Rows, the number of marks would increase to 114. But this is not the same as changing the view’s level of detail.

- The number of marks in the view is not guaranteed to correspond to the number you would get by multiplying the number of dimension values in each of the dimensions that make up the level of detail. There are multiple reasons why the number of marks could be lower. To increase the number of marks in this view from 57 to 60 in the view above, right-click (Control-click on a Mac) on one of the Date headers in the view and the date or bin headers and choose Show Missing Values. For more information about how to
show missing values, see **Missing Values** on page 559

Continuous and Discrete

*Continuous* and *discrete* are mathematical terms. Continuous means "forming an unbroken whole, without interruption"; discrete means "individually separate and distinct."

In Tableau, fields can be either continuous or discrete. When you drag a field from the **Measures** area to **Columns** or **Rows**, the values are continuous by default and Tableau creates an axis. When you drag a field from the **Dimensions** area of the **Data** pane to **Columns** or **Rows**, the values are discrete by default and Tableau creates column or row headers. Let’s consider why this is so.

**Continuous fields produce axes**

If a field has values that are numbers that can be added, averaged, or otherwise aggregated, Tableau assigns that field to the **Measures** area of the **Data** pane when you first connect to a data source. Tableau is assuming that the values are continuous.

Tableau displays an axis when you drop a continuous field on **Rows** or **Columns**. An axis is a measuring line that shows values between a minimum and a maximum. Rulers and analog thermometers are examples of physical objects that display axes.

Tableau must be able to show a range of actual and potential values, because in addition to the initial values in the data source, it is always possible that new values will emerge as you work with a continuous field in the view.
While there are value labels on a continuous axis (0, 0.5, ... 3.0 in the following image), actual marks don't have to align with these labels as they would with column headers. For example, in the following image, the blue bar actually extends to a value of 6.940 on the horizontal axis, not 7.0 exactly.

![Continuous Axis](image)

The number of potential values for continuous fields is impossible to anticipate. For example, if you have a field named Ratings and the initial values are 1, 3, 3.5, 3.6, and 4, that's five distinct values. But if you drop Ratings on Rows, Tableau automatically aggregates that value as SUM (which you would then immediately change to AVG, because it's more logical to average grades than to add them), and that would then create a sixth value (3.02) that didn't exist until you added the field to the view. And if you then applied a filter that eliminated two of the initial values, the average would change as well, so that would be yet another value. And then if you changed the aggregation, ... You get the idea. The number of potential values is, if not infinite, then certainly immense.

The fact that a field contains numbers does not automatically indicate that those values are continuous. Postal codes are the classic example: though they are often composed entirely of numbers, they are actually string values which should never be added or averaged. If Tableau assigns such a field to the Measures area, you should drag it up to the Dimensions area.

**Discrete fields create headers**

If a field contains values that are names, dates, or geographical locations—anything other than numbers—Tableau assigns that field to the Dimensions area of the Data pane when you first connect to a data source. Tableau treats the values as discrete.

Tableau creates headers when you drop a discrete field on Columns or Rows. The individual values for a discrete field become the row or column headings. (Because such values are never aggregated, no new field values are created as you work with your view, so there is no need for an axis).

**Recognizing the difference**

If a field is continuous, the background color is green. If it is discrete, the background color is blue. Background color does not indicate dimension vs. measure—it indicates continuous vs.
discrete.

What tells you whether a field in the view is a measure or a dimension is whether it is aggregated.

On the left below you see a view where **Quantity**, which was dragged from the **Measures** area of the **Data** pane, has been converted from a measure to a dimension but is still continuous, with an axis along the bottom of the view. We know that the field is continuous because of the axis and because the background is green. We know that it is a dimension because it is not aggregated.

On the right, you see a view where that view has been further modified by clicking **Quantity** on the **Columns** shelf and choosing **Discrete**. Now there are headers along the bottom of the view, instead of an axis.

<table>
<thead>
<tr>
<th>Continuous</th>
<th>Discrete</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Columns</strong></td>
<td><strong>Quantity</strong></td>
</tr>
<tr>
<td><strong>Rows</strong></td>
<td><strong>SUM(Sales)</strong></td>
</tr>
</tbody>
</table>

![Continuous vs. Discrete Views](image-url)
Implications for filters

When you drop a discrete field on the Filters shelf, Tableau prompts you to choose which "members" of the discrete field to include in the view.

When you drop a Date field on Filters, the result can be a discrete filter or a continuous filter. For more information, see Filter Data from Your Views on page 630.

When you drop a continuous measure on Filters, Tableau first prompts you to choose an aggregation for the filter, and then prompts you to specify how to filter the continuous range of values.

When you drop a continuous dimension on Filters (other than a Date), Tableau prompts you to specify how to filter the continuous range of values.

For more on filtering various types of fields, see Drag dimensions, measures, and date fields to the Filters shelf on page 632.

Implications for color

When you drop a discrete field on Color, Tableau displays a categorical palette and assigns a color to each value of the field.

When you drop a continuous field on Color, Tableau displays a quantitative legend with a continuous range of colors.

For more information about color palettes, see Color Properties on page 184.
Convert Fields between Discrete and Continuous

You can convert measures from discrete to continuous or from continuous to discrete. And you can convert date dimensions and other numeric dimensions to be either discrete or continuous.

Convert measures

You can convert measures from discrete to continuous or from continuous to discrete. Click the field and choose Discrete or Continuous. The field is green when it is continuous, and blue when it is discrete.

For measures in the Data pane, right-click the field and choose Convert to Discrete or Convert to Continuous. The color of the field changes accordingly.

Convert date fields

You can convert Date fields between discrete and continuous. Click any Date field in the view and choose one of the options on the context menu to change it from discrete to continuous or from continuous to discrete:
Click any of the options in the blue areas to configure the field as a discrete date. Choosing one of these options creates what is known as a "date part."

Click any of the option in the green areas to configure the field as a continuous date. Choosing one of these options creates what is known as a "truncated date."

To convert a Date field in the Data pane (and thus to determine the default result when you drag it into a view), right-click the field and choose Convert to Discrete or Convert to Continuous.

**Tableau's Order of Operations**

The order of operations in Tableau, sometimes called the query pipeline, is the order in which Tableau performs various actions. (Actions are also known as operations).
Many operations apply filters, which means that as you build a view and add filters, those filters always execute in the order established by the order of operations.

Sometimes, you might expect Tableau to execute filters in one order, but the order of operations dictates that they be executed in a different order, which gives you unexpected results. When this happens, you can sometimes change the order in which operations are executed in the pipeline.

This topic provides two scenarios for updating a view to correct problems resulting from the order of operations: converting a dimension filter to a context filter, and converting a table calculation to a FIXED level of detail expression.

The Tableau order of operations includes all the elements in the following illustration. Filters are shown in blue; other operations, which are mostly calculations, are shown in black.
Extract Filters

Data Source Filters

Context Filters

Sets, Conditional and Top N Filters, FIXED Level of Detail expressions (calculated)

Dimension Filters

Data Blending

INCLUDE and EXCLUDE Level of Detail expressions (calculated)

Measure Filters

Totals (calculated)

Forecasts and Table Calculations (calculated)

Trend Lines, Reference Lines (calculated)
**Example 1: Convert a Dimension Filter to a Context Filter**

This and the following example use the **Sample – Superstore** data source provided with Tableau Desktop.

In this example, the view addresses the following question: Who are the top 10 customers, by total sales, in New York City?

The view contains two dimension filters, one that you create on the **General** tab in the Filters dialog box, and the other on the **Top N** tab. The problem is that these filters are executing simultaneously, whereas you would like to general filter to be applied before the top n filter, so that the top n filter can act on the results as previously filtered by the general filter. The solution is to redefine one of the filters as a context filter so that a clear order of precedence is established.

Here are the steps for building this view.

1. Drag **Sales** to **Columns**.
2. Drag **City** and [**Customer Name**] to **Rows**.
3. Drag **City** from the **Data** pane again, this time to **Filters**. On the **General** tab in the Filter dialog box, set the filter to show just a single value: New York City. Do this by clicking **None** and then choosing **New York City**. This creates a general dimension filter.
4. Click the **Sort Descending** button ( ) on the toolbar. Your view now looks like this:

![Image of Tableau view](image)

Note the first few names in the list: Ashbrook, Fuller, Vernon, etc.

5. Now drag [**Customer Name**] from the **Data** pane to **Filters**, and create a Top 10 Filter, to show only the top 10 customers by total sales:
After you apply this second filter, the view looks right, but notice that the names shown are no longer the same as before:

What happened to Peter Fuller, formerly in second place? The goal was to show the top 10 customers in New York City, but now the view is actually showing the top 10 customers overall.

The problem is that top and general dimension filters are applied simultaneously—they are both dimension filters, and they appear in the same place in the Tableau order of operations:
The solution is to add the general dimension filter (on City) to context—that is, by turning it into a context filter, which is executed before any other filter that you create in a worksheet.

For details, see *Improve View Performance with Context Filters* on page 652.

6. Right-click **City** on the Filters shelf (Control-click on a Mac) and choose **Add to Context**. As a context filter, this filter now takes precedence over the dimension filter, and so the view now shows what it's supposed to:
Example 2: Convert a Table Calculation to a FIXED Level of Detail Expression

In this example, the view addresses the following question: What is the percent of total sales by product sub-category?

The view contains a dimension filter and a table calculation. Tableau applies the dimension filter before executing the table calculation. To invert the order of these operations, use a FIXED level of detail expression instead of a table calculation.

Here are the steps for building this view.

1. In a new worksheet, drag Sales to Columns.
2. Drag Sub-Category to Rows.
3. Right-click SUM(Sales) on Columns and select a quick table calculation – Percent of Total.
4. Click the Sort Descending button (↑) on the toolbar to sort the categories from most to least.
5. Click the Show Mark Labels button (I) on the toolbar to display measure values in the view.

Your view now looks like this:
Note the percentages for the first few items: 14.37%, 14.30%, etc.

6. Right-click **Sub-Category** on **Rows** and choose **Show Filter**.

7. Clear the check mark for **Chairs** in the filter.

In the view, the percentages are now different—the highest percentage is now over 16%. In some cases, this may be just the result that you want (that is, for percentages to be
recalculated as you work with the quick filter). But in other cases you may want the percentages to hold steady even as you filter items in or out. That’s what we want in this case.

In the order of operations, a dimension filter is applied before a table calculation:

<table>
<thead>
<tr>
<th>Order of Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extract Filters</td>
</tr>
<tr>
<td>Data Source Filters</td>
</tr>
<tr>
<td>Context Filters</td>
</tr>
<tr>
<td>Dimension Filters</td>
</tr>
<tr>
<td>Sets, Conditional and Top N Filters, FIXED Level of Detail expressions (calculated)</td>
</tr>
<tr>
<td>Measure Filters</td>
</tr>
<tr>
<td>Totals (calculated)</td>
</tr>
<tr>
<td>Forecasts and Table Calculations (calculated)</td>
</tr>
<tr>
<td>Trend Lines, Reference Lines (calculated)</td>
</tr>
<tr>
<td>Dimension filter</td>
</tr>
<tr>
<td>Table Calculation</td>
</tr>
</tbody>
</table>
To have Tableau calculate the percentages before it acts on the quick filter, you create a FIXED level of detail expression, and then use that instead of the table calculation.

FIXED level of detail expressions compute a value using the specified dimensions, without reference to the dimensions in the view. In this case you’ll use it to establish percentages for the various sub-categories—percentages that won’t be affected by your general dimension filter. Why? Because FIXED level of detail expressions are computed before dimension filters are applied.

For details, see Level of Detail Expressions on page 824.

8. The FIXED level of detail expression must divide the sum of Sales (for a particular measure value) by the total sum of Sales for the view. Because the numerator is aggregated, the denominator must be as well, so the expression you write is:

\[ \frac{\text{SUM}([\text{Sales}])}{\text{SUM}([\text{Sales}])} \]

9. Save that expression as FixedSumOfSales and then drag it from the Data pane to Columns, dropping it to the right of the existing \text{SUM(Sales)} field that uses the table calculation. (Keep them both in the view for comparison.) Here is what your view now looks like:

![Image of the chart](image)

The percentage numbers in the chart on the right are now consistent, regardless of which fields you select or don’t select with the quick filter. All that remains is to format the values for FixedSumOfSales so that they show as percentages.

10. Right-click FixedSumOfSales on Columns and choose Format. In the Format pane, choose Numbers and then Percentage:
This gives you the final view:

As you select or clear items in the **Sub-Category** quick filter, the percentages in the bar chart on the left change, but the percentages in the bar chart on the right do not.

**Understanding Data Fields**

The data in all data sources are categorized into fields such as Customer, Sales, Profit, Temperature, etc. These fields are made from the columns in your data source. When you connect to a data source with Tableau, the fields are displayed along the left side of the workbook in the Data pane. The fields are what you will use to build views of your data. Each
field is automatically assigned a data type (such as integer, string, and date) and a pair of data roles.

Understanding the Data Pane

All data sources contain fields. In Tableau, these fields appear in the Data pane. For cube (multidimensional) data sources, the fields are determined by the dimensions and measures of a cube. In Tableau, cube data sources are supported only in Windows. For relational data sources, the fields are determined by the columns of a table or view. Each field contains a unique attribute of the data such as customer name, sales total, product type, and so on. For example, some of the fields of an Excel worksheet are shown below.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Row ID</td>
<td>Order ID</td>
<td>Date</td>
<td>Ship Date</td>
<td>Mode</td>
<td>Customer ID</td>
<td>Sales Na Segment</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>CA-2013-152156</td>
<td>11/9/2014</td>
<td>11/12/2014</td>
<td>Second Class CG-12520</td>
<td>Claire Gute</td>
<td>Consumer</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>CA-2013-152156</td>
<td>11/9/2014</td>
<td>11/12/2014</td>
<td>Second Class CG-12520</td>
<td>Claire Gute</td>
<td>Consumer</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>CA-2013-115812</td>
<td>6/9/2012</td>
<td>6/14/2012</td>
<td>Standard Cl: BH-11710</td>
<td>Brosna Hoff Consumer</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>18</td>
<td>CA-2013-167164</td>
<td>5/13/2012</td>
<td>5/15/2012</td>
<td>Second Class AG-10270</td>
<td>Alejandro Gric Consumer</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>19</td>
<td>CA-2011-143336</td>
<td>8/27/2012</td>
<td>9/1/2012</td>
<td>Second Class ZD-21925</td>
<td>Zuschuss Dor Consumer</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>20</td>
<td>CA-2011-143336</td>
<td>8/27/2012</td>
<td>9/1/2012</td>
<td>Second Class ZD-21925</td>
<td>Zuschuss Dor Consumer</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>21</td>
<td>CA-2011-143336</td>
<td>8/27/2012</td>
<td>9/1/2012</td>
<td>Second Class ZD-21925</td>
<td>Zuschuss Dor Consumer</td>
<td></td>
</tr>
</tbody>
</table>

After you connect to your data and set up the data source with Tableau, the data source fields appear on the left side of the workbook in the Data pane.
The Data pane organizes fields into different areas:

- **Dimensions** – Fields that typically hold discrete qualitative data. Examples of dimensions include dates, customer names, and customer segments.

- **Measures** – Fields that typically hold numerical data that can be aggregated. Examples of measures include sales, profit, number of employees, temperature, frequency, and pressure.

- **Sets** – An additional area that stores custom fields based on existing dimensions and criteria that you specify. Named sets from an MS Analysis Services server or from a Teradata OLAP connector also appear in Tableau in this area of the Data pane. You can interact with these named sets in the same way you interact with other custom sets in Tableau.

- **Parameters** – An additional area that stores parameters that you have created. Parameters are dynamic variables that can be used as placeholders in formulas.

**Note:** For cube data sources, fields are explicitly defined as dimensions or measures when the database is created. For relational data sources, Tableau automatically organizes the fields. By default, fields containing text, date or boolean values are dimensions, while fields containing numerical values are measures.
The Data pane for an Excel worksheet (a relational database) is shown below. The **Discount** and **Sales** fields contain numbers and appear as measures, in the lower part of the Data pane. The **Segment** field contains text and the **Order Date** field contains dates. These fields appear as dimensions in the upper part of the Data pane.
**Note:** By default the field names defined in the data source are displayed in the Data pane. You can rename fields as well as member names.

**Hierarchies (For Relational Databases)**

Unlike cube (multidimensional) data sources, relational data sources don’t have built-in hierarchies. However, often relational data sources have related dimensions that have an inherent hierarchy. For example, a data source may have fields for Country, State, and City. These fields could be grouped into a hierarchy called Location. You can assemble relational hierarchies by dragging and dropping in the Data pane.

1. Drag a field in the Data pane and drop it directly on top of another field.

2. When prompted, enter a name for the relational hierarchy and click **OK**.

**Note:** When you want to create a hierarchy from a field inside a folder, right-click (control-click on a Mac) the field and then select **Create Hierarchy**.
3. Drag any additional fields into the hierarchy. You can also re-order fields in the hierarchy by dragging them to a new position.

Hierarchies support single-click navigation up and down the levels. When you use the fields in the view, a plus button displays on the field so you can drill down and up in the hierarchy.

**Relational and Cube Data**

The Data pane for a relational and cube data source are shown below. Note that the panes look essentially the same for both data sources in that the fields are organized into dimensions and
measures. However, the cube data source contains hierarchies for dimensions. For example, notice that the Employee dimension in the cube Data pane contains hierarchical members such as Manager Name and Employee Dept.

**Note:** In Tableau, cube (multidimensional) data sources are supported only in Windows.

You can expand or collapse the various hierarchies in both relational and cube Data panes by clicking the arrow. You can hide the Data pane all together by clicking the minimize button in the upper-right corner of the Data pane.
**Measure Values and Measure Names**

The Data pane contains a few fields that are not part of your data, two of which are Measure Values and Measure Names.

The Measure Values field always appears at the bottom of the Measures area of the Data pane and contains all the measures of your data collected into one field.

The Measure Names field always appears at the bottom of the Dimensions area of the Data pane and contains all the names of the measures collected into a single dimension.

Tableau automatically creates these fields so that you can build certain types of views that involve multiple measures. In particular, use these fields if you want to display multiple measures in the same pane simultaneously. As shown below, creating a view with Measure Values and Measure Names is one way to display all the data in your data source.

---

**Where do these fields come from?**

When you connect to a data source, Tableau automatically fields to contain all of the measure names and measure values.

For example, below is a simple data source that contains three measures. From this data source, Tableau creates the fields shown on the right.
Common uses

Create a details table

Use a details table to show all of the measure values for specified categories.

For example, the text table below shows financial measures for each product type. When you use the Measure Names and Measure Values fields, the Measure Values card automatically opens below the Marks card. You can use this card to quickly add and remove measures from the view.

Drag measures to or from the Measure Values card to add them to or remove them from the view.
**Blend measures on a single axis**

To learn how to blend measures on a single axis, see **Blended Axes** on page 563.
**Number of Records**

In addition to the Measure Names and Measure Values fields, the Data pane contains a **Number of Records** field that is also not part of the underlying data. This field represents the number of rows in the data source. It is useful when you are working with a data source that is primarily categorical resulting in very few measures.

**Latitude and Longitude (generated)**

If you have defined any fields to be geographic fields, that is, they can be used with maps, Tableau automatically geocodes your data and includes **Latitude (generated)** and **Longitude (generated)** fields. You can use these fields to overlay your data on live maps.

**Data Pane Features and Functions**

The Data pane has many features and functions to help you organize your data fields, find specific fields, and hide others.

**Organize the Data Pane**

You can reorganize the items in the Data pane from its default layout using folders or through sorting.

**Folders**

To make data sources with many fields easier to work with, you can organize the Data pane items into folders. Items like fields, parameters, and sets can be grouped into folders. The **Group by Folder** option can be accessed from the Data pane menu. Alternatively, you can also access this option from the field context menu.
When you connect to a single table in your data source, grouping by folder is enabled by default. When you connect to a data source with multiple tables, grouping by table is enabled. When the **Group by Data Source Table** option is selected, the dimensions and measures are grouped according to the database table they belong to. This is especially useful when you have several joined tables.

**To group fields into folders:**

1. In the Data pane, select the fields you want to group together or right-click (control-click on Mac) an empty area in the Data pane.
2. Select **Create Folder**.
3. When prompted, name the new folder.
After you create a folder structure, you can drag fields from one folder to another or duplicate a field you want to have available in more than one folder.

**To add a field to a folder:**

- Drag a field on top of the folder name to add the field to the folder. If the folder is expanded, you can drag the field into the general area of the folder.
Sort

When organizing the Data pane with or without folders, you can have Tableau sort the items. These **Sort by** options are also located in the Data pane menu.
You can sort by one of the following options:

- **Sort by Name** – lists the dimensions and measures in alphabetical order according to their field aliases.

- **Sort by Data Source Order** – lists the dimensions and measures in the order they are listed in the underlying data source.

**Find Fields**

You can search for fields, folders and hierarchies in the Data pane. When there are many fields in your data source it can be difficult to find a specific one like “Date” or “Customer” or “Profit,” or to find all fields that end in “xyz.” To find an item, do the following:

Click the **Find Field** icon at the top of the Data pane (Ctrl + F in Windows, Command-F on a Mac) and enter the name of the item you want to search for. You can also enter a string of characters, to search for all item names that contain that string.

As you type in the search box, search filters the contents of the Data pane to show all fields, folders or hierarchies that contain the typed string.
Search remains open until you click the **Find Field** icon or press **Ctrl + F** again.

**Rename Fields**

You can rename fields in the Data pane. For example, you could rename a field named **Customer Segment** in the data source to be **Business Segment** in Tableau. You can also rename user-created fields. Renaming a field does not change the name of the field in the underlying data source, rather it is given a special name that appears only in Tableau workbooks. The changed field name is saved with the workbook as well as when you export the data source. You can rename any type of field: dimensions, measures, sets, or parameters.

**Rename a Field**

1. Click field name in the Data pane and hold the mouse button down until the field name is shown in an edit box:

   ![Data Pane Screenshot]

   You can also press F2 or Ctrl + Enter to make the field name editable.

2. Type the new name for the field and press Enter.
The field displays with the new name in the Data pane.

Revert to the Default Field Name

If the field you renamed was from the original data source you can click the field name in the Data pane and hold the mouse button down until the field name is shown in the box. At the right of the edit field is a small circular arrow that you can click to restore the original data source field name:

![Diagram showing Location hierarchy with Country, Province, CityA, and Postal Code dimensions]

To revert the names of multiple fields that were in the original data source, select them all, right-click, and then choose Reset Names.

Combine Fields

Combine fields to create a cross product of members from different dimensions. You can combine dimensions if you want to encode a data view using multiple dimensions.

To combine the fields, select multiple dimensions in the Data pane and then right-click (control-click on a Mac) the fields and select Create > Combined Field.

**Note:** For cube (multidimensional) data sources, you must select levels from different hierarchies. In Tableau, cube data sources are supported only in Windows.

For example, the selections shown below will produce a new field that consists of the Category and Sub-Category dimensions.
The two dimensions are combined into a new dimension. The name of the field is automatically created from the names of the original fields. Right-click (control-click on a Mac) the new field and select **Rename** to change the name.

When you use the new field in a view, a header is created for each combination of the two original dimensions. For example, the view below shows the members of the combined Category and Sub-Category fields.
Note: For cube data sources, to choose to display the fully qualified name, right-click (control-click on a Mac) the combined field in the Data pane and select Qualify Member Names.

Hide or Unhide Fields

You can selectively hide or show fields in the Data pane. To hide a field, right-click (control-click on a Mac) the field and select Hide.

When you want to change your fields from hidden to visible, select Show Hidden Fields on the Data pane menu.
The hidden fields are then shown in gray in the Data pane. You can then select one or more hidden fields, right-click (control-click on a Mac) and select **Unhide**.

Select **Hide All Unused Fields** on the Data pane menu to quickly hide all of the fields that are not being used in the workbook.

**Note:** Hiding fields can be a good way to decrease the size of a data extract file because hidden fields are automatically excluded from the extract.
Add Calculated Fields to the Data Pane

You can create calculated fields that appear in the Data pane. These new computed fields can be used like any other field. Select **Create Calculated Field** on the Data pane menu. Alternatively, select **Analysis > Create Calculated Field**.

Navigating Data Sources in the Data Pane

The top of the Data pane lists all of the data sources in a given workbook. Simply select the data source you want to use and the Data pane updates to show the corresponding fields in that data source.

You can resize the data source list area in the Data pane to save space. When you resize to a limited vertical height, you can scroll down to a data source.

Each data source has an icon to indicate its type. For example, the icon can indicate whether the data source is relational, cube (multidimensional), or an extract. In Tableau, cube data sources are supported only in Windows.
You can right-click (control-click on a Mac) the data source to access the commands that are on the Data menu. For example, you can right-click (control-click on a Mac) a data source and rename, export, or close it.
**Editing Field Properties**

When you drag fields to shelves, the data is represented as marks in the view. You can specify settings for how the marks from each field will be displayed by setting mark properties. For example, when you place a dimension on the color shelf, the marks will be colored by the values within that dimension. You can set the Color property so that anytime you use that dimension on the color shelf your chosen colors are used. Using field properties, you can set the aliases, colors, shapes, default aggregation, and so on.

**Comments**

Fields can have comments that describe them. The comments display in a tooltip in the Data pane and in the Calculated fields dialog box. Field comments are a good way to give more context to the data in your data source. Comments are especially useful when you are building a workbook for others to use.

**Adding a Comment to a Field**

1. Right-click (control-click on a Mac) a field in the Data pane and select **Default Properties > Comment**.
2. Write a comment in the subsequent dialog box. Comments support rich text formatting that will be represented in the tooltip.
3. When finished, click **OK**.
Now when you hover the cursor over the field in the Data pane, you see the comment.

Aliases

Aliases are alternate names for specific values within a dimension. For example, you may want to assign aliases for the values of the “Customer Segment” dimension. Perhaps you want the “Consumer” members of this field to display as “Home Consumer” in all views.

Aliases can be created for the members of most dimensions in the Data pane. You cannot, however, define aliases for continuous dimensions and dates, and they do not apply to measures. The method for creating aliases depends on the type of data source you are using.

Aliases with a Relational Data Source

To create alias for individual dimension values in a relational data source, right-click (control-click on Mac) a field name and select **Aliases**.
A dialog box opens allowing you to define aliases for each value within the selected dimension. You can reset the member names back to their original names by clicking the **Clear Aliases** button in the bottom right corner of the Edit Aliases dialog box.

**Aliases with a Cube Data Source**

Aliases for cube databases are created on the server by the server administrator and can be activated in Tableau using the **Alias File** option on the **Data** menu. Please talk to your database administrator to find out whether your database has aliases available. Aliases are not supported by Microsoft Analysis Services databases.

By default the alias for every member of every dimension is initially defined to be the original member name. For example, the figure below shows a bar chart built from an Essbase database. By default, the original member names are displayed (example on the left). As you can see, these names are not very intuitive. By selecting **Data > Aliases File** and selecting an appropriate alias file set up by the database administrator, meaningful names are displayed in the headers.
Note: In Tableau, cube (multidimensional) data sources are supported only in Windows.

Example – Editing Aliases

This example shows how you can use aliases to rename specific field values within a dimension. You might want to do this to show labels in your view that are more relevant to your users or your analysis than what Tableau shows by default.

In this example, suppose you have a data source that contains a measure called Discount. Discount contains values from 0 to .25 that you want to analyze by grouping them into three categories: low discount, medium discount, and high discount. To create the categories, you can use bins.

For more information about how to create bins, see Create Bins from a Continuous Measure on page 554.

1. In a worksheet, under Measures, right-click (control-click on a Mac) Discount, and then select Create > Bins.

![Create Bins dialog box]

2. In the Create Bins dialog box, set Size of bins to 0.1.

   The new binned field is named Discount (bin) and appears in the Dimensions area of the Data pane.

3. Place Discount (bin) on the Rows or Columns shelf. The default aliases for the bins are defined by the lower limit of the bin’s numerical range as shown below.
4. To make this view easier to understand, you can define aliases such as "Lowest discount," "Very low discount," and "Low discount" to replace the default column headings "0.0%," "10.0%," and "20.0%," and so on. To do so, right-click Discount (bin) in the Data pane, and select Aliases.

5. In the Edit Aliases dialog box, assign an alias to every member of Discount (bin). For example, for the member originally labeled "0.0%," assign a label “Low discount.”

6. To change an alias, right-click Discount (bin) in the Data pane, and then select Aliases.

   In the Edit Aliases dialog box, click the alias that you want to change, and then enter the new name. Use the Tab key to move from one value to the next.

   To restore the original aliases, click Clear Aliases. You can also sort the members or their aliases by clicking the appropriate column header.
Colors
When you use a dimension to color encode the view, default colors are assigned to the field's values. Color encodings are shared across multiple worksheets that use the same data source to help you create consistent displays of your data. For example, if you define the Western region to be green, it will automatically be green in all other views in the workbook. To set the default color encodings for a field, right-click (control-click on Mac) the field in the Data pane and select Default Properties > Color.

For information about color properties, and how to configure and customize colors in Tableau, see Color Properties on page 184.

Shapes
When you use a dimension to shape encode the view, default shapes are assigned to the field's values. Shape encodings are shared across multiple worksheets that use the same data source to help you create consistent displays of your data. For example, if you define that Furniture products are represented with a square mark, it will automatically be changed to a square mark in all other views in the workbook. To set the default shape encodings for a field, right-click (control-click on Mac) the field in the Data pane and select Default Properties > Shape.

Formats
You can set the default number format for date and number fields. For example, you may want to always show the Sales values as currency using the U.S. dollar sign and two decimal places. Or you may want to always show Discount as a percentage. To set the default formats, right-click (control-click on Mac) a date or number field and select either Date Format or Number Format on the Default Properties menu. A dialog box opens where you can specify a default format.
Sort

You can set a default sort order for the values within a categorical field so that every time you use the field in the view, the values will be sorted correctly. For example, let’s say you have an Order Priority field that contains the values High, Medium, and Low. When you place these in the view, by default they will be listed as High, Low, Medium because they are shown in alphabetical order. You can set a default sort so that these values are always listed correctly. To set the default sort order, right-click (control-click on a Mac) a dimension and select Default Properties > Sort. Then use the sort dialog box to specify a sort order.

Note: The default sort order also controls how the field values are listed in a filter in the view.

Aggregation

You can also specify a default aggregation for any measure. The default aggregation will be used automatically when the measure is first totaled in the view.

1. Right-click (control-click on a Mac) any measure in the Data pane and select Default Properties > Aggregation.
2. On the Aggregation list, select an aggregation.
Whether you are specifying the aggregation for a field on a shelf or the default aggregation in the Data pane, you can select from several aggregations. See Aggregations on page 322 to learn about each type of aggregation.

**Measure Names**

When you want to show multiple measures in a view, you can use the Measure Values and the Measure Names fields. When you add Measure Names to a view, all of the measure names appear as row or column headers in the view. The headers include each measure name. This feature becomes useful when you are working with a text table that shows multiple measures. For example, suppose you have a text table containing the aggregated profit of each product category by region.
Now suppose you want to show both the Profit and the Sales for each category and region. When you add Sales to the text table (by dragging it and dropping it in the view), the measures are combined and the Measure Values field is added to Text. The Measure Names field is automatically added to the Rows shelf.

Notice how the header names removed the aggregation label by default. You may want to include the aggregations or call it "Total Profit" and "Total Sales." To change the measure
names, right-click (control-click on Mac) the Measure Names field on the Rows shelf and select **Edit Aliases**. Make the changes and click **OK**.

<table>
<thead>
<tr>
<th>Region</th>
<th>Category</th>
<th>Furniture</th>
<th>Office Supplies</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Profit</td>
<td>-$2,871</td>
<td>$8,880</td>
<td>$33,697</td>
</tr>
<tr>
<td></td>
<td>Total Sales</td>
<td>$163,797</td>
<td>$167,026</td>
<td>$170,416</td>
</tr>
<tr>
<td>East</td>
<td>Total Profit</td>
<td>$3,045</td>
<td>$41,015</td>
<td>$47,462</td>
</tr>
<tr>
<td></td>
<td>Total Sales</td>
<td>$208,291</td>
<td>$205,516</td>
<td>$264,974</td>
</tr>
<tr>
<td>South</td>
<td>Total Profit</td>
<td>$6,771</td>
<td>$19,986</td>
<td>$19,992</td>
</tr>
<tr>
<td></td>
<td>Total Sales</td>
<td>$117,299</td>
<td>$125,651</td>
<td>$148,772</td>
</tr>
<tr>
<td>West</td>
<td>Total Profit</td>
<td>$11,505</td>
<td>$52,610</td>
<td>$44,304</td>
</tr>
<tr>
<td></td>
<td>Total Sales</td>
<td>$252,613</td>
<td>$220,853</td>
<td>$251,992</td>
</tr>
</tbody>
</table>

**Special Values**

Some data requires special handling in Tableau. Specifically:

- null values
- unrecognized or ambiguous geographic locations
- negative or zero values when working with a logarithmic scale
- negative or zero values when working with treemaps

When your data contains any of these special values, Tableau cannot plot them in the view. Instead, it displays an indicator in the lower right corner of the view. Click the indicator to see options for how to handle these values.
Null Numbers and Dates and Negative Values on Log Axes

When you drag a measure or continuous date to the view, the values are shown along a continuous axis. If the field contains null values or if there are zeroes or negative values on a logarithmic axis, Tableau cannot plot them. Tableau displays an indicator in the lower right corner of the view. Click the indicator and choose from the following options:

- **Filter Data** - exclude the null values from the view using a filter. When you filter data, the null values are also excluded from any calculations used in the view.

- **Show Data at Default Position** - show the data at a default location on the axis. The null values will still be included in calculations. The default position depends on the data type. The table below defines the defaults.

<table>
<thead>
<tr>
<th>Type of Data</th>
<th>Default Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers</td>
<td>0</td>
</tr>
<tr>
<td>Dates</td>
<td>12/31/1899</td>
</tr>
<tr>
<td>Negative Values on a Log Axis</td>
<td>1</td>
</tr>
<tr>
<td>Unknown Geographic Location</td>
<td>(0,0)</td>
</tr>
</tbody>
</table>

**Note:** See *Logical Functions* on page 1380 for functions, such as ISNULL() and IFNULL(), that you can use to handle null values with a calculated field.
Unknown Geographic Locations

When working with maps and geographic fields, unknown or ambiguous locations are identified by the indicator in the lower right corner of the view. Click the indicator and choose from the following options:

- **Edit Locations** - correct the locations by mapping your data to known locations.
- **Filter Data** - exclude the unknown locations from the view using a filter. The locations will not be included in calculations.
- **Show Data at Default Position** - show the values at the default position of (0, 0) on the map.

Zero and Negative Values in Treemaps

When working with treemaps, any null or zero values display in the indicator in the lower right corner of the view. Click the indicator and choose from the following options:

- **Filter Data** - exclude the unknown locations from the view using a filter. The locations will not be included in calculations.
- **Use Absolute Values** - use the absolute value to determine the size of the corresponding area in the view. For example, both values of 5 and -5 are shown as the same size.

If you don’t know how to handle the values, you can choose to leave the special values indicator. Generally, you should continue to show the indicator so that you know there is data that is not being shown in the view. However, to hide the indicator, right-click (control-click on a Mac) it and select **Hide Indicator**.
Aggregations

Sometimes it is useful to look at numerical data in an aggregated form such as a summation or an average. The mathematical functions that produce aggregated data are called aggregation functions. Aggregation functions perform a calculation on a set of values and return a single value. For example, a measure that contains the values 1, 2, 3, 4 aggregated as a sum returns a single value: 13. Or if you have 3,000 sales transactions from 50 products in your data source, you might want to view the sum of sales for each product, so that you can decide which products have the highest revenue.

You can use Tableau to set an aggregation only for measures in relational data sources. Multidimensional data sources contain aggregated data only.

**Note:** Using floating-point values in combination with aggregations can sometimes lead to unexpected results. For details, see Data Types on page 1358.

Tableau provides a set of predefined aggregations that are shown in the table below. You can set the default aggregation for any measure that is not a calculated field that itself contains an aggregation, such as `AVG([Discount])`. See How to Set the Default Aggregation for a Measure on page 326. You can also set the aggregation for a field already in the view. See Aggregating Data on page 328.

<table>
<thead>
<tr>
<th>Aggregation</th>
<th>Description</th>
<th>Result for measure that contains 1, 2, 2, 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute</td>
<td>Returns the value of the given expression if it only has a single value for all rows in the group, otherwise it displays an asterisk (*) character. Null values are ignored. This aggregation is particularly useful when aggregating a dimension. To set a measure in the view to this aggregation, right-click (control-click on Mac) the measure and choose Attribute. The field then changes to show the text ATTR:</td>
<td>N/A</td>
</tr>
<tr>
<td>Dimension</td>
<td>Returns all unique values in a measure or dimension.</td>
<td>3 values (1, 2, 3)</td>
</tr>
<tr>
<td>Sum</td>
<td>Returns the sum of the numbers in a measure. Null values are ignored.</td>
<td>1 value (8)</td>
</tr>
<tr>
<td>Aggregation</td>
<td>Description</td>
<td>Result for measure that contains 1, 2, 2, 3</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Average</td>
<td>Returns the arithmetic mean of the numbers in a measure. Null values are ignored.</td>
<td>1 value (2)</td>
</tr>
<tr>
<td>Median</td>
<td>Returns the median of the numbers in a measure. Null values are ignored. This aggregation is not available for workbooks created before Tableau Desktop 8.2 or that use legacy connections. It is also not available for connections using any of the following data sources: - Access - Amazon Redshift - Cloudera Hadoop - HP Vertica - IBM DB2 - IBM Netezza - Microsoft Excel - Microsoft SQL Server - MySQL - Teradata - Text files If you are connected to a workbook of that uses one of these data sources, Median is unavailable and shows the message &quot;Requires extract.&quot; To use this aggregation, extract your data. See Extract Your Data on page 409.</td>
<td>1 value (2)</td>
</tr>
<tr>
<td>Count</td>
<td>Returns the number of rows in a measure or a dimension. When applied to a dimension, Tableau creates a new temporary column that is a measure because the result of a count is a number. You can count numbers, dates, booleans, and strings. Null values are ignored in all cases.</td>
<td>1 value (4)</td>
</tr>
<tr>
<td>Count (Distinct)</td>
<td>Returns the number of unique values in a measure or dimension. When applied to a dimension, Tableau creates a new temporary column that is a measure because the result of a count is a number. You can count numbers, dates, booleans, and strings. Null values are ignored in all cases.</td>
<td>1 value (3)</td>
</tr>
<tr>
<td>Aggregation</td>
<td>Description</td>
<td>Result for measure that contains 1, 2, 2, 3</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>values are ignored in all cases. This aggregation is not available for the following types of workbooks:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Workbooks created before Tableau Desktop 8.2 and that use Microsoft Excel or Text File data sources.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Workbooks that use legacy connections.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Workbooks that use Microsoft Access data sources.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>If you are connected to a workbook that uses one of these types, Count (Distinct) is unavailable and Tableau shows the message &quot;Requires extract.&quot; To use this aggregation, extract your data. See Extract Your Data on page 409.</td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>Returns the smallest number in a measure or continuous dimension. Null values are ignored.</td>
<td>1 value (1)</td>
</tr>
<tr>
<td>Maximum</td>
<td>Returns the largest number in a measure or a continuous dimension. Null values are ignored.</td>
<td>1 value (3)</td>
</tr>
<tr>
<td>Percentile</td>
<td>Returns the value at the specified percentile for the measure. When you select this aggregation, you must choose from a submenu offering a range of percentile values: 5, 10, 25, 50, 75, 90, 95. When you set this aggregation on a field in the view, the field shows PCT and the percent value assigned. For example:</td>
<td>1 value. The value for PCT50 would be 2 for the given data.</td>
</tr>
<tr>
<td></td>
<td><img src="PCT95(BMI)" alt="PCT95(BMI)" /></td>
<td></td>
</tr>
<tr>
<td></td>
<td>If you want to use a percentage value other than the ones listed, use the PERCENTILE function in a calculation and specify the percentile you want. See Aggregate Functions on page 1386.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>This aggregation is available for:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Non-legacy Microsoft Excel and Text File</td>
<td></td>
</tr>
<tr>
<td>Aggregation</td>
<td>Description</td>
<td>Result for measure that contains 1, 2, 2, 3</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| connections.      | • Extracts and extract-only data source types (for example, Google Analytics, OData, or Salesforce).  
|                   | • Sybase IQ 15.1 and later data sources.  
|                   | • Oracle 10 and later data sources.  
|                   | • Cloudera Hive and Hortonworks Hadoop Hive data sources.  
|                   | • EXASolution 4.2 and later data sources.  
<p>|                   | If you are not connected to a workbook that uses one of these data sources, Percentile is unavailable and Tableau shows the message &quot;Requires extract.&quot; In this case, if you want to use the Percentile aggregation, consider creating an extract. See Extract Your Data on page 409. |                                                                             |
| Std. Dev          | Returns the standard deviation of all values in the given expression based on a sample population. Null values are ignored. Returns a Null if there are fewer than 2 members in the sample that are not Null. Use this function if your data represents a sample of the population. | 1 value (0.8165) |
| Std. Dev (Pop.)   | Returns the standard deviation of all values in the given expression based on a biased population. Assumption that its arguments consist of the entire population. Use this function for large sample sizes. | 1 value (0.7071) |
| Variance          | Returns the variance of all values in the given expression based on a sample. Null values are ignored. Returns a Null if there are fewer than 2 members in the sample that are not Null. Use this function if your data represents a sample of the population. | 1 value (0.6667) |
| Variance (Pop.)   | Returns the variance of all values in the given expression based on a biased population. Assumptions | 1 value (0.5000) |</p>
<table>
<thead>
<tr>
<th>Aggregation</th>
<th>Description</th>
<th>Result for measure that contains 1, 2, 2, 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disaggregate</td>
<td>Returns all records in the underlying data source. To disaggregate all measures in the view, select <strong>Aggregate Measures</strong> from the Analysis menu (to clear the check mark). Tableau allows you to view data in disaggregated form (relational databases only). When data are disaggregated, you can view all of the individual rows of your data source. For example, after discovering that the sum of sales for rubber bands is $14,600, you might want to see the distribution of individual sales transactions. To answer this question, you need to create a view that shows individual rows of data. That is, you need to disaggregate the data (see <strong>Disaggregating Data on page 332</strong>). Another way to look at disaggregated data is to view the underlying data for all or part of a view. See <strong>View Data on page 529</strong>.</td>
<td>4 values (1, 2, 2, 3)</td>
</tr>
</tbody>
</table>

You can also define custom aggregations as described in **Aggregate Calculations on page 762**. Depending on the type of data view you create, Tableau will apply these aggregations at the appropriate level of detail. For example, Tableau will apply the aggregation to individual dimension members (the average delivery time in the East region), all members in a given dimension (the average delivery time in the East, West, and Central regions), or groups of dimensions (the sum of sales for all regions and for all markets).

**How to Set the Default Aggregation for a Measure**

You can set the default aggregation for any measure that is not a calculated field that itself contains an aggregation, such as `AVG([Discount])`. A default aggregation is a preferred calculation for summarizing a continuous or discrete field. The default aggregation is automatically used when you drag a measure to a view. To change the default aggregation, right-click (control-click on Mac) a measure in the Data pane and select **Default Properties > Aggregation** and then select one of the options.
**Note:** You can use Tableau to aggregate measures only with relational data sources. Multidimensional data sources contain aggregated data only.
**Aggregating Data**

In Tableau, you can aggregate measures or dimension, though it is more typical to aggregate measures.

**Aggregating Measures**

When you add a measure to the view, Tableau automatically aggregates its values. Sum, average, and median are common aggregations; for a complete list, see [Aggregations on page 322](#). The current aggregation appears as part of the measure's name in the view. For example, **Sales** becomes **SUM(Sales)**. Every measure has a default aggregation which is set by Tableau when you connect to a data source. You can view or change the default aggregation for a measure—see [How to Set the Default Aggregation for a Measure on page 326](#).

You can aggregate measures using Tableau only for relational data sources. Multidimensional data sources contain data that is already aggregated. In Tableau, multidimensional data sources are supported only in Windows.

You can change the aggregation for a measure in the view from its context menu:
Aggregating Dimensions

You can aggregate a dimension in the view as **Minimum**, **Maximum**, **Count**, or **Count (Distinct)**. When you aggregate a dimension, you create a new temporary measure column, so the dimension actually takes on the characteristics of a measure.
The **Count (Distinct)** aggregation is not supported for Microsoft Access, Microsoft Excel, and Text File data sources. If you are connected to one of these types of data sources, the **Count (Distinct)** aggregation is unavailable and shows the remark "Requires extract." This means that if you save the data source as an extract, you will be able to use the **Count (Distinct)** aggregation.

Another way to view a dimension is to treat it as an **Attribute**. Do this by choosing **Attribute** from the context menu for the dimension. The **Attribute** aggregation has several uses:

- It can ensure a consistent level of detail when blending multiple data sources.
- It can provide a way to aggregate dimensions when computing table calculations, which require an aggregate expression.
- It can improve query performance because it is computed locally.

Tableau computes **Attribute** using the following formula:

\[
\text{IF } \min([\text{dimension}]) = \max([\text{dimension}]) \text{ THEN } \min([\text{dimension}]) \text{ ELSE }^{*} \text{ END}
\]

The formula is computed in Tableau after the data is retrieved from the initial query. The asterisk (*) is actually a visual indicator of a special type of Null value that occurs when there are multiple values. See **Troubleshoot Data Blending** on page 376 to learn more about the asterisk.

Below is an example of using **Attribute** in a table calculation. The table shows sales by market, market size, and state. Suppose you wanted to compute the percent of total sales each state contributed to the market. When you add a Percent of Total **Quick Table Calculations** on
that computes along State, the calculation computes within the red area shown below. This is because the Market Size dimension is partitioning the data.

When you aggregate Market Size as an Attribute, the calculation is computed within the Market (East, in the following image), and the Market Size information is used purely as a label in the display.
Disaggregating Data

To disaggregate all measures in the view, select Analysis > Aggregate Measures.

Tableau typically aggregates measures in your view, which means that it collects individual row values from your data source into a single value (which becomes a single mark) adjusted to the level of detail in your view. The different aggregations available for a measure determine how the individual values are collected: they can be added (SUM), averaged (AVG), or set to the maximum (MAX) or minimum (MIN) value from the individual row values. For a complete list of the available aggregations, Aggregations on page 322. The level of detail is determined by the dimensions in your view—for information about the concept of level of detail, see Dimensions and the Level of Detail on page 270.
Disaggregating your data means that Tableau will display a separate mark for every row data value in your data source. This can be useful for analyzing measures that you may want to use both independently and dependently in the view. For example, you may be analyzing the results from a product satisfaction survey with the Age of participants along one axis. You can aggregate the Age field to determine the average age of participants or disaggregate the data to determine at what age participants were most satisfied with the product.

Disaggregating data can be useful when you are viewing data as a scatter plot. See Example – Scatter Plots and Aggregation below.

**Note:** If your data source is very large, disaggregating the data can result in a significant performance degradation.

**Example – Scatter Plots and Aggregation**

If you place one measure on the **Rows** shelf and another measure on the **Columns** shelf, you are asking Tableau to compare two numerical values. Typically, Tableau chooses a scatterplot as the default visualization in such cases. The initial view can be disappointing—a single mark, showing the sum for all values for the two measures. There are various ways to add detail to a basic scatterplot: you can use dimensions to add detail, you can add additional measures and/or dimensions to the Rows and Columns shelves to create multiple one-mark scatter plots in the view, or you can disaggregate the data. (Or you can use any combination of these options.) This topic looks at these alternatives, and uses the **Sample-Superstore** data source. To create the initial view, follow these steps:

1. Place the **Sales** measure on the **Columns** shelf.
2. Place the **Profit** measure on the **Rows** shelf.

The measures are automatically aggregated as sums. The default aggregation (SUM) is indicated in the field names. The values shown in the tooltip show the sum of sales and profit values across every row in the data source.
Follow the steps below to use dimensions to add detail to the view and to disaggregate data.

**Using Dimensions to Add Detail**

Follow these steps to develop the scatter plot view you created above by adding dimensions to show additional levels of detail.

1. Drag the **Category** dimension to **Color** on the Marks card.

   This separates the data into three marks—one for each dimension member—and encodes the marks using color.
2. Drag the **State** dimension to **Detail** on the Marks card.

Now there are many more marks in the view. The number of marks is equal to the number of distinct states in the data source multiplied by the number of categories.
Although more marks are now displayed, the measures are still aggregated. So regardless of whether there is one row in the data source where State = North Dakota and Category= Furniture, or 100 such rows, the result is always a single mark.

Maybe this process is developing the view in a direction you find useful, or maybe you prefer to go in a different direction—for example, by adding a time dimension to the view, or by introducing trend lines or forecasting. You decide what questions to ask.

**Adding More Fields to the Rows and Columns Shelves**

Revert to the original one-mark view and follow these steps to develop the scatter plot view by adding fields to the **Rows** and **Columns** shelves.

1. Drag the **State** dimension to the **Columns** shelf.

   Even if you drop **Continent** to the right of **SUM(Sales)**, Tableau moves it to the left of **SUM(Sales)**. This is because you cannot insert a dimension within a continuous axis. Instead, your view shows a separate axis for each member of the dimension.
2. Drag the **Segment** dimension to the **Rows** shelf.

You now have a view that provides an overview of Sales and Profit across states and customer segments. It can be interesting to hover over the marks in the view to see tooltip data for various segments:

**Disaggregate Data**

Another way to modify your original one-mark scatter plot to display more marks is by
disaggregating the data.

Select **Analysis >Aggregate Measures**.

What you have actually done is to dis-aggregate the data, because this command is a toggle that was originally selected (check mark present). Tableau aggregates data in your view by default.

Now you see a lot of marks—one for each row in your original data source:
When you disaggregate measures, you no longer are looking at the average or sum for the values in the rows in the data source. Instead, the view shows a mark for every row in the data source. Disaggregating data is a way to look at the entire surface area of the data. It's a quick way to understand the shape of your data and to identify outliers. In this case, the disaggregated data shows that for many rows in the data, there is a consistent relationship between sales income and profit—this is indicated by the line of marks aligned at a forty-five degree angle.
Connect to Your Data

Before you can build a view and analyze your data, you must first connect Tableau to your data. Tableau Desktop supports connecting to a wide variety of data, stored in a variety of places. For example, your data might be stored on your computer in a spreadsheet or a text file, or in a big data, relational, or cube (multidimensional) database on a server in your enterprise. Or, you might connect to public domain data available on the web such as U.S. Census Bureau information, or to a cloud database source, such as Google Analytics, Amazon Redshift, or Salesforce.

When you launch Tableau Desktop, the data connections that are available to you are listed on the Connect pane, which is the left pane on the Start page. File types are listed first, then common server types, or servers that you’ve recently connected to. Click More Servers to see the complete list of data connections you can use. The data connections supported by your copy of Tableau Desktop are determined by the version you purchased. For more information, see the list of Data Connections on the Tableau website.

After you’ve connected to data sources, you can save the connections to have them show up under the Saved data sources section on the Connect pane.

You supply different information for each data connection that you want to make. For example, for most data connections, you’ll need to supply a server name and your sign-in information. With some data connections, you can Run Initial SQL on page 343 statements, and SSL-enabled servers require that you select the Require SSL check box when you connect. The following sections discuss the specific information you need to provide for each data source you want to connect to.

Connect to your specific data source

Select from the following topics for information about how to connect to your data.

Quick Starts - short, simple introductory guides that introduce key concepts or list basic steps to accomplish a task

Quick Start: Connect to Your Data on page 1460
Quick Start: Connect to Google Analytics on page 1455
Quick Start: Query All Data from Google Analytics on page 1507
Quick Start: Connect to Salesforce on page 1457
Quick Start: SAP HANA Single Sign-On on page 1488 (Windows only)
Quick Start: Use Tableau Server Data Sources on page 1503

Data source connection reference

Connectors are listed in the order that they appear on the Connect pane.
Excel on page 1167
Text File on page 1171
Access on page 1165
Statistical File on page 1174
Other Files on page 1177 (such as Tableau .tde, .tds, .twbx)
Tableau Server on page 1178
Actian Matrix on page 1182
Actian Vector on page 1184
Amazon Aurora on page 1187
Amazon EMR on page 1191
Amazon Redshift on page 1194
Aster Database on page 1197
Cisco Information Server on page 1201
Cloudera Hadoop on page 1204
DataStax Enterprise on page 1209
EXASolution on page 1212
Firebird on page 1215
Google Analytics on page 1218
Google BigQuery on page 1223
Google Cloud SQL on page 1228
Google Sheets on page 1231
Hortonworks Hadoop Hive on page 1238
HP Vertica on page 1242
IBM BigInsights on page 1246
IBM DB2 on page 1249
IBM PDA (Netezza) on page 1252
Kognitio on page 1255
MapR Hadoop Hive on page 1258
Marketo on page 1262
MarkLogic on page 1266
MemSQL on page 1269
Microsoft Analysis Services on page 1272
Microsoft PowerPivot on page 1274
Microsoft SQL Server on page 1276
MonetDB on page 1280
MySQL on page 1283
OData on page 1286
Oracle on page 1288
Oracle Essbase on page 1292
Pivotal Greenplum Database on page 1295
PostgreSQL on page 1298
Presto on page 1302
Progress OpenEdge on page 1305
QuickBooks Online on page 1308
Salesforce on page 1315
SAP HANA on page 1319
SAP NetWeaver Business Warehouse on page 1325
SAP Sybase ASE on page 1329
SAP Sybase IQ on page 1333
Snowflake on page 1336
Spark SQL on page 1339
Splunk on page 1318
Teradata on page 1343
Teradata OLAP Connector on page 1352
Web Data Connector on page 1354
Other Databases (ODBC) on page 1357

Tip: You can quickly create a data source in Tableau by copying and pasting data using the clipboard. For more information, see Create a Data Source or Add a New Connection with Clipboard Data on page 346.
Run Initial SQL

When connecting to some databases, you can specify an initial SQL command to run when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. This initial SQL is different than a custom SQL connection, which defines a relation (table) to issue queries against.

You can use this command to:

- Set up temporary tables to use during the session.
- Set up a custom data environment.

You have the option to add an initial SQL command in the Server Connection dialog box or on the Data Source page.

**Note:** If your data source supports running an initial SQL statement, an Initial SQL link appears in the lower-left corner of the Server Connection dialog box. For information about your data source, see [Connector Examples](#) on page 1165.

To use initial SQL

1. In the Server Connection dialog box, click Initial SQL. Or, on the Data Source page, select Data > Initial SQL or Data > Query Banding and Initial SQL depending on the database you connect to.
2. Enter the SQL command into the Initial SQL dialog box.

```
CREATE TABLE test_table (testID int)
```

**Note:** Tableau does not examine the statement for errors. This SQL statement is simply sent to the database when you connect.

Your software license may restrict you from using initial SQL with your connection. If you publish to Tableau Server, the server must be configured to allow Initial SQL statements. By default, the server software is configured to allow these statements to run when the workbook is loaded in a web browser. Administrators can disable the functionality on the **Data Connections** tab of the Tableau Server Configuration utility. If the server does not allow initial SQL statements, the workbook opens, but the initial SQL commands are not sent.

**Parameters in an initial SQL statement**

You can pass parameters to your data source in an initial SQL statement. There are several reasons why this is useful:

- You can configure impersonation using the **TableauServerUser** or **TableauServerUserFull** parameters.
- If your data source supports it, you can set up row-level security (for example, for Oracle
VPD or SAP Sybase ASE) to make sure that users see only the data that they are authorized to see.

- You can provide more details in logging, for example, the Tableau version or the workbook name.

The following parameters are supported in an initial SQL statement:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Example of returned value</th>
</tr>
</thead>
<tbody>
<tr>
<td>TableauServerUser</td>
<td>The user name of the current server user. Use when setting up impersonation on the server. Returns an empty string if the user is not signed in to Tableau Server.</td>
<td>asmith</td>
</tr>
<tr>
<td>TableauServerUserFull</td>
<td>The user name and domain of the current server user. Use when setting up impersonation on the server. Returns an empty string if the user is not signed in to Tableau Server.</td>
<td>domain.lan\asmith</td>
</tr>
<tr>
<td>TableauApp</td>
<td>The name of the Tableau application.</td>
<td>Tableau Desktop Professional Tableau Server</td>
</tr>
<tr>
<td>TableauVersion</td>
<td>The version of the Tableau application.</td>
<td>9.3</td>
</tr>
<tr>
<td>WorkbookName</td>
<td>The name of the Tableau workbook. Use only in workbooks with an embedded data source.</td>
<td>Financial-Analysis</td>
</tr>
</tbody>
</table>

**Examples**

The following examples show different ways you can use parameters in an initial SQL statement.

- This example sets the security context on Microsoft SQL Server:
  ```sql```
  EXECUTE AS USER = [TableauServerUser] WITH NO REVERT;
  ```

- This example shows how, on a DataStax data source, you can use parameters to add detail to logging or to set up a session variable to keep track of the data:
  ```sql```
  SET TABLEAUVERSION [TableauVersion];
  ```

- This example can be used to help set up row-level security for Oracle VPD:
  ```sql```
  begin

DBMS_SESSION.SET_IDENTIFIER([TableauServerUser]);
end;

Note: Oracle PL/SQL blocks require a trailing semicolon to terminate the block. Consult Oracle documentation for the proper syntax.

Defer execution to the server
You can defer an initial SQL statement so that it is executed only on the server. One reason to defer execution to the server is if you don’t have permission to execute the commands that set up impersonation. Use <ServerOnly></ServerOnly> tags to enclose the commands to be executed only on the server.

Example:

CREATE TEMP TABLE TempTable(x varchar(25));
INSERT INTO TempTable VALUES (1);
<ServerOnly>INSERT INTO TempTable Values(2);</ServerOnly>

Security and impersonation
If you use the TableauServerUser, TableauServerUserFull, or WorkbookName parameter in an initial SQL statement, you will create a dedicated connection that can’t be shared with other users. This will also restrict cache sharing, which can enhance security, but may also slow performance.

Create a Data Source or Add a New Connection with Clipboard Data
Sometimes you want to pull in data from an outside source for some quick analysis. Rather than create a whole data source and then connect in Tableau, you can copy and paste the data directly into your workbook. Tableau automatically creates a data source that you can begin analyzing.

When you paste data on the data source page, Tableau creates a new connection in the existing data source.

When you paste data on the sheet, Tableau creates a new data source that you can begin analyzing. When you paste the data as a data source, the data source is saved as a text file to your Tableau Repository when you save the workbook.

You can copy and paste data from a variety of office applications including Microsoft Excel and Microsoft Word. You can also copy and paste HTML tables from web pages. Tables that are copied as comma separated values or tab delimited can be pasted into Tableau.

Note: Not all applications use these formats when copying.
1. Select the data you want and copy it to the clipboard.

2. Open Tableau Desktop and do one of the following:
   1. On the data source page, select **Data > Paste Data as a Connection** or **Paste Data as a Data Source**.
   2. On the sheet, select **Data > Paste Data** to paste the data as a data source.

3. Select **File > Save** to save the data source.

   When you save the workbook, the data source either becomes a part of the existing data source or is added to your repository, depending on which of the methods you choose. If you paste the data as a data source, the data source is saved with the workbook when you save the workbook as a packaged workbook (.twbx).
Set Up Data Sources

After you connect to your data, use the Data Source page to set up the data source and prepare your data for analysis. There are many optional configurations that you can make before you begin your analysis. The configurations that you make on the Data Source page creates the data source that Tableau uses to interpret and interact with your data.

The topics in this section describe how to use these configurations in order to optimize your data source for analysis.

Join Your Data

In this topic:

- **Overview of join types** on the next page
- **Combine tables from the same database** on page 351
- **Combine tables from different databases** on page 354
  - **About working with multi-connection data sources** on page 357
  - **Join Your Data above**
- **Review join results in the data grid** on page 359
- **Troubleshoot joins** on page 360

The data that you analyze in Tableau is often made up of a collection of tables that are related by specific fields (that is, columns). Joining is a method for combining the related data on those common fields. The result of combining data using a join is a table that is typically extended horizontally by adding columns of data.

For example, suppose you are analyzing data for a publisher. The publisher might have two tables. The first table contains ID numbers, first name, last name, and publisher type. The second table contains ID numbers, price, royalty, and title of published books. The related field between the two tables might be **ID**.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Table 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Book Title</td>
</tr>
<tr>
<td>20-034</td>
<td>Weather in the</td>
</tr>
<tr>
<td>20-034</td>
<td>Adam Davis</td>
</tr>
</tbody>
</table>
In order to analyze these two tables together, you can join the tables on **ID** to answer questions like, "How much was paid in royalties for authors from a given publisher?". By combining tables using a join, you can view and use related data from different tables in your analysis.

<table>
<thead>
<tr>
<th>ID</th>
<th>First Name</th>
<th>Last Name</th>
<th>Publisher Type</th>
<th>Book Title</th>
<th>Price</th>
<th>Royalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>20034</td>
<td>Adam</td>
<td>Davis</td>
<td>Independent</td>
<td>The Magic Shoe Lace</td>
<td>15.99</td>
<td>7,000</td>
</tr>
<tr>
<td>20165</td>
<td>Ashley</td>
<td>Garcia</td>
<td>Big</td>
<td>Weather in the Alps</td>
<td>19.99</td>
<td>5,000</td>
</tr>
</tbody>
</table>

### Overview of join types

In general, there are four types of joins that you can use to combine your data in Tableau: inner, left, right, and full outer. The tables you can join and the different join types you can use depend on the database or file you connect to. You can tell which join types your data supports by checking the join dialog after you've connected to your data and have at least two tables on the canvas.

<table>
<thead>
<tr>
<th>Join Type</th>
<th>Result</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inner</td>
<td>When you use an inner join to combine tables, the result is a table that contains values that have matches in both tables.</td>
<td><img src="image" alt="Inner Join" /></td>
</tr>
<tr>
<td>Left</td>
<td>When you use a left join to combine tables, the result is a table that contains all values from the left table and corresponding matches from the right</td>
<td><img src="image" alt="Left Join" /></td>
</tr>
<tr>
<td>Join Type</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>When a value in the left table doesn't have a corresponding match in the right table, you see a null value in the data grid.</td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>When you use a right join to combine tables, the result is a table that contains all values from the right table and corresponding matches from the left table. When a value in the right table doesn't have a corresponding match in the left table, you see a null value in the data grid.</td>
<td></td>
</tr>
<tr>
<td>Full outer</td>
<td>When you use a full outer join to combine tables, the result is a table that contains all values from both tables. When a value from either table doesn't have a match with the other table, you see a null value in the data grid.</td>
<td></td>
</tr>
</tbody>
</table>

**Combine tables from the same database**

If the tables you need to analyze are from the same database, or workbook (for Excel), or directory (for text) then use the following procedure to combine tables. Combining tables that are from the same database require only a single connection in the data source. Typically, joining tables from the same database yields better performance. This is because querying data that is stored on the same database takes less time and leverages the native capabilities of the database to perform the join.

**Note:** Depending on the level of detail of the tables you want to combine, you might consider data blending instead. For more information, see [Blend Your Data](#) on page 363.

**To join tables**

1. On the start page, under *Connect*, click a connector to connect to your data. This step creates the first connection in the Tableau data source.
2. Select the file, database, or schema, and then double-click or drag a table to the canvas.
3. Double-click or drag another table to the canvas, and then click the join relationship.

4. Add one or more join conditions by selecting a field from one of the available tables used in the data source, a join operator, and a field from the added table. Inspect the join condition to make sure it reflects how you want to connect the tables.

For example, in a data source that has a table of order information and another for returns information, you could use an inner join to combine the two tables based on the **Order ID** field that exists in both tables.
5. When you are finished, close the Join dialog box.

After you’ve created a join, review the data grid to make sure that the join produces the results that you expect. For more information, see Review join results in the data grid on page 359.

Continue to prepare your data source for analysis. You can rename and reset fields, create calculations, clean your Excel data with the Data Interpreter, change the data types of text and Excel-based fields, and so on.

About null values in join keys

In general, joins are performed at the database level. If the columns used to join tables contain null values, most databases return data without the rows that contain the null values. However, if you’ve set up your single-connection data source to use an Excel, text, or Salesforce connection, Tableau provides an additional option to allow you to join columns that contain null values with other columns that contain null values.

To join on null values

- After you’ve set up your data source, on the data source page, select Data > Join null values to null values.

For example, suppose you have two tables of data that you want to join: Orders_June and Orders_July.

<table>
<thead>
<tr>
<th>Orders_June</th>
<th>Orders_July</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Location</td>
</tr>
<tr>
<td>1</td>
<td>New York</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
If you join on both the **ID** and **Location** columns, most databases return the following table of data:

Join (of Orders_June and Orders_July)

<table>
<thead>
<tr>
<th>ID</th>
<th>Location</th>
<th>ID(Orders_July)</th>
<th>Location (Orders_July)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>New York</td>
<td>1</td>
<td>New York</td>
</tr>
<tr>
<td>3</td>
<td>Miami</td>
<td>3</td>
<td>Miami</td>
</tr>
</tbody>
</table>

If you are using a single Excel, text, or Salesforce connection in your data source, select **Data > Join null values to null values** to return the following table:

Join (of Orders_June and Orders_July)

<table>
<thead>
<tr>
<th>ID</th>
<th>Location</th>
<th>ID(Orders_July)</th>
<th>Location (Orders_July)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>New York</td>
<td>1</td>
<td>New York</td>
</tr>
<tr>
<td>2</td>
<td><em>null</em></td>
<td>2</td>
<td><em>null</em></td>
</tr>
<tr>
<td>3</td>
<td>Miami</td>
<td>3</td>
<td>Miami</td>
</tr>
</tbody>
</table>

**Note:** This option is available for single-connection data sources that use text, Excel, and Salesforce connections. If you add a second connection to a data source that uses this option, the join reverts back to the default behavior of excluding rows with null values.

**Combine tables from different databases**

Beginning with Tableau version 10.0, if the tables you need to analyze are stored in different databases, or workbooks (for Excel), or directories (for text), use the following procedure to combine tables using a **cross-database join**.

Cross-database joins require that you first set up a multi-connection data source – that is, you create a new connection to each database before you join tables. When you connect to multiple databases, a data source becomes a multi-connection data source. Multi-connection data sources can be advantageous when you need to analyze data for an organization that uses different internal systems or when you need to work with data that is managed separately by both internal and external groups.
**Note:** In many cases, using a cross-database is the primary method for combing your data. However, there are some cases that you might need to combine your data using data blending instead. For more information, see Blend Your Data on page 363.

After you've combined tables using a cross-database join, Tableau colors the tables in the canvas and the columns in the data grid to show you which connection the data comes from.

**To join tables from different databases**

1. On the Start page, under **Connect**, click a connector to connect to your data. This step creates the first connection in the Tableau data source.

2. Select the file, database, or schema, and then double-click or drag a table to the canvas.

3. In the left pane, under **Connections**, click the **Add** button to add a new connection to the Tableau data source. A new connection is required if you have related data stored in another database.
Note: If the connector you want is not available from the Connect list, cross-database joins are not supported for the combination of sources that you want to join. This includes connections to cube data (e.g., Microsoft Analysis Services), extract-only data (e.g., Salesforce, Google Analytics, and OData), and Tableau Server data sources. Instead of joining tables, consider using data blending. For more information, see Blend Your Data on page 363.

4. Add one or more join conditions by selecting a field from one of the available tables used in the data source, a join operator, and a field from the added table. Inspect the join condition to make sure it reflects how you want to connect the tables.

For example, in a data source that has a table of order information and another table of returns information, you could join the two tables based on the Order ID field that exists in both tables. Select the type of join.

<table>
<thead>
<tr>
<th>Join</th>
<th>Inner</th>
<th>Left</th>
<th>Right</th>
<th>Full Outer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Source</td>
<td>Order ID</td>
<td>=</td>
<td>Order ID (Staples)</td>
<td></td>
</tr>
</tbody>
</table>

Add new join clause
5. When you are finished, close the Join dialog box.

Tables and columns are colored to show you which connection the data comes from.

After you've created a cross-database join, continue to prepare your multi-connection data source for analysis. You can rename and reset fields, create calculations, clean your Excel data with the Data Interpreter, change the data types of text and Excel-based fields, and so on.

**About working with multi-connection data sources**

Working with multi-connection data sources is just like working with any other data source, with a few caveats, discussed in this section.

**Make extract files the first connection**

When connecting to extract files in a multi-connection data source, make sure that the connection to the extract (.tde) file is the first connection. This preserves any customizations that might be a part of the extract, including changes to default properties, calculated fields, groups, aliases, etc.

**Note:** If you need to connect to multiple extract files in your multi-connection data source, only the customizations in the extract in the first connection are preserved.

**Calculations and multi-connection data sources**

Only a subset of calculations can be used in a multi-connection data source. You can use a specific calculation if it is both:
- Supported by all the connections in the multi-connection data source
- Supported by Tableau extracts.

**Stored procedures**

Stored procedures are not available for multi-connection data sources.

**Pivot data from within a connection**

To pivot data, you must use text columns or Excel columns from the same connection. That is, you cannot include columns from different databases in a pivot.

**Union data from within a connection**

To union data, you must use text tables or Excel tables from the same connection. That is, you cannot union tables from different databases. For more information, see the Union Your Data on page 382.

**Collation**

Collation refers to the rules of a database that determine how string values should be compared and sorted. In most cases, the collation is handled by the database. However, when you work with cross-database joins, you might join columns that have different collations.

For example, suppose your cross-database join used a join key comprised of a case-sensitive column from SQL Server and a case-insensitive column from Oracle.

In cases like this, Tableau maps certain collations to others to minimize interpreting values incorrectly.

The following rules are used in cross-database joins:

- If a column uses collation standards of the International Components for Unicode (ICU), Tableau uses the collation of the other column.
- If all columns use collation standards of the ICU, Tableau uses the collation of the column of the left table.
- If no columns use collation standards of the ICU, Tableau uses a binary collation. A binary collation means the locale of the database and data type of the columns determine how string values should be compared and sorted.

**Note:** Collation of Japanese characters, that is, Kana-sensitivity, depends on the database that you are connected to.

**About queries and cross-database joins**

For each connection, Tableau Desktop sends independent queries to the databases in the join. The results are stored in a temporary table, in the format of an extract (.tde) file.

For example, suppose you create connections to two tables, dbo.listings and reviews$. These tables are stored in two different databases, SQL Server and Excel. Tableau queries the
database in each connection independently. The database performs the query and applies customizations such as filters and calculations, and Tableau stores the results for each connection in a temporary table. In this example, FQ_Temp_1 is the temporary table for the connection to SQL Server and FQ_Temp_2 is the temporary table for the connection to Excel.

**SQL Server table**

```
[FQ_Temp_1]
select
[dbo].[listings...]
```

**Excel table**

```
[FQ_Temp_2]
select
[reviews$]
```

When you perform a cross-database join, the temporary tables are joined together by Tableau Desktop. These temporary tables are necessary for Tableau to perform cross-database joins.

After the tables have been joined, "topn" filter is applied to limit the number of values shown in the data grid to the first 1,000 rows. This filter is applied to help maintain responsiveness of the data grid and the overall performance of the Data Source page.

**Joined tables**

```
select
join
[topn]
[FQ_Temp_1] [FQ_Temp_2]
```

**Review join results in the data grid**

After you have created a join on the canvas, review the data grid to make sure the join produces the results that you expect. If the data grid displays data that you don't expect, you might need modify the join.

- **No data** If no data displays in the data grid, you might need to change the join type or a join column used in the join condition.
- **Duplicate data** If you see duplicate data, there a few things you can do. Consider changing the aggregation of the measure that use in your analysis, use a calculation, or use data blending instead. For more information about data blending, see Blend Your
Troubleshoot joins

Over-counting values

When you connect to and join multiple tables together, you set up a denormalized version of the data. In some cases, Tableau treats the multiple tables as one table. When multiple tables are treated as one table, after the tables are joined, all tables are queried. This can cause values to be over-counted.

For example, suppose you have two tables. The first table contains employee information, such as employee ID and salary. The second table contains organizational information, such as department names.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Table 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Employee ID</strong></td>
<td><strong>Department</strong></td>
</tr>
<tr>
<td>2010-6</td>
<td>Kim, Michelle</td>
</tr>
<tr>
<td>2010-6</td>
<td></td>
</tr>
<tr>
<td>2010-7</td>
<td>Wilson, Henry</td>
</tr>
<tr>
<td>2010-8</td>
<td>Smith, Andrew</td>
</tr>
</tbody>
</table>
If you join these tables, an employee's salary is counted more than once because the employee is associated with the multiple departments.

<table>
<thead>
<tr>
<th>Employee ID</th>
<th>Name</th>
<th>Salary</th>
<th>Department</th>
<th>Hire Date</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>20107</td>
<td>Wilson, Henry</td>
<td>61,000</td>
<td>Support</td>
<td>7/28/2015</td>
<td>Operations</td>
</tr>
<tr>
<td>20107</td>
<td>Wilson, Henry</td>
<td>61,000</td>
<td>Sales</td>
<td>8/25/2016</td>
<td>Operations</td>
</tr>
</tbody>
</table>

To help resolve this issue, depending on your analysis, you can use the **MIN** aggregation to remove double counting.

**Broken cross-database joins**

Before you join tables using a cross-database join, make sure that the data types of the join keys match. If the data types of the join keys don't match, the join breaks, which is indicated by a red exclamation point. To fix a broken join, take one of the following steps:

- For text or Excel-based data, modify the data type of one of the text or Excel fields in the join key using the data type menu in the data grid.
- For most connections, you can use the **Convert to custom SQL** option to change the data type of one of the fields in the join key, using a function like **CAST()**. The **Convert to custom SQL** option is available only when the data source contains only one connection. In this case, remove the second connection and then select **Data > Convert to custom SQL**.

**Assuming Referential Integrity**

In some cases, you can improve query performance by selecting the option to **Assume Referential Integrity** from the **Data** menu. When you use this option, Tableau will include the joined table in the query only if it is specifically referenced by fields in the view.
Using this setting is appropriate when you know that your data has referential integrity (see definition below) but your database is not enforcing or cannot enforce referential integrity. If you have the option of configuring referential integrity in your database that is a better option than using this setting because it can improve performance both in the database and in Tableau. The **Assume Referential Integrity** option in Tableau can only affect performance on Tableau’s end. If your data does not have referential integrity and you turn on this setting, query results may not be reliable.

To understand what referential integrity is, imagine connecting to sales data that has two tables: Sales and Product Catalog. These two tables are shown below:

<table>
<thead>
<tr>
<th>Sales</th>
<th>Product Catalog</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product ID (Foreign Key)</td>
<td>Product ID (Primary Key)</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Because all products that are sold must have a listing in the Product Catalog, every row in the Sales table has a matching row in the Product Catalog table. When these two tables are joined on Product ID, you end up with a table that looks like this:
Now let's say you build a view to look at Sale Amount by Region. By default, dragging the Sale Amount field to the view may create a query like this:

```sql
SELECT SUM([Sales Amount]) FROM [Sales] S INNER JOIN [Product Catalog] P ON S.ProductID = P.ProductID
```

By selecting **Assume Referential Integrity**, you tell Tableau that the joined tables have referential integrity. In other words, you are confirming that the Sales table will always have a matching row in the Product Catalog table. Because that is true, Tableau doesn't need any information from the Product Catalog table in order to return these results. When you drag the Sale Amount field into the view, Tableau can simplify the query to:

```sql
SELECT SUM([Sales Amount]) FROM [Sales]
```

This simplified query can often return quicker results because it removes the join operation. This option impacts only inner joins and does not affect data sources with a single table.

**Blend Your Data**

In this topic:

- **Prerequisites for data blending** on page 365
- **Differences between joins and data blending** on page 365
- **Blend your data** on page 367
- **Data blending limitations** on page 370

Data blending is a method for combining data that supplements a table of data from one data source with columns of data from a second data source.

Usually you use joins to perform this kind of data combining, but there are times, depending on factors like the type of data and its granularity, when it's better to use data blending.

For example, suppose you have transactional data stored in Salesforce and quota data stored in an Excel workbook. The data you want to combine is stored in different databases, and the
granularity of the data captured in each table is different in the two data sources, so data blending is the best way to combine this data.

Data blending is useful under the following conditions:

- **You want to combine data from different databases that are not supported by cross-database joins.**

  Cross-database joins do not support connections to cubes (for example, Oracle Essbase) or to some extract-only connections (for example, Salesforce). In this case, set up individual data sources for the data you want to analyze, and then use data blending to combine the data sources on a single sheet.

- **Data is at different levels of detail.**

  Sometimes one data set captures data using greater or lesser granularity than the other data set.

  For example, suppose you are analyzing transactional data and quota data. Transactional data might capture all transactions. However, quota data might aggregate transactions at the quarter level. Because the transactional values are captured at different levels of detail in each data set, you should use data blending to combine the data.

Use data blending instead of joins under the following conditions:

- **Data needs cleaning.**

  If your tables do not match up with each other correctly after a join, set up data sources for each table, make any necessary customizations (that is, rename columns, change column data types, create groups, use calculations, etc.), and then use data blending to combine the data.

- **Joins cause duplicate data.**

  Duplicate data after a join is a symptom of data at different levels of detail. If you notice duplicate data, instead of creating a join, use data blending to blend on a common dimension instead.

- **You have lots of data.**

  Typically joins are recommended for combining data from the same database. Joins are handled by the database, which allows joins to leverage some of the database’s native capabilities. However, if you're working with large sets of data, joins can put a strain on the database and significantly affect performance. In this case, data blending might help. Because Tableau handles combining the data after the data is aggregated, there is less data to combine. When there is less data to combine, generally, performance improves.
Note: When you blend on a field with a high level of granularity, for example, date instead of year, queries can be slow.

Prerequisites for data blending
Your data must meet the following requirements in order for you to use data blending.

Primary and secondary data sources
Data blending requires a primary data source and at least one secondary data source. When you designate a primary data source, it functions as the main table or main data source. Any subsequent data sources that you use on the sheet are treated as a secondary data source. Only columns from the secondary data source that have corresponding matches in the primary data source appear in the view.

Using the same example from above, you designate the transactional data as the primary data source and the quota data as the secondary data source.

Note: Cube (multidimensional) data sources must be used as the primary data source. Cube data sources cannot be used as a secondary data source.

Defined relationship between the primary and secondary data sources
After designating primary and secondary data sources, you must define the common dimension or dimensions between the two data sources. This common dimension is called the linking field.

Continuing the example from above, when you blend transactional and quota data, the date field might be the linking field between the primary and secondary data sources.

- If the date field in the primary and secondary data sources have the same name,

  Tableau creates the relationship between the two fields and shows a link icon ( evidenza ) next to the date field in the secondary data source when the field is in the view.

- If the two dimensions don’t have the same name, you can define a relationship that creates the correct mapping between the date fields in the primary and secondary data sources.

Differences between joins and data blending
Data blending simulates a traditional left join. The main difference between the two is when the join is performed with respect to aggregation.
**Left join**

When you use a left join to combine data, a query is sent to the database where the join is performed. Using a left join returns all rows from the left table and any rows from the right table that has a corresponding row match in the left table. The results of the join are then sent back to and aggregated by Tableau.

For example, suppose you have the following tables. If the common columns are **User ID** and **Patron ID**, a left join takes all the data from the left table, as well as all the data from the right table because each row has a corresponding row match in the left table.

<table>
<thead>
<tr>
<th>User ID</th>
<th>District</th>
<th>Branch</th>
<th>Patron ID</th>
<th>Dist User ID</th>
<th>District</th>
<th>Level</th>
<th>Branch</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>A001</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>A001</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>B001</td>
<td></td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>A001</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>C001</td>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>C001</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>C001</td>
<td>W</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>B001</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>null</td>
</tr>
</tbody>
</table>

**Data blending**

When you use data blending to combine data, a query is sent to the database for each data source that is used on the sheet. The results of the queries, including the aggregated data, are sent back to and combined by Tableau. The view uses all rows from the primary data source, the left table, and the aggregated rows from the secondary data source, the right table, based on the dimension of the linking fields. Dimension values are aggregated using the ATTR aggregate function, which means the aggregation returns a single value for all rows in the secondary data source. If there are multiple values for the rows, an asterisk (*) is shown. Measure values are aggregated based on how the field is aggregated in the view.

You can change the linking field or add more linking fields to include different or additional rows of data from the secondary data source in the blend, changing the aggregated values.

For example, suppose you have the following tables. If the linking fields are **User ID** and **Patron ID**, blending your data takes all of the data from the left table, and supplements the left table with the data from the right table. In this case, not all values can be a part of the resulting table because of the following:

- A row in the left table does not have a corresponding row match in the right table, as indicated by the null value.
- There are multiple corresponding values in the rows in the right table, as indicated by the asterisk (*).
Suppose you have the same tables as above, but the secondary data source contains a new field called **Fines**. Again, if the linking fields are **User ID** and **Patron ID**, blending your data takes all of the data from the left table, and supplements it with data from the right table. In this case, you see the same null value and asterisks in the previous example in addition to the following:

- Because the **Fines** field is a measure, you see the row values for the **Fines** field aggregated before the data in the right table is combined with the data in the left table.
- As with the previous example, a row in the left table does not have corresponding row for the **Fines** field, as indicated by the second null value.

**Blend your data**

You can use data blending when you have data in separate data sources that you want to analyze together on a single sheet. The following example demonstrates how to blend data from two data sources: an Excel data source and an SQL Server data source.

**To blend your data**

**Step 1: Connect to your data and set up the data sources**
1. Connect to a set of data and set up the data source on the data source page. This example uses the **Sample - Superstore** data source.

2. Select **Data > New data source**, connect to the second set of data, and then set up the data source. This example uses a SQL Server data source that contains information about forecasted sales, called Sales Plan.

3. Click the sheet tab to start building your view.

**Step 2: Designate a primary data source**

Drag at least one field from your primary data source into the view to designate it as the primary data source.

1. In the **Data** pane, click the data source that you want to designate as the primary data source. In this example, **Sample - Superstore** is selected.

2. Drag the fields you want to use from the data source into the view. In this example, a view is created that shows Sales by Segment and Category.

**Step 3: Designate a secondary data source**

Any fields used in the view from data sources that are not the primary data source or active links automatically designate subsequent data sources as the secondary data source.

1. In the **Data** pane, click the data source that you want to designate as the secondary data source. In this example, the Sales Plan data source is selected.

   When you complete this step, an orange bar displays down the left side of the Data pane. The orange bar indicates the secondary data source. In addition to the orange bar, broken link icons display next to potential linking fields.

2. Click a broken link icon ( ) to establish a relationship between the secondary and primary data sources. This is the field that determines the level of detail that Tableau should aggregate to. In this example, Segment is the linking field.

   If a broken link icon does not appear next to the field that should be the linking field or no broken links appear, see **Step 4: (Optional) Define or edit relationships** below.

3. Drag the fields you want to use from the secondary data source into the view. In this example, Sales Plan field is used on the **Detail** card to change the level of detail of the view.

**Step 4: (Optional) Define or edit relationships**

Tableau detects when a field from the primary data source also exists in a secondary data source, and indicates that the fields are potential linking fields by marking them with a broken link icon in the **Data** pane. You click a broken link icon to establish a relationship between the primary and secondary data sources, and have Tableau blend data from both data sources on a single sheet.
You must have at least one linked field in order to use data from the secondary data source.

1. Select Data > Edit Relationships.

2. In the Relationships dialog box, verify that the primary data source is selected from the Primary data source drop-down list. In this example, the Sample - Superstore data source is selected.

3. Select the secondary data source in the Secondary data source pane, select Custom in the relationships list, and then click the Add button. In this example, the Sales Plan data source is selected.

4. In the Add/Edit Field Mapping dialog box, do the following:
   1. Select a field from the primary data source.
   2. Select a field from the secondary data source to establish the linking field or the relationship between the data sources even though the fields do not have the same name.
   3. Click OK.

   In this example, a relationship between Segment field in the Superstore – Sample data source is selected and Customer Segment field in the Sales Plan data source is selected. You can map these two fields to create a relationship even though they don't have the same name.

5. (Optional) Continue to add and remove as many relationships as necessary and then click OK.

   The related fields are shown in the secondary data source as potential linking fields.

6. Click the broken link icon (_BREAK) next to these fields in the data pane to make the relationship between the primary and secondary data sources active. In this case, the broken link icon next to Customer Segment is made into an active link icon (ACT).

   If the related field from the primary data source is used in the view, the link becomes active automatically.

When data blending, the relationship matches values based on the member aliases. You can fix fields that don't match by editing the aliases. For example, when you map a Segment field in the primary data source to the Segment field in the secondary data source, “Small Business” will not map correctly to “S. Business”. You must edit the aliases in one of the data sources. For more information, see Example – Editing Aliases on page 313.

You can also use a secondary data source to re-alias the field values in a primary data source. For more information, see Alias Field Values Using Data Blending on the next page.
Data blending limitations

There are some data blending limitations around non-additive aggregates, such as COUNTD, MEDIAN, and RAWSQLAGG. For more information, see Troubleshoot Data Blending on page 376.

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Alias Field Values Using Data Blending

Data blending is a method for combing data. Data blending works by supplementing the data in the primary data source with the data in the secondary data source.

Aliasing is the alternative name that you can assign to a value in a dimension field. You can use aliases to rename specific values within a dimension. This can be useful when you want to show more relevant or descriptive dimension values in your view than what the original data provides.

You can use data blending as a method for re-aliasing values in a data source by using field values from another data source. To do this, there must be a field in the secondary data source that contains aliases for a field in the primary data source.

For example, suppose you have a primary data source that contains information on fruit, including fruit names and code values that the fruit are associated with. A secondary data source contains a field with more descriptive code values.

<table>
<thead>
<tr>
<th>Primary data source</th>
<th>Secondary data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>Fruit ID</td>
</tr>
<tr>
<td>Apple</td>
<td>A</td>
</tr>
<tr>
<td>Banana</td>
<td>B</td>
</tr>
</tbody>
</table>

When you re-alias a field in your primary data source, you can create a view that replaces the original code values with the more descriptive code values.

**Note:** After you have used the secondary data source to provide aliases for the primary data source, you no longer need the secondary data source and can close it.

To alias field values

1. Set up the primary and secondary data sources and establish a relationship between the data sources. For more information, see Step 4: (Optional) Define or edit relationships on page 368. The data sources used in this example are Fruit Stand and Alternate ID.
2. Select the primary data source in the **Data** pane, and then drag the field that you want to alias to the view. For this example, Fruit Stand is the primary data source.

3. Select the secondary data source in the **Data** pane, and drag the field that contains the alias information to the view. For this example, Alternate ID is the secondary data source. **Note:** The field you are using to alias the field values in the primary data source cannot be the linking field you are using to link the primary and secondary data sources.

In this example, Alternate ID field in the secondary data source contains the aliasing information needed by the Fruit Stand field in the primary data source.

4. Right-click (control-click on a Mac) the field from the secondary data source and select **Edit Primary Aliases**.

Values in the primary data source must have corresponding alias values in the secondary data source. An asterisk under **Has Alias** confirms that the data sources have corresponding alias values.
Note: If asterisks don't appear under Has Alias, then either the secondary data source doesn't have the corresponding aliases to match the field values in the primary data source, or there is more than one field value in the primary data source that has the same alias in the secondary data source. In cases like this, aliasing field values in the primary data source with data from the secondary data source is not possible.

5. Click OK. The alias values in the secondary data source replace the field values in the primary data source. In this example, the more descriptive code values from Alternate ID field replaces the values in the Fruit ID field.

6. (Optional) Select the secondary data source from the Data menu, and select Close.

To watch a video that demonstrates aliasing field values using data blending, see Cleaning Data by Bulk Re-Aliasing.
Bring a Field into the Primary Data Source

Data blending is a method for combining data. Data blending works by supplementing the data in the primary data source with the data in the secondary data source.

In cases where you might only need just some of the data in the secondary data source, you can create a primary group to bring only the fields that you need into the primary data source. This eliminates the need for the secondary data source, which reduces the size of the workbook and can improve workbook performance.

For example, suppose you have two data sources: Superstore and Population. The Superstore data source contains lots of data, but most importantly, it contains data about states and the region each of the states is associated with. The Population data source contains state and population data, but doesn't contain any data about regions. In this case, you can blend the Population and Superstore data sources to create a primary group. Then so that you can pull in the Region field from the Superstore data source into the Population data source, thereby eliminating the need for the Superstore data source all together.

To blend two data sources and create a primary group

1. Download and open the following workbook from Tableau Public.
   1. Go to https://public.tableau.com/profile/publish/BringaFieldintothePrimaryDataSource/Sheet1#!/publish-confirm.
   2. Click Download Workbook in the upper-right corner.

In the workbook, the State dimension is already on the Rows shelf, making it the first field in the view and establishing the Population data source as the primary data source for the sheet. The Superstore data source is also included in the workbook and functions as the secondary data source.

2. In the Data pane, select Superstore, and then drag the Region dimension to the Rows shelf and place it in front of State.

The view shows the regions from the Superstore data source (secondary) and the states in the Population data source (primary) that are associated with those regions. There are two states, Alaska and Hawaii, from Population data source (primary) that are not associated with a specific region. These two states are assigned to a "null" region.
3. Right-click the **Region** field in the **Rows** shelf from the Superstore data source (secondary), and select **Create Primary Group**.

4. In the Edit Group dialog box, drag Alaska and Hawaii (from the "null" region) to the **West** region. This task assigns the states in the Population data source (primary) in the "null" region into a region.
5. Click **OK** to close the Edit Group dialog box.

6. In the **Data** pane, select the State data source (secondary). Now you see a new group field listed in the Population data source (primary) called **State (group)**.

7. Drag the **State (group)** dimension over the Region dimension on the **Rows** shelf to replace it.

8. Drag the **2016 Population** measure to the **Columns** shelf to see Population based on the regions from the Superstore (secondary) data source.

9. (Optional) You can close the Superstore data source (secondary), and then continue with your analysis. You can also publish the data source or workbook without the secondary data source. This is because the field you were using from the secondary data source, **Region**, is replaced by the primary group field that you created in the primary data source.
To watch a video that demonstrates another example of the Create a Primary Group functionality, see Cleaning Data by Bulk Re-Aliasing.

Troubleshoot Data Blending

In this topic:

- Common warnings and errors when blending data sources below
- Asterisks show in the sheet on page 379
- Null values appear after blending data sources on page 380
- Blending issues after publishing data sources on page 381
- Blending with a cube (multidimensional) data source on page 381
- Other data blending issues on page 381

When you use data blending to combine your data from different data sources, there are a few common issues that might arise. This topic lists them and describes how you can respond to each situation.

Common warnings and errors when blending data sources

No relationship to the primary data source

When you drag a field from a secondary data source to the view, you might see a warning that says:

*Fields cannot be used from the [name of secondary data source] data source, because there is no relationship to the primary data source. In the Data pane, switch to the*
[name of secondary data source] data source, and click at least one link icon to blend these data sources.

This warning occurs when you have no active links in the secondary data source.

For example, suppose you have two data sources that are related by the State and Date fields.

At least one of these fields must have the active link icon (🔗) next to it in the secondary data source. You can make the link active by clicking the link icon in the Data pane or by using the related field from the primary data source in the view.

The secondary data source may not have any relationships to the primary data source. Look in the Data pane for the link icon. Tableau automatically links fields that have the same name. If your fields do not have the same name, you must define a relationship between them. For more information, see Step 4: (Optional) Define or edit relationships on page 368.

Primary and secondary connections are from tables in the same data source

When you drag a field from a secondary data source to the view, you might see a warning that says:

The primary and secondary connections are from tables in the same data source. Instead of linking the connections, use the Data menu to join the data. Joins can integrate data from many tables and may improve performance and filtering.

This warning occurs when the workbook contains separate data sources that connect to the same database. Though you can combine data in this way, Tableau recommends that you use a join to combine data from the same database instead. Joins are typically handled by the database, which means that joins leverage some of the database’s native performance capabilities.

Cannot blend the secondary data source because one or more fields use an unsupported aggregation

Data blending has some limitations regarding non-additive aggregates such as COUNTD, MEDIAN, and RAWSQLAGG. Non-additive aggregates are aggregate functions that produce results that cannot be aggregated along a dimension. Instead, the values have to be calculated individually.

These limitations cause certain fields in the view to become invalid under certain circumstances. If you hover your mouse cursor over one of these invalid fields, you see the following error:

Cannot blend the secondary data source because one or more fields use an unsupported aggregation.
This error can occur for one of the following reasons:

- **Groups in the primary data source**: If a non-additive aggregation from the primary data source is in the view, you cannot use a group created in the primary data source. To work around this limitation, convert the group to a calculated field.

- **Non-additive aggregates from the primary data source**: Non-additive aggregates are only supported in the primary data source if the data in the data source comes from a relational database that allows the use of temporary tables. To work around this issue, consider creating an extract of your data source. Extracts support temporary tables.

- **Non-additive aggregates from a multi-connection data source that uses a live connection**: Multi-connection data sources that connect to data using a live connection do not support temporary tables. Therefore, using a multi-connection data source that connects to data using a live connection prohibits the use of blending functionality with non-additive aggregates. To work around this issue, consider creating an extract of your multi-connection data source. Extracts support temporary tables.

- **Linking field in the view before the use of an LOD expression**: This error can also appear when you use a level of detail expression in a view that uses data blending. To resolve the error, make sure the linking field in the primary data source is in the view before you use an LOD expression from the secondary data source.

- **Published data sources as the primary data source**: Because certain versions of Tableau Server does not support temporary tables, there are some limitations around non-additive aggregates.
For Tableau 8.3 and earlier, Tableau Server does not support temporary tables. Therefore, using a published data source as your primary data source prohibits the use of the blending functionality with non-additive aggregates.

For Tableau 9.0 and later, you can use COUNTD and MEDIAN with blending functionality in a published data source that is used as the primary data source. However, the other limitations listed above still apply.

**Asterisks show in the sheet**

When you blend data, make sure that there is only one matching value in the secondary data source for each mark in the primary data source. If there are multiple matching values, you see an asterisk in the view that results after you blend data.

For example, suppose you have two data sources: Population and Superstore. The primary data source, Population, has a field called State. The secondary data source, Superstore, contains fields called State and Segment. In the secondary data source, each state has multiple segments. Alabama, for example, has Consumer, Corporate, and Home Office segments.

<table>
<thead>
<tr>
<th>Primary data source</th>
<th>Secondary data source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Data</td>
</tr>
<tr>
<td>Population</td>
<td>Population</td>
</tr>
<tr>
<td>Superstore</td>
<td>Superstore</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Dimensions</td>
</tr>
<tr>
<td>State</td>
<td>State</td>
</tr>
<tr>
<td>Abc Measure Names</td>
<td>Abc Measure Names</td>
</tr>
<tr>
<td>Measures</td>
<td>Measures</td>
</tr>
<tr>
<td>2010 Population</td>
<td>2010 Population</td>
</tr>
<tr>
<td>2015 Population</td>
<td>2015 Population</td>
</tr>
<tr>
<td>Change</td>
<td>Change</td>
</tr>
</tbody>
</table>

When you blend the two data sources on the State field, you create a relationship where individual state values (in the primary data source) can have multiple segment values (in the secondary data source). Multiple values for segments in the secondary data source for each corresponding state value in the primary data source cause asterisks to appear in the view, as demonstrated by the images below.
Avoid this by making sure that there is only one matching value in the secondary data source for each mark in the primary data source.

**Blended data**

![Blended data data](image)

**Null values appear after blending data sources**

Null values can sometimes appear in place of the data you want in the view when you use data blending. Null values can appear for a few reasons:

- The secondary data source does not contain values for the corresponding values in the primary data source.
- The data types of the fields you are blending on are different.
- The values in the primary and secondary data sources use different casing.

Data blending works by supplementing the data in the primary data source with data from the secondary data source based on the linking field. This means Tableau takes all the data in the primary data source, and only the corresponding matches in the secondary data source. If Tableau cannot identify at least one matching value in the secondary data source for the corresponding value in the primary data source, null values appear.

You can resolve this issue by doing the following:

- **Insert data in the secondary data source:** Insert missing data in the secondary data source so that all records in the primary data source have a match. For example, suppose your primary data source contains values for all 50 U.S. states, but your secondary data source only has values for 30 U.S. states. To resolve this issue, you can add values for the remaining 20 U.S. states to the underlying data set of the secondary data source. Alternatively, you might be able to [Bring a Field into the Primary Data Source](#) on page 373 or [Alias Field Values Using Data Blending](#) on page 370 to work around null values if you cannot modify the underlying data.

- **Verify data types in the primary and secondary data sources match:** For
example, both data sources should use string data for the fields you are blending on, or both fields should contain numbers. You can't blend fields where one field contains numbers and the other contains strings.

- **Verify the casing of the values in the primary and secondary data sources match**: If one data source uses a mix of upper- and lowercase names, and the other uses only uppercase, you'll see null values. For more information, see [Nulls Show When Data Blending](#).

### Blending issues after publishing data sources

When you make a field-level customization that blends two data sources, the customization is based on one of the data sources, the primary data source. Then, when the primary and secondary data sources are published to Tableau Server or Tableau Online, the primary data source, which contains the customization (i.e., the reference to the secondary data source) no longer works. The customization no longer works because the relationship between the primary and secondary data sources is lost. This is because the relationship between the primary and secondary data sources is defined at the workbook level.

For example, suppose you have two data sources: Store - Main and Store - West. You create a field-level customization, like a calculation, that combines the sales totals from the primary data source, Store - Main, with the sales totals from the secondary data source, Store - West. As soon as you publish the data sources to Tableau Server or Tableau Online, the calculation in Store - Main no longer works. This is because the calculation refers to the secondary data source, Store - West, whose location is now undetermined.

To work around this scenario, do the following:

1. Before creating any field-level customizations, publish each data source first.
2. Connect to each data source.
3. Create a workbook that contains the field-level customizations that you need.
4. Publish the workbook to Tableau Server.

   You can use this workbook as a "template" that can be shared and downloaded by you and others.

### Blending with a cube (multidimensional) data source

Cube data sources can only be used as the primary data source for blending data in Tableau. They cannot be used as secondary data sources.

### Other data blending issues

For other issues that emerge while blending data, see the following links.

**Sort is not available**
- For issues sorting on a calculated field, see Sorting by Fields is Unavailable for Data Blended Measures.
- For issues with a computed sort, see Sort Options Not Available from Toolbar When Data Blending.

**Actions do not behave as expected**

- Fields from the secondary data source cannot be added to a URL action. See Fields from Blended Data Source Unavailable for URL Actions.
- Action filters are not behaving as expected. See Action Filters with Blended Data Not Working as Expected.

**Unexpected values and field changes**

- Invalid fields when using COUNTD, MEDIAN, and RAWSQLAGG. See COUNTD Invalid in Published Data Sources When Blending.
- Duplicate totals after every date value in the view. See Issues with Blending on Date Fields.
- Latitude and longitude fields are grayed out. See Error "Invalid field formula" Creating Map.
- Underlying data shows different values than blended data. See Underlying Data Not Consistent with Blended Data.

**Union Your Data**

You can union your data to combine two or more tables from Excel workbook or text file data. The workbooks or text files must be in the same folder and come from the same connection.

You union tables by appending values (rows) from one table to another.

For best results, the tables that you combine must have the same structure. That is, each table must have the same number of fields, and related fields must have matching field names and data types.

For example, suppose you have the following customer purchase information stored in three tables, separated by month. The table names are "May2016," "June2016," and "July2016."

<table>
<thead>
<tr>
<th>May2016</th>
<th>June2016</th>
<th>July2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D-ay</strong></td>
<td><strong>Customer</strong></td>
<td><strong>Purchases</strong></td>
</tr>
<tr>
<td>4</td>
<td>Lane</td>
<td>5</td>
</tr>
</tbody>
</table>

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A union of the these tables creates the following single table that contains all rows from all tables.

### Union

<table>
<thead>
<tr>
<th>Day</th>
<th>Customer</th>
<th>Purchases</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Lane</td>
<td>5</td>
<td>Credit</td>
</tr>
<tr>
<td>10</td>
<td>Chris</td>
<td>6</td>
<td>Credit</td>
</tr>
<tr>
<td>28</td>
<td>Juan</td>
<td>1</td>
<td>Credit</td>
</tr>
<tr>
<td>1</td>
<td>Lisa</td>
<td>3</td>
<td>Credit</td>
</tr>
<tr>
<td>28</td>
<td>Isaac</td>
<td>4</td>
<td>Cash</td>
</tr>
<tr>
<td>28</td>
<td>Sam</td>
<td>2</td>
<td>Credit</td>
</tr>
<tr>
<td>2</td>
<td>Mario</td>
<td>2</td>
<td>Credit</td>
</tr>
<tr>
<td>15</td>
<td>Wei</td>
<td>1</td>
<td>Cash</td>
</tr>
<tr>
<td>21</td>
<td>Jim</td>
<td>7</td>
<td>Cash</td>
</tr>
</tbody>
</table>

**To union tables**

To union distinct text files or Excel sheets, drag individual tables from the left pane of the data source page and into the Union dialog box.
1. On the data source page, double-click **New Union** to set up the union.

2. Drag a table from the left pane to the Union dialog box.

3. Select another table from the left pane and drag it directly below the first table.
**Tip:** To add multiple tables to a union at the same time, press Shift or Ctrl (Shift or Command on a Mac), select the tables you want to union in the left pane, and then drag them directly below the first table.

**To rename, modify, or remove unions**

**To rename a union**

1. Double-click the union table on the canvas.
2. Enter a new name for the union.

**To add or remove tables in the union**

1. Click the union drop-down arrow and then select **Edit Union**.
2. You can drag additional tables that you want to union from the left pane, or hover over a table until the remove icon displays and then click the icon to remove the table.

**To remove a union**
• Click the union drop-down arrow and select Remove.

Matching field names or field ordering
Table in a union are combined by matching field names. If there are no matching field names (or your tables do not contain column headers), you can tell Tableau to combine tables based on the order of the fields in the underlying data by creating the union and then selecting Generate field names automatically option from the union drop-down menu.

Metadata about unions
After you create a union, additional fields about the union are generated and added to the grid. The new fields provide information about where the original values in the union come from, including the sheet and table names. These fields are useful when unique information that is critical to your analysis is embedded in the sheet or table name.

For example, the tables used in the example above have unique month and year information stored in the table name instead of in the data itself. In this case, you can use the Table name field that is generated by the union to access this information and use it in your analysis.
If a named range is used in a union, null values display under the Sheet name field.

**Note:** You can use the fields generated by a union, Sheet name and Table name, as join keys. You can use a unioned table in a join with another table or unioned table.

**Merge mismatched fields in the union**

When field names in the union do not match, fields in the union contain null values. You can merge the non-matching fields into a single field using the merge option to remove the null values. When you use the merge option, the original fields are replaced by a new field that displays the first non-null value for each row in the non-matching fields.

You can also create your own calculation or modify the underlying Excel or text data to combine the non-matching fields.

For example, suppose a fourth table, "August2016", is added to the underlying data. Instead of the standard "Customer" field name, it contains an abbreviated version called "Cust."

**August2016**

<table>
<thead>
<tr>
<th>Day</th>
<th>Cust.</th>
<th>Purchases</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Maria</td>
<td>2</td>
<td>Credit</td>
</tr>
<tr>
<td>9</td>
<td>Kathy</td>
<td>1</td>
<td>Credit</td>
</tr>
<tr>
<td>18</td>
<td>Vijay</td>
<td>7</td>
<td>Cash</td>
</tr>
</tbody>
</table>
A union of these tables creates a single table that contains all rows from tables, with several null values. You can use the merge option to combine the related customer fields into a single field.

**Union (with null values)**

<table>
<thead>
<tr>
<th>Day</th>
<th>Customer</th>
<th>Purchases</th>
<th>Type</th>
<th>Cust.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Lane</td>
<td>5</td>
<td>Credit</td>
<td>null</td>
</tr>
<tr>
<td>10</td>
<td>Chris</td>
<td>6</td>
<td>Credit</td>
<td>null</td>
</tr>
<tr>
<td>28</td>
<td>Juan</td>
<td>1</td>
<td>Credit</td>
<td>null</td>
</tr>
<tr>
<td>1</td>
<td>Lisa</td>
<td>3</td>
<td>Credit</td>
<td>null</td>
</tr>
<tr>
<td>28</td>
<td>Isaac</td>
<td>4</td>
<td>Cash</td>
<td>null</td>
</tr>
<tr>
<td>28</td>
<td>Sam</td>
<td>2</td>
<td>Credit</td>
<td>null</td>
</tr>
<tr>
<td>2</td>
<td>Mario</td>
<td>2</td>
<td>Credit</td>
<td>null</td>
</tr>
<tr>
<td>15</td>
<td>Wei</td>
<td>1</td>
<td>Cash</td>
<td>null</td>
</tr>
<tr>
<td>21</td>
<td>Jim</td>
<td>7</td>
<td>Cash</td>
<td>null</td>
</tr>
<tr>
<td>7</td>
<td>null</td>
<td>2</td>
<td>Credit</td>
<td>Maria</td>
</tr>
<tr>
<td>9</td>
<td>null</td>
<td>1</td>
<td>Credit</td>
<td>Kathy</td>
</tr>
<tr>
<td>18</td>
<td>null</td>
<td>7</td>
<td>Cash</td>
<td>Vijay</td>
</tr>
</tbody>
</table>

**Union (with columns that have been merged)**

<table>
<thead>
<tr>
<th>Day</th>
<th>Purchases</th>
<th>Type</th>
<th>Customer, Cust.</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
<td>Credit</td>
<td>Lane</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>Credit</td>
<td>Chris</td>
</tr>
<tr>
<td>28</td>
<td>1</td>
<td>Credit</td>
<td>Juan</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>Credit</td>
<td>Lisa</td>
</tr>
<tr>
<td>28</td>
<td>4</td>
<td>Cash</td>
<td>Isaac</td>
</tr>
<tr>
<td>28</td>
<td>2</td>
<td>Credit</td>
<td>Sam</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Credit</td>
<td>Mario</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
<td>Cash</td>
<td>Wei</td>
</tr>
<tr>
<td>21</td>
<td>7</td>
<td>Cash</td>
<td>Jim</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>Credit</td>
<td>Maria</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Credit</td>
<td>Kathy</td>
</tr>
<tr>
<td>18</td>
<td>7</td>
<td>Cash</td>
<td>Vijay</td>
</tr>
</tbody>
</table>

After you merge fields, you can use the field generated from the merge in a pivot or split, or use the field as a join key. You can also change the data type of the field generated from a merge.
To merge mismatched fields

1. Select two or more columns in the grid.
2. Click the column drop-down arrow, and then select **Merge mismatched fields**.

To remove a merge

- Click the column drop-down arrow of the merged field and select **Remove merge**.

At a glance: Working with unions

- A unioned table can be used in a join.
- A unioned table can be used in a join with another unioned table.
- The fields generated by a union, **Sheet name** and **Table name**, can be used as the join key.
- If a named range is used in union, null values display under the **Sheet name** field.
- The field generated from a merge can be used in a pivot or split.
- The field generated from a merge can be used as a join key.
- The data type of the field generated from a merge can be changed.
- Union tables from within the same connection. That is, you cannot union tables from different databases.

Connect to a Custom SQL Query

For most relational data sources you can connect to a specific query rather than the entire data source. Often this can be useful when you know exactly the information you need and you understand how to write SQL queries.

**Note:** For Excel and text file data sources, this option is available only in workbooks that were created before Tableau Desktop 8.2 or when using Tableau Desktop on Windows with the legacy connection. To connect to Excel or text files using the legacy connection, connect to the file, and in the Open dialog box, click the **Open** drop-down menu, and then select **Open with Legacy Connection**.

To connect to a custom SQL query

1. After connecting to your data, double-click the **New Custom SQL** option on the Data Source page.
2. Type or paste the query into the text box.

3. When finished, click OK.

When you finish the connection, only the relevant fields display in the Data pane.

If your SQL query references duplicate columns, you may get errors when trying to use one of the columns in Tableau. This will happen even if the query is valid. For example, consider the following query:

```
SELECT * from authors, titleauthor where authors.au_id = titleauthor.au_id
```

The query is valid, but the au_id field is ambiguous because it exists in both the “authors” table and the “titleauthor” table. Tableau will connect to the query but you will get an error anytime you try to use the au_id field. That’s because Tableau doesn’t know which table you are referring to.
To edit a custom SQL query

1. On the data source page, in the canvas, hover over the custom SQL table until the edit button displays.
2. Click the edit button.
3. In the dialog box, edit the custom SQL query.

Using Parameters in a Custom SQL Query

You can use parameters in a custom SQL query statement to replace a constant value with a dynamic value. You can then update the parameter in the workbook to modify the connection. For example, you may connect to a custom SQL query that provides web traffic data for a particular page that is specified by a pageID. Instead of using a constant value for the pageID value in the SQL query, you can insert a parameter. Then after finishing the connection, you can show a parameter control in the workbook. Use the parameter control to switch out the pageID and pull in data for each page of interest without having to edit or duplicate the connection.

You can create a parameter directly from the Custom SQL dialog box or use any parameters that are part of the workbook. If you create a new parameter, it becomes available for use in the workbook just like any other parameter. See Parameters on page 917 to learn more.

To add a parameter to a custom SQL query

1. On the data source page, in the canvas, hover over the table until the edit icon displays, and then click the edit button.
2. At the bottom of the dialog box, click Insert Parameter.
3. Select a constant value in the SQL statement and then, from the Insert Parameter drop-down menu select the parameter you want to use instead. If you have not created a parameter yet, select Create a new parameter. Follow the instructions in Creating Parameters on page 917 to create a parameter.

**Note:** Parameters can only replace literal values. They cannot replace expressions or identifiers such as table names.

The workbook in the example below connects to a Custom SQL query that returns all orders with that are marked as Urgent priority. In the SQL statement, the order priority is the constant value. If you want to change the connection to see the High priority orders, you would have to edit the data source.
Instead of creating and maintaining many variations of the same query, you can replace the constant order priority value with a parameter. The parameter should contain all of the possible values for Order Priority.

After you create a parameter, you can insert it into the SQL statement to replace the constant value.
After you finish editing the connection, the new parameter is listed in the Parameters area at the bottom of the Data pane and the parameter control displays on the right side of the view. As you select different values, the connection updates.
**Note:** If you are using an extract, you must refresh the extract in order to reflect changes to the parameter. Publishing a data source that uses Custom SQL parameters includes the parameters. The parameters are transferred to any workbooks that connect to the data source.

**Use a Stored Procedure**

A stored procedure is a subroutine available to applications that access a relational database system. When you connect to a SAP Sybase ASE, Microsoft SQL Server, or Teradata database with Tableau, you can use a stored procedure to define the connection.

For Oracle, you can use a table function to define the connection. Oracle table functions act similarly to stored procedures and are listed under **Stored Procedures** on the Data Source page.

When you create a data source using one of these data types, available procedures are listed under **Stored Procedures**, as shown in the Microsoft SQL Server example:
From the left pane, drag the procedure to the canvas or double-click one of the listed procedures. If parameters are available in the procedure, the Parameters dialog box automatically displays.

Instead of entering a value, you can use an existing Tableau parameter, or create a new Tableau parameter for the value:
If you then expose the Tableau parameter in the view, users are able to change the value of the parameter in the procedure interactively.

Notes on Stored Procedures

If you use stored procedures to define a data source for Tableau, keep the following in mind:

- If a stored procedure returns more than one result set, Tableau reads the first one and ignores the rest.
- If a stored procedure has output parameters, Tableau filters out the stored procedure.
- Stored procedures that have parameters of a non-scalar type are excluded.
- Result set columns that don’t have matching types in Tableau (such as varbinary, geometry, and hierarchyid) are logged. If all result set columns map to unknown data types, Tableau displays a message:
  
  "The result set... has no usable columns."

- Stored procedures that return no result sets are listed on the data source page but fail if selected.
- If no value is provided for a parameter that the stored procedure requires, an error occurs. Tableau cannot determine in advance whether parameters are required.
- Tableau does not perform any transaction management for stored procedures. That is, stored procedure writers must not depend on Tableau to start transactions before invoking stored procedures, or to commit them afterward.
- Column names must be unique for stored procedures to work. If two columns have the same name, or if no name is provided, the procedure can result in an error message:
  
  "InsertData: unbound column error"

- If there are multiple queries in a stored procedure (for example, to read values from another table or to hold temporary combinations) each of the queries must return the
same sets of columns in the same order (same names and data types). To ensure that column order and names match in the query results, you may need to explicitly \texttt{CAST} to ensure the data type is correct, for example \texttt{CAST(Username as VARCHAR(20))}, and explicitly name the columns. If a stored procedure does not follow these guidelines, an error message can result:

"InsertData: unbound column error"

- If there are multiple queries in a stored procedure (for example, to read values from another table or to hold temporary combinations) and the procedure is generating an error, try adding \texttt{SET NOCOUNT ON} to the top of the procedure. This prevents the message which shows the count of number of rows affected by a Transact-SQL statement from being returned as part of the result set for a query.

In addition, the following constraints apply for specific databases.

**Stored Procedure Constraints for Teradata Databases**

The following constraints apply for stored procedures on Teradata databases.

- Values must be provided for every parameter. If the user does not provide a value for one or more parameters, Tableau displays a Teradata database error stating there are too few values provided for the stored procedure.

**Stored Procedure Constraints for SQL Server Databases**

The following constraints apply for stored procedures on SQL Server databases.

- If the result set for a stored procedure contains columns of type \texttt{IMAGE} or \texttt{TEXT}, the stored procedure will fail with an "Incorrect syntax" error message.

- If the total width of the result set (number of bytes in each row) exceeds 8060, the stored procedure fails. This can occur with very wide tables (hundreds of columns) or with tables having large text columns, intended to hold thousands of characters of text.

- Tableau does not display stored procedures from schema "sys".

- If the user does not provide a value for one or more parameters that the procedure requires, Tableau displays a SQL Server database error in the form "The procedure requires a value for parameter @x but one was not provided."

- Stored procedures that contain multiple queries should follow the guidelines listed in Notes on Stored Procedures (above).

- Tableau Desktop does not support the Microsoft SQL Server \texttt{TIME} data type. When fields of this type are included in a stored procedure on a Microsoft SQL Server database Tableau Desktop will not import them.
**Stored Procedure Constraints for SAP Sybase ASE Databases**

The following constraints apply for stored procedures on SAP Sybase ASE databases (Windows only).

- The database must have a properly configured remote server.
- If the user does not provide a value for one or more parameters that the procedure requires, Tableau displays a Sybase ASE database error in the form "The procedure requires a value for parameter @x but one was not provided."

**Pivot Data from Columns to Rows**

You can pivot the data in your Microsoft Excel, text file, and Google Sheets data sources from crosstab format into columnar format to more easily perform analysis.

Or, if you are not working with the types of data listed, you can use custom SQL as an alternative way to pivot your data in Tableau.

**Pivot Excel, text, and Google Sheets data**

For example, suppose your data source contains sales values by year:

<table>
<thead>
<tr>
<th>Region</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>500</td>
<td>450</td>
<td>150</td>
</tr>
<tr>
<td>East</td>
<td>150</td>
<td>300</td>
<td>225</td>
</tr>
<tr>
<td>South</td>
<td>325</td>
<td>300</td>
<td>375</td>
</tr>
<tr>
<td>West</td>
<td>200</td>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>Central</td>
<td>300</td>
<td>200</td>
<td>250</td>
</tr>
</tbody>
</table>

The following image shows the example data source in the grid (left) and a view that you can create with the example data source (right).
Although you see a breakdown of sales by year, suppose you want to show all sales values by year, irrespective of region. To do this with the example data source, use pivot to change the format of the existing fields so that all year values are contained in one field, and all sales values are contained in another.

The following image shows the example data source in the grid after using pivot (left) and a view that you can create with the pivot fields (right).
To pivot fields

1. On the data source page, in the grid, select two or more fields to pivot.
2. Click the drop-down arrow next to the field name, and then select Pivot.

<table>
<thead>
<tr>
<th>Region</th>
<th>Sheet1 2014</th>
<th>Sheet1 2015</th>
<th>Sheet1 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>500</td>
<td>450</td>
<td>1</td>
</tr>
<tr>
<td>South</td>
<td>150</td>
<td>300</td>
<td>2</td>
</tr>
<tr>
<td>East</td>
<td>325</td>
<td>300</td>
<td>3</td>
</tr>
<tr>
<td>West</td>
<td>200</td>
<td>200</td>
<td>1</td>
</tr>
<tr>
<td>Central</td>
<td>300</td>
<td>200</td>
<td>250</td>
</tr>
</tbody>
</table>

The original fields in the data source are replaced with new fields called “Pivot field names” and “Pivot field values.” You can always rename the new pivot fields. If you decide that using pivot does not help, you can undo the changes or remove the pivot. Alternatively, you can change the data type of the pivot field to adjust how the data is interpreted.

To add more fields to a pivot

1. On the data source page, in the grid, click the drop-down arrow next to the field name.
2. Select Add Data to Pivot.

To remove a pivot

1. On the data source page, in the grid, click the drop-down arrow next to the field name.
2. Select Remove Pivot. All new pivot fields are removed and the original fields are restored.

At a glance: Working with pivots

- The Pivot option is available from the grid and metadata grid.
- All fields in the pivot must be from the same connection.
- Only one pivot is allowed per data source.
- Pivot fields can be used as the join key.
- The Pivot option cannot be used in calculated fields.
Troubleshooting pivots

- Red fields in the view and fields with exclamation points in the Data pane:
  Because the original fields are replaced with new pivot fields, any references to the
  original fields in the view will no longer work. They cause fields to become red in the view
  or show a red exclamation point next to the field in the Data pane.

- Null values in the grid: If all of the original fields used in the pivot are removed, for
  example in an extract refresh, null values display in the pivot fields.

Pivot using custom SQL

You can also use custom SQL to pivot your data. When you use the UNION ALL operator in a
custom SQL query, you can take values from distinct columns and put them into a new column.

For example, suppose you have a table called Contest.

Contest

<table>
<thead>
<tr>
<th>Runner</th>
<th>Start Time</th>
<th>End Time</th>
</tr>
</thead>
</table>

To optimize your analysis of this data in Tableau, you can use the following custom SQL query
to pivot the "Start Time" and "End Time" columns so that their values are in a single column.

Select [Runner],
  'Start' as [Action],
  [Start Time] as [Time]
From [Contest]
Union ALL
Select [Runner],
  'End' as [Action],
  [End Time] as [Time]
From [Contest]

The above custom SQL query does the following:
• Pivots the Start Time column header into a string value called Start and adds that value to a new column called Action.
• Pivots the End Time column header into a string value called End and adds that value to a new column called Action.
• Pivots the Start Time and End Time columns so that their values are in a new column called Time.

The following table shows the results of this custom SQL query.

<table>
<thead>
<tr>
<th>Runner</th>
<th>Action</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amanda</td>
<td>Start</td>
<td>9/3/2016 3:04 PM</td>
</tr>
<tr>
<td>Oscar</td>
<td>Start</td>
<td>9/3/2016 3:04 PM</td>
</tr>
<tr>
<td>William</td>
<td>Start</td>
<td>9/3/2016 3:04 PM</td>
</tr>
<tr>
<td>Amanda</td>
<td>End</td>
<td>9/3/2016 3:25 PM</td>
</tr>
<tr>
<td>Oscar</td>
<td>End</td>
<td>9/3/2016 3:21 PM</td>
</tr>
<tr>
<td>William</td>
<td>End</td>
<td>9/3/2016 3:16 PM</td>
</tr>
</tbody>
</table>

To pivot data using custom SQL

1. Connect to your data.
2. Double-click the New Custom SQL option in the left pane. For more information, see Connect to a Custom SQL Query on page 389.
3. In the Edit Custom SQL dialog box, copy and paste the following custom SQL query and replace the contents with information about your table:

   Select [Static Column]
   , 'New Value (from Column Header 1)' as [New Column Header]
   , [Pivot Column Values 1] as [New Values]
   From [Table]
   Union ALL
   Select [Static Column]
   , 'New Value (from Column Header 2)' as [New Column Header]
   , [Pivot Column Values 2] as [New Values]
From [Table] Union ALL

Select [Static Column]

, 'New Value (from Column Header 3) as [New Column Header]

, [Pivot Column Values 3] as [New Values]

From [Table]

Where the following is true:

- **Static Column**: A comma-delimited list of the columns from Table, both dimensions and measures, which should not be included in the pivot.

- **New Value (from Column Header 1-3)**: New names that you give to the original column headers, which are used as row values in the pivot.

- **Pivot Column Values 1-3**: The columns whose values need to be pivoted into a single column.

- **New Column Header**: The name you give the new column that contains the new row values from New Value (from Column Header 1-3).

- **New Values**: The name give the new column that contains the original values from Pivot Column Values 1-3.

- **Table**: The table that you connected to.

4. Click **OK**.

**Split a Field into Multiple Fields**

If you have string fields in your data that contain multiple units of information, for example, the first and last name of a customer, it might be easier to analyze the data if you split the values in that field into separate fields. You can use split or custom split options in Tableau to separate the values based on a separator or a repeated pattern of values present in each row of the field. In this example, the common separator is a space character ( ).
The new fields created by the split or custom split are added to the data source as calculated fields.

Splits and custom splits are based on the SPLIT string function. For more information, see String Functions on page 1369.

You can tell if your data supports the SPLIT function by checking the field drop-down menu:

- On the data source page, check the menu for **Split** and **Custom Split**.
- On the Data pane in the worksheet, check the menu for **Transform > Split** and **Custom Split**.

Because different connection types support different functionality in Tableau, you may need to check both places to determine if your data supports the split and custom split options.

**Split fields automatically**

A string field can be split automatically based on a common separator that Tableau detects in the field.

Depending on the connection type, a split can automatically separate a field’s values in up to ten new fields. The data type of the new fields generated by the split can vary depending on the pattern combination that Tableau detects in the separator that is used to split the original field.

**Note:** In some cases, if the split takes too long to generate new fields or Tableau cannot find a common separator, a custom split dialog box displays. For more information, see the Custom split on page 406 section.
To split a field automatically

1. On the Data Source page, in the grid, click the drop-down arrow next to the field name.
2. Select **Split**.

![Field dropdown menu with options](image)

**Note:** You can also use the split option from the Data pane in the worksheet. In the Data pane, right-click the field you want to split, and then select **Transform > Split**.

If you do not like the results of the split, you can go to the Data pane and edit the calculated fields that are created by the split. Alternatively, you can click undo in the Tableau Desktop toolbar or remove the split.

To remove fields created by a split

1. On the Data Source page, in the grid, click the drop-down arrow next to the field name.
2. Select **Delete**.
3. Repeat steps 1-2 to remove all the fields created by the split.

Alternatives to automatic split

Sometimes, using automatic split is not the best option. The following are example of cases when you should not split fields automatically:

- **Values contain different number of separators:** Fields cannot be split automatically if the number of separators varies from value to value. For example, suppose a field has the following values:
jsmith | accounting | north
dnguyen | humanresources
lscott | recruiting | west
karnold | recruiting | west

In cases like this, consider using a custom split. For more information, see the Custom split below section.

- **Values contain mixed separators**: Fields cannot be split automatically if the separator types are different. For example, suppose a field contains the following values:
  
smith.accounting
dnguyen-humanresources
lscott_recruiting
karnold_recruiting

  In cases like this, consider using regular expressions to create new fields. For more information, see Additional Functions on page 1409.

**Custom split**

You can use the custom split option to specify a common separator for the split. Like the split option, a custom split can separate a field’s values in up to ten new fields. In addition, you can choose to split the values at the first n occurrences of the separator, the last n occurrences of the separator, or at all occurrences of the separator. The data type of the new fields generated by the custom split always results in a string data type.

**To use a custom split**

1. On the Data Source page, in the grid, click the drop-down arrow next to the field name.
2. Select Custom Split.
Note: You can also access the custom split option from the Data pane. In the Data pane, right-click the field you want to split, and then select Transform > Custom Split.

If you do not like the results of the split, you can go to the Data pane and edit the calculated fields that are created by the split. Alternatively, you can click undo in the toolbar or remove the split.

To remove fields created by a custom split
1. On the Data Source page, in the grid, click the drop-down arrow next to the field name.
2. Select Delete.
3. Repeat steps 1-2 to remove all the fields created by the custom split.

At a glance: Working with splits and custom splits
The following is a list of additional notes you might need to know about splits and custom splits.

- New fields generated from a split or custom split cannot be used as keys to join tables, but can be used to blend data sources.
- New fields generated from a split or custom split cannot be used in a pivot.
- Split and custom split options are not supported for sets, groups, parameters, and bins.
- Microsoft SQL Server only allows up to four split fields.
- To generate more than ten new fields, consider using a split or custom split on the field that was previously generated by a split or custom split.
Troubleshooting splits and custom splits

The following is a list of issues you might experience when using splits and custom splits:

- **Split and custom split options missing for a supported data source type:** Split and custom split options are available only for fields that are a string data type.

- **Null values or empty cells:** After creating a split or a custom split, new fields might contain null values or no values at all. Null values or empty cells occur when there are no values for all of the expected new fields.

- **Data has been removed:** Tableau might use portions of the field’s values as a separator. If a portion of a field’s values is used as a separator, those values no longer appear in the new fields. For example, suppose a field contains the following values:
  
  ZIP-98102  
  ZIP-98109  
  ZIP-98119  
  ZIP-98195

  In this case, the split will create a new field with the following values:
  
  98102  
  98109  
  98119  
  98195

  The split will not create a separate field for “ZIP-“ because the split uses it as a separator.

Filter Data from Data Sources

You can create filters on a data source, thereby reducing the amount of data in the data source.

If you create an extract from a data source that already has data source filters in place, those filters are automatically recommended as extract filters, and will appear in the Extract dialog. Those recommended filters are not required to be part of the Extract filter list, and can safely be removed without affecting the existing set of data source filters.

Data source filters can be useful for restricting the data users can see when you publish a workbook or data source. When you publish a data source to Tableau Server, the data source and any associated files or extracts are transported in entirety to the Server. As you publish a data source you can define access permissions for downloading or modifying the data source, and you can also choose the users and groups who can remotely issue queries through
Tableau Server against that data source. When users have query permission and no download permission, you can share a rich data model having calculated fields, aliases, groups, sets and more—but only for querying.

Furthermore, users who query published data source will never be able to see or modify any data source filters present on the originally published data source, but all of the users’ queries will be subject to those data source filters. This is a great way to offer a restricted subset of your data, for example by filtering dimensions for specific users and groups, or by defining data source filters based on a fixed or relative date range. This is often useful for data security, and it also allows you to manage performance of the remote database which Tableau Server will ultimately query on a user’s behalf. For systems that rely heavily on partitions or indexing, data source filters may yield tremendous control over the performance of queries issued by Tableau.

Create a data source filter

The primary way to create a data source filter is from the data source page.

To create a data source filter

1. On the data source page, click Add in the Filters section in the upper-right corner of the page.

To create a data source filter on a worksheet, right-click (control-click on a Mac) the data source and choose Edit Data Source Filters.

Whether you start from the Data Source page or from a worksheet, you see an Edit Data Source Filter dialog box, listing any existing data source filters.

2. Click Add to open an Add Filter dialog box listing all fields in the data source.

3. Click to select a field to filter; then specify how the field should be filtered, just as you would for a field on the Filters shelf.

To add an additional data source filter, repeat this procedure.

Extract Your Data

Extracts are saved subsets of a data source that you can use to improve performance or to take advantage of Tableau functionality that is not available in the underlying data. When you extract your data to create an extract, you can reduce the total amount of data by defining filters and
limits. After you create an extract you can refresh it with data from the original data. When refreshing the data, you have the option to either fully refresh the data, which replaces all of the extract contents, or you can incrementally refresh the extract, which only adds rows that are new since the previous refresh.

Extracts can:

- Improve performance. For file based data sources such as Excel or Access, a full extract takes advantage of the Tableau data engine. For large data sources, a filtered extract can limit the load on the server when you only need a subset of data.
- Take advantage of Tableau functionality that is not available in the original data source, such as the ability to compute Count Distinct.
- Provide offline access to your data. If your data source is not available (for example, because you are traveling), you can extract the data to a local data source.

**To create an extract**

1. On the Data Source page, select a data source on the Data menu and then select Extract Data to open the Extract Data dialog box.

2. Optionally define filters to limit the data that will be extracted. Any fields that are hidden in the Data pane will be automatically excluded from the extract. Click the Hide All Unused Fields button to quickly remove them from the extract.

   To add filters, click the Add button under the Filters list.
3. Specify whether to **Aggregate data for visible dimensions**. When you select this option the measures are aggregated using their default aggregation. Aggregating the data can minimize the size of the extract file and increase performance.

When you choose to aggregate the data you can also choose to **Roll up dates** to a specified date level such as Year, Month, etc.

![Aggregation Options](image)

The examples below show how the data will be extracted for each aggregation option.

<table>
<thead>
<tr>
<th>Original Data</th>
<th>Aggregate Data (no roll up)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Date</td>
<td>Region</td>
<td>Sales</td>
</tr>
<tr>
<td>2</td>
<td>1/1/2009</td>
<td>South</td>
<td>$500</td>
</tr>
<tr>
<td>3</td>
<td>1/1/2009</td>
<td>West</td>
<td>$200</td>
</tr>
<tr>
<td>4</td>
<td>1/1/2009</td>
<td>West</td>
<td>$100</td>
</tr>
<tr>
<td>5</td>
<td>1/1/2009</td>
<td>East</td>
<td>$300</td>
</tr>
<tr>
<td>6</td>
<td>1/2/2009</td>
<td>South</td>
<td>$600</td>
</tr>
<tr>
<td>7</td>
<td>1/2/2009</td>
<td>South</td>
<td>$400</td>
</tr>
<tr>
<td>8</td>
<td>1/2/2009</td>
<td>East</td>
<td>$100</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Each record is shown as a separate row. There are 7 rows in the data source.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Date</td>
<td>Region</td>
<td>Sales</td>
</tr>
<tr>
<td>2</td>
<td>1/1/2009</td>
<td>East</td>
<td>$300</td>
</tr>
<tr>
<td>3</td>
<td>1/1/2009</td>
<td>South</td>
<td>$500</td>
</tr>
<tr>
<td>4</td>
<td>1/1/2009</td>
<td>West</td>
<td>$300</td>
</tr>
<tr>
<td>5</td>
<td>1/2/2009</td>
<td>East</td>
<td>$100</td>
</tr>
<tr>
<td>6</td>
<td>1/2/2009</td>
<td>South</td>
<td>$1,000</td>
</tr>
</tbody>
</table>

Records with the same date and region have been aggregated into a single row. There are 5 rows in the data source.
4. Select the number of rows you want to extract. You can extract all or the top N rows. Tableau first applies any filters and aggregation and then extracts the number of rows from the filtered and aggregated results. The number of rows options depend on the type of data source you are extracting from. For example, not all data sources support sampling so that option is not always available.

5. When finished, click Extract.

6. In the subsequent dialog box, select a location to save the extract into and give the file a name. Then click Save.

   Note: If the Save dialog does not display, see the Troubleshooting extracts section, below.

**Troubleshooting extracts**

- **Creating an extract takes a long time**: Depending on the size of your data set, extracting the data can take a long time. However, after you have extracted the data and saved it to your computer, performance will improve.

- **Extract is not created**: If your data set contains a really large number of columns (e.g., in the thousands), in some cases Tableau might not be able to create the extract. If you encounter problems, consider extracting fewer columns or restructuring the underlying data.

- **Save dialog does not display or extract is not created from a .twbx**: If you follow
the above procedure to extract data from a packaged workbook, the Save dialog does not display. When an extract is created from a packaged workbook (.twbx), the extract file is automatically stored in the package of files associated with the packaged workbook. To access the extract file that you created from the packaged workbook, you must unpack the workbook. For more information, see Packaged Workbooks on page 1144 to unpack the packaged workbook.

**Use Extracts**

After you create an extract, the current workbook begins using the extract. However, the extract connection is not saved with the workbook until the next time you save. That means, if you close the workbook without saving first, the workbook will connect to the original data source the next time you open it.

You may want to create an extract with a sample of the data so you can set up the view and then switch to the whole data source, thus avoiding long queries every time you place a field on the shelf. You can toggle between using the extract and using the entire data source by selecting a data source on the Data menu and then selecting **Use Extract**.

You can remove an extract at anytime by selecting a data source on the Data menu and then selecting **Extract > Remove**. When you remove an extract you can choose to Remove the extract from the workbook only or Remove and delete the extract file, which will delete the extract from your hard drive.

You can see when the extract was last updated and other details by selecting a data source on the Data menu and then selecting **Extract > History**.

![Extract History](image)

If you open a workbook that was saved with an extract and the relevant extract file (.tde) is missing, Tableau prompts you for what to do next:
The options are:

- **Locate the extract**
  Select this option if the extract exists but not in the location where Tableau originally saved it. Click **OK** to open an Open File dialog box where you can specify the new location for the extract file.

- **Remove the extract**
  Select this option if you have no further need for the extract. This is equivalent to closing the data source. All open worksheets that reference the data source are deleted.

- **Deactivate the extract**
  Use the original data source from which the extract was created, instead of the extract.

- **Regenerate the extract**
  Recreates the extract. All filters and other customizations you specified when you originally created the extract are automatically applied.

**Refresh Extracts**

When the underlying data changes, you can refresh the extract by selecting a data source on the **Data** menu and then selecting **Extract > Refresh**. Extracts can be configured to be fully refreshed, replacing all of the data with what’s in the underlying data source, or incrementally refreshed, adding just the new rows since the last refresh.
Full Refresh

By default, extracts are fully refreshed. That means that every time you refresh the extract, all of the rows are replaced with the data in the underlying data source. While this kind of refresh ensures you have an exact copy of what is in the underlying data source, it can sometimes take a long time and be expensive on the database depending on how big the extract is.

If the extract is not set up for incremental extract, selecting to refresh the extract will fully refresh the extract. If you’re publishing the data source to Tableau Server, you can specify the type of refresh in the Scheduling & Passwords dialog box. Most data sources support an incremental refresh.

Incremental Refresh

Rather than refreshing the entire extract, you can set it up to only add the rows that are new since the last time you extracted data. For example, you may have a data source that is updated daily with new sales transactions. Rather than rebuild the entire extract each day, you can just add the new transactions that occurred that day. Then once a week you may want to do a full refresh just to be sure you have the most up to date data.

Follow the steps below to set up an extract to be incrementally refreshed.

1. Select a data source on the Data menu and then select Extract.
2. In the Extract Data dialog box, select All rows as the number of Rows to extract. Incremental refresh can only be defined when you are extracting all rows in the database. You cannot increment a sample extract.
3. Select Incremental refresh and then specify a column in the database that will be used to identify new rows. For example, if you select a Date field, refreshing will add all rows whose date is after that last time you refreshed. Alternatively, you can use an ID column that increases as rows are added to the database.

Note: Tableau Data Engine stores time values with a precision of up to 3 decimal places. If you specify a datetime or timestamp column for Identify new rows using column, and your database uses a higher precision than Tableau, you can
end up with duplicate rows after an incremental refresh. For example, if the database has two rows, one with a datetime value of 2015-03-13 17:30:56.502352 and one with a datetime value of 2015-03-13 17:30:56.502852, Tableau will store both rows using a datetime value of 2015-03-13 17:30:56.502 thereby creating duplicate rows.

4. When finished, click **Extract**.

The steps above can be used to define a new extract or configure an existing extract for incremental refresh. If you are editing an existing extract, the last refresh is shown so you can be sure you are updating the extract with the correct data.

If you publish the data source to Tableau Server you can specify a schedule for incremental refresh as well as full refresh in the Schedules & Passwords dialog box.

**Extract History**

You can see a history of when the extract was refreshed by selecting a data source on the **Data** menu and then select **Extract > History**.

The Extract History dialog box shows the date and time for each refresh, whether it was full or incremental, and the number of rows that were added. If the refresh was from a file, it also shows the source file name.

![Extract History dialog box](image)

**Add Data to Extracts**

There are two ways you can add new data to an extract: from a file or from a data source. However, to add new data, you must connect to your data and create a new data source, and the columns in the file or data source must match the columns in the extract.
Add data from a file

You can add new data to an extract from a file-based data source. Use this option when the file type of the extract is the same as the file type of the data that you want to add. Alternatively, you can add data from a Tableau data extract (.tde) file. For example, you may have text files that are generated for a task that is performed every day. To add each day's worth of information to your extract whose original data source is also a text file, use the Append Data from File command.

To add data from a file

1. On the Data menu, select a data source, and then select Extract > Append Data from File.
2. Browse to and select the file that has the new data.
   
   **Note:** By default, the file format of the extract's original data source is used. To add data from a Tableau data extract, click the file format drop-down list, and then select Tableau Data Extract (*.tde).
3. When finished, click OK.

Add data from a data source

You can also add new data to an extract from another data source that's already open in the workbook. Use this option when the data from the data source that you want to add matches the extract data source before it was extracted. For example, you created an extract from a SQL Server database that has the past ten years worth of data. However, the maintained version of that data is stored on a different SQL Server database. You can add new data to the extract by using the Append Data from Data Source command.

**Note:** Joins or custom SQL should be specified in the data source before adding data to the extract.

To add data from a data source

1. On the Data menu, select a data source, and then select Extract > Append Data from Data Source.
2. In the dialog box, select the data source that you want to append.
3. When finished, click OK.

Using either option will add new rows to the extract. To see a summary of the number of rows that were added, select a data source on the Data menu and then select Extract > History.
Note: When you refresh this extract, the data will be replaced with the data from the original data source.

Optimize Extracts

To improve performance when working with extracts you can optimize the extract. Optimizing an extract creates secondary structure in the extract that speed up future queries.

Optimize the extract by selecting a data source on the Data menu and then selecting Extract > Optimize.

The following types of optimizations are made:

Materialized Calculated Fields

Calculated fields are computed in advance and stored in the extract. In future queries, Tableau can look up the already computed value rather than running the computation again. The following types of calculated fields ARE NOT materialized:

- Calculations that use unstable functions such as NOW() and TODAY()
- Calculations that use external functions such as RAWSQL and R
- Table calculations

In addition, if the formula for a materialized calculation changes or the calculation is deleted from the data source, the materialized calculation is dropped from the extract until the extract is optimized again.

Acceleration Views

When a workbook contains filters that are set to show only relevant values, computing the available values for that filter can be an expensive query. For these filters, Tableau must evaluate the other filters in the workbook first and then compute the relevant values based on their filter selections. To speed up these queries, a view can be created that computes the possible filter values and caches them for faster lookup later.

Update Server Data Sources that Are Using Extracts

You have the following options for updating data sources that are using extracts that have been published to Tableau Server or Tableau Online:

- You can add the data source or a workbook that connects to it to a refresh schedule in Tableau Server or Tableau Online (cloud-based data sources only).
- You can update the data source in Tableau Desktop and then republish it.
- You can add to or refresh the data source on Tableau Server or Tableau Online, from Tableau Desktop, without first adding to or refreshing the extract in Tableau Desktop.

The remainder of this topic describes the third option.
Update Server Extracts From Tableau Desktop

Before you attempt to update a data source on Tableau Server or Tableau Online that is using an extract, verify that Tableau Desktop is connected to the published data source on Tableau Server, as indicated by the Tableau Server icon next to the data source name in the Data pane:

![Data and Analytics pane](image)

To update the server data source, right-click (control-click on a Mac) the data source in the Tableau Desktop Data pane, select **Tableau Data Server**, and choose one of the following options:

- **Edit Server and Site Path**
  If you have changed the location of the data source in Tableau Server or Tableau Online, choose this option to point Tableau Desktop to the new, correct location.

- **Refresh from Source**
  Refreshes the extract (full or incremental) using the data in the original data source. This command is available only for extracts that include a connection to the original data source. If you connected directly to a Tableau Data Extract file (.tde) and then published it, the connection to the original data source is not included and this option is therefore unavailable.

- **Append from Data Source**
  Updates the extract from another open (and compatible) data source. If you connected directly to a Tableau Data Extract file (.tde) and then published it, the connection to the original data source is not included and this option is therefore unavailable.

**Note:** If you see the Tableau Data Server option, but the commands in the submenu are unavailable, the data source exists on the server, but is not an extract.

It is also possible to update an extract on Tableau Server using a command-line utility. See **Tableau Data Extract Command-Line Utility** below.

**Tableau Data Extract Command-Line Utility**

You can automate extract refresh tasks using the Tableau Data Extract Utility. This is a command-line utility that comes with Tableau Desktop, through which you can refresh
published data sources or append data to them from a file.

**Note:** The Tableau Data Extract Utility is available only with Tableau Desktop on Windows.

**Run the utility**

1. Open the Command Prompt as an administrator and change to the Tableau Desktop bin directory. For example:
   ```
   cd C:\Program Files\Tableau\Tableau 10.0\bin
   ```

2. Use either of the following commands, adding parameters described in the tables below.
   - `tableau refreshextract`
   - `tableau addfiletoextract`

**Note:** When using the utility, always specify `tableau` on the command line or in scripts, never `tableau.exe`.

**Syntax and parameters for the `tableau refreshextract` command**

Use `tableau refreshextract` to refresh an extract on Tableau Server or Tableau Online. Refreshing an extract updates an existing extract with any modifications that have been made to the data source since the last refresh.

To see help for this command, at the Windows command prompt, type the following command:

```
tableau refreshextract --help
```

**Using parameters**

- All options have a full form that you use with a double hyphen (for example, `--server`).
- Some options also have a short form that you use with a single hyphen (for example, `--s`).
- If the value for an option contains spaces, enclose it in quotation marks.

**tableau refreshextract command options**

<table>
<thead>
<tr>
<th>Short Form</th>
<th>Full Form</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>--source-username</code> &lt;user&gt;</td>
<td>A valid user name for the data source connection. Use this option with <code>--source-password</code>, or</td>
<td></td>
</tr>
<tr>
<td>Action</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td><strong>--source-password</strong> &quot;&lt;password&gt;&quot;</td>
<td>The password for the data source user.</td>
<td></td>
</tr>
<tr>
<td><strong>--original-file</strong> path and file name</td>
<td>Path and file name for the data source to be refreshed on the server. For example: <strong>--original-file</strong> c:\folder\file.csv. To refresh a multi-file data source, pass the path to a folder that contains the data files. For example: <strong>--original-file</strong> c:\folder. If the file is on a network share, use the UNC format for the path: \server\path\filename.csv.</td>
<td></td>
</tr>
<tr>
<td><strong>--force-full-refresh</strong></td>
<td>If the data source is set up for incremental refreshes, use this option to force a full extract refresh. If this option is not included, an incremental refresh is performed. Not all data sources support incremental refresh.</td>
<td></td>
</tr>
<tr>
<td><strong>-s</strong> &lt;server http address&gt;</td>
<td>The URL for the Tableau server on which the data is published. For Tableau Online, specify <a href="https://online.tableau.com">https://online.tableau.com</a>.</td>
<td></td>
</tr>
<tr>
<td><strong>--site</strong> &lt;siteid&gt;</td>
<td>In a multiple-site environment, specifies the site to which the command applies. For Tableau Online, specify <strong>--site</strong> &lt;siteid&gt;.</td>
<td></td>
</tr>
</tbody>
</table>
Online, use this argument if your user name is associated with more than one site. For Tableau Server, if you do not specify a site, the default site is assumed.

The site id is independent of the site name, and it is indicated in the URL when you view the site in a browser. For example, if the URL for the page you see after signing in to Tableau Online is

https://online.tableau.com/t/vernazza/views

the site id is *vernazza*.

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>--data-source &lt;data-source&gt;</code></td>
<td>The name of the data source, as published to Tableau Server or Tableau Online.</td>
</tr>
<tr>
<td><code>--project &lt;projectname&gt;</code></td>
<td>The project to which the data source belongs. If this option is not included, the default project is assumed.</td>
</tr>
<tr>
<td><code>-u &lt;username&gt;</code></td>
<td>Valid Tableau Server or Tableau Online user.</td>
</tr>
<tr>
<td><code>--password &quot;&lt;password&gt;&quot;</code></td>
<td>The password for the specified Tableau Server or Tableau Online user.</td>
</tr>
<tr>
<td><code>--proxy-username &lt;username&gt;</code></td>
<td>The user name for a proxy server.</td>
</tr>
<tr>
<td><code>--proxy-password &quot;&lt;password&gt;&quot;</code></td>
<td>The password for a proxy server.</td>
</tr>
<tr>
<td><code>-c &quot;&lt;path and filename&gt;&quot;</code></td>
<td>Path and file name information for a file containing configuration options for the command. Always enclose the path in double quotation marks. For more information, see <strong>Using a config file</strong> on page 426 below.</td>
</tr>
</tbody>
</table>
Sample tableau refreshextract command

The following command refreshes an extract named CurrentYrOverYrStats that has been published to Tableau Server on-premises. This command specifies the following:

- The name of your Tableau Server.
- Server user name and password.
- Project name.
- The name of the data source to refresh, along with the data source username and password.

```
C:\Program Files\Tableau\Tableau 10.0\bin>tableau
refreshextract --server https://our_server_name --username
OurServerSignIn --password "OurServerPwd" --project "New
Animations" --datasource "CurrentYrOverYrStats" --source-
username OurDatabaseSignIn --source-password
"OurDatabasePassword"
```

The following command refreshes an extract named CurrentYrOverYrStats that has been published to Tableau Online. This command specifies the following:

- Tableau Online user and password.
- Tableau Online site and project names.
- The data source, which in this case is hosted by a cloud-based data source provider (for example, Salesforce.com), and the username and password to sign in to the hosted data source.

```
C:\Program Files\Tableau\Tableau 10.0\bin>tableau
refreshextract --server https://online.tableau.com --
username email@domain.com --password "OurServerPwd" --site
vernazza --project "New Animations" --datasource
"CurrentYrOverYrStats" --source-username database_
user@hosted_datasource_provider.com --source-password "db_
password"
```

To refresh an extract of file-based data source, provide the path to the original file from which you created the extract. If the file is on a network share, use the UNC format instead of a mapped drive.

```
C:\Program Files\Tableau\Tableau 10.0\bin>tableau
refreshextract --server https://online.tableau.com --
username email@domain.com --password "OurServerPwd" --site
vernazza --project "New Animations" --datasource
```

- 423 -
"CurrentYrOverYrStats" --original-file "\server\path\filename.csv"

**Syntax for tableau addfiletoextract**

Use `tableau addfiletoextract` to append file content to an extract that has been published to Tableau Server or Tableau Online. This command combines the two files.

If you want simply to update an existing extract with the latest changes, use the `refreshextract` command instead. Using `addfiletoextract` to update an existing extract will duplicate data instead.

To see help for this command, at the Windows command prompt, type the following command:

```
tableau addfiletoextract --help
```

All options have a full form that you use with a double hyphen (for example, `--server`). Some options also have a short form that you use with a single hyphen (for example, `-s`). If the value for an option contains spaces, enclose it in quotation marks.

**tableau addfiletoextract command options**

<table>
<thead>
<tr>
<th>Short Form</th>
<th>Full Form</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-s</code></td>
<td><code>--server &lt;URL&gt;</code></td>
<td>The URL for the Tableau server on which the data is published. For Tableau Online, specify <code>https://online.tableau.com</code></td>
</tr>
<tr>
<td><code>-t</code></td>
<td><code>--site &lt;site id&gt;</code></td>
<td>In a multiple-site environment, specifies the site to which the command applies. For Tableau Online, you must include this argument if your user name is</td>
</tr>
</tbody>
</table>

Path and file name information for the data file containing data to append. The file can be from Excel, Access, a Tableau data extract, or a delimited text file. It cannot be password protected. Use UNC format if the file is on a network share. For example, `\server\path\filename.csv`
<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>--datasource &lt;data-source&gt;</td>
<td>The name of the data source, as published to Tableau Server or Tableau Online.</td>
</tr>
<tr>
<td>--project &lt;projectname&gt;</td>
<td>The project to which the data source belongs. If this option is not included, the default project is assumed.</td>
</tr>
<tr>
<td>-u &lt;username&gt;</td>
<td>Valid Tableau Server or Tableau Online user.</td>
</tr>
<tr>
<td>-p &quot;&lt;password&gt;&quot;</td>
<td>The password for the specified Tableau Server or Tableau Online user.</td>
</tr>
<tr>
<td>--proxy-username &lt;username&gt;</td>
<td>The user name for a proxy server.</td>
</tr>
<tr>
<td>--proxy-password &quot;&lt;password&gt;&quot;</td>
<td>The password for a proxy server.</td>
</tr>
<tr>
<td>-c &quot;&lt;path and filename&gt;&quot;</td>
<td>Path and file name information for a file containing configuration options for the command. Always enclose the path in double quotation marks. For more information, see Using a config file on the next page below.</td>
</tr>
</tbody>
</table>

Sample tableau addfiletoextract command

```
C:\Program Files\Tableau\Tableau 10.0\bin>tableau addfiletoextract --server https://our_server_name --username OurServerSignIn --password "OurServerPwd" --project "New Animations" --datasource "CurrentYrOverYrStats" --file "C:\Users\user1\Documents\DataUploadFiles\AprMay.csv"
```

```
C:\Program Files\Tableau\Tableau 10.0\bin>tableau addfiletoextract --server https://online.tableau.com --username email@domain.com --password "OurServerPwd" --site
```
Using a config file

You can use a plain text editor, such as Notepad or Text Edit, to create a config file (configuration) that you can use with `tableau refreshextract` or `tableau addfiletoextract`. A config file can be useful if you expect to update the same data source regularly over time. Instead of having to type the same options each time you run a command, you specify the config file. A config file also has the advantage of not exposing user names and passwords on the command line.

Create the config file

For example, say you created a file called `config.txt` and saved it to your `Documents` folder. And in the file, you included the parameter information shown below.

For an extract published to Tableau Server:

```
server=https://our_server_name
username=OurServerSignIn
password=OurServerPwd
project=New_Animations
datasource=CurrentYrOverYrStats
```

For an extract from a hosted data source, published to Tableau Online, where `server` is https://online.tableau.com:

```
server=https://online.tableau.com
username=email@domain.com
password=OurPassword
project=New_Animations
datasource=CurrentYrOverYrStats
source-username=database_user@hosted_datasource_provider.com
source-password=db_password
```

Reference the Config File from the Command Line

After you create the config file, you run the `tableau refreshextract` or `tableau addfiletoextract` command, pointing to the config file as the only option you use on the command line, and enclosing the config file’s path in double quotation marks. The syntax is as follows:

```
vernazza --project "New Animations" --datasource "CurrentYrOverYrStats" --file "C:\Users\user2\Documents\DataUploadFiles\AprMay.csv"
```
tableau refreshextract --config-file "<path>"

For example, to refresh the extract specified in the sample in the Create the config file on the previous page section, you would run the following command (making sure that you are working in the bin directory for your version of Tableau Desktop):

```
C:\Program Files\Tableau\Tableau 10.0\bin>tableau
refreshextract --config-file
"C:\Users\user1\Documents\config.txt"
```

Syntax Differences for Config Files

The syntax for specifying options inside a config file differs from the syntax you use on the command line in the following ways:

- Option names do not begin with dashes or hyphens.
- You use an equals sign (with no spaces) to separate option names from option values.
- Quotation marks are not necessary (or allowed) around values, even when they include spaces (as for the `project` option in the example shown earlier).

Use Windows Task Scheduler to Refresh Extracts

You can use Windows Task Scheduler, in combination with the Tableau Data Extract Command-Line Utility, to automate regular updates to Tableau Desktop data sources from within your corporate firewall. You can configure a task to occur once per day, week, or month, or after a specific system event. For example, run the task when the computer starts.

To learn more, see the Task Scheduler How To... page in the Microsoft TechNet library.

Tableau Data Extract API

Starting in Tableau 9.1, the Tableau Data Extract API is incorporated into the Tableau SDK. You can use the Tableau SDK to create an extract and publish it to Tableau Server. The SDK supports Windows, Linux, and the Mac, using C, C++, Java, and Python.

For more information, see the Tableau SDK documentation.
Manage Data Sources

The topics in this section describe the tasks you can perform after you have set up data sources.

Edit Data Sources

At anytime during your analysis you can edit the data source used in the workbook. You might want to edit the data source to:

- **Specify a new location for the data source.** For example, suppose the name or location of a data source you were using has changed and is no longer available using the previous connection information. In this case, you can direct the workbook to the correct location without losing your work.

- **Apply analyses created using one data source to another data source.** Suppose you create a workbook containing several views involving markets, products, sales, and profits and you want to apply the analyses to a new data source. Instead of recreating each view, you can edit the original data connection and specify a new data source.

- **Add and remove tables.**

- **Create custom SQL queries for supported data sources.**

- **Use stored procedures for supported data sources.**

To edit the data source

1. On the **Data** menu, select a data source, and then select **Edit Data Source**.
2. On the data source page, make the changes to the data source.

   For example, if you are using a **Microsoft Excel** data source, you can specify a new file by clicking the Excel file name under **Workbook**. Alternatively, you can select a different table to analyze.

Replace Field References

When you successfully connect to a new data source, all worksheets in the workbook that previously referred to the original data source now refer to the new data source. If the new data source does not have the same field names as the original workbook, the fields become invalid and are marked with an exclamation point ¡. You can quickly resolve the problem by replacing the field’s references.

For example, say you have a workbook connected to a data source that contains a Product Category field. Then you edit the data source to point to a new data source that has all the same data but instead of Product Category, the field name has been changed to Product Type.
The Product Category field remains in the Data pane but is marked as invalid. To make the field valid, you can replace the references, which means you can map the invalid field to a valid field in the new data source (for example, Product Category corresponds to Product Type).

To replace field references

1. Right-click (control-click on a Mac) the invalid field in the Data pane and then select Replace References.
2. In the Replace References dialog box, select a field from the new data source that corresponds to the invalid field.

Duplicate the Data Source

Sometimes you’ll want to make changes to a data source such as add more tables, hide and show fields, set field defaults, and so on. When you make these changes it affects all sheets that use the data source. You can duplicate the data source so that you can make the changes without affecting the existing sheets.

To duplicate a data source

- On the Data menu, select a data source, and then select Duplicate.

When you duplicate a data source, the duplicate source name has “(copy)” appended to the end.

Rename the Data Source

When you connect to a data source, you are given the option to give it a name for use in Tableau Desktop.

To rename the data source

- On the Data menu, select Rename.

Naming a connection is useful when you have a single workbook connected to many data sources. The name you assign can help you keep track of the specifics of the connection. You can also review the connection properties by selecting a data source on the Data menu, and then selecting Properties.

Refresh Data Sources

If the underlying data changes—for example, if new fields or rows are added, data values or field names are changed, or data is deleted, Tableau will reflect those changes the next time you connect to the data source. However, because Tableau Desktop queries the data and does not import the data, you can immediately update Tableau to reflect the data modifications without disconnecting, provided the changes have been saved in the underlying data first.
If you are connected to a data source that has been modified, you can immediately update Tableau Desktop with the changes by selecting a data source on the Data menu and then selecting Refresh.

If a field that is used in a Tableau worksheet is removed from the underlying data of the data source and then the data source is refreshed, a warning message displays indicating that the field will be removed from the view and the worksheet will not display correctly because of the missing field.

Replace Data Sources

There are times when you may want to update a workbook or sheet to use a different data source. Rather than rebuild your workbook using the new connection, you can replace the data source.

**Note:** When you publish a data source to Tableau Server or Tableau Online, the current workbook in Tableau Desktop will automatically connect to the published data source, and automatically close the local data source. So it is not necessary to replace the data source when you publish a data source.

You can only replace one data source with another when both data sources are relational data sources, or when both data sources are cube (multidimensional) data sources. In Tableau, cube data sources are supported only in Windows.

The two data sources do not have to be identical, however, any differences will affect the sheets in the workbook. Any fields, groups, sets, and calculated fields that don’t exist in the new data source (or have a different name) are removed from the Data pane. If these fields were used by any sheets in the workbook, they will remain in the Data pane but will be marked invalid. Additionally, you may see changes to custom sets, groups, and calculated fields that depend on the missing fields. For information about how to replace field references to correct invalid fields, see Edit Data Sources on page 428.

Replacing a data source does not merge or edit the data sources. Rather, replacing a data source simply redirects fields in the worksheet to map to corresponding fields in the new data source. To successfully replace a data source, any fields in the original data source (for example, calculated, groups, sets, and parameters), should also exist in the new data source. If not, then you may want to manually copy and paste these fields to the new data source before replacing the old one.

Follow the steps below to replace a data source:

1. Open a workbook that connects to the old data source.
2. Select Data > New Data Source and then connect to the new data source.
3. Select Data > Replace Data Source.
You will only be able to see the Replace Data Source command when you are on a worksheet tab—not when you are on the Data Source page. You will only be able to select it when there is at least one field in the view.

4. In the Replace Data Source dialog box, select the Current data source and the Replacement data source.

5. When finished, click OK.

All worksheets, dashboards, and stories that used the original data source are updated to use the new data source. Click Undo on the toolbar to revert the change and return to your original data source.

Export Data Sources

At any time while connected to a data source, you can export data source information as a shortcut that allows you to quickly connect to the data source in the future. You might want to do this if you often connect to the same data source multiple times or if you’ve added joined tables,
default properties, or custom fields, such as groups, sets, calculated fields, and binned fields, to the Data pane.

**Note:** You can also save custom fields by saving the workbook or by creating a bookmark file.

### Export Data Source in Tableau Desktop on Windows

You can export the data source on a Windows computer in either of the following two formats:

**Data Source (.tds)** - contains just the information you need to connect to the data sources such as data source type, location, and custom fields. If you connect to local file data sources (Excel, Access, text, extracts), the file path is stored in the data source file.

Data source files contain the following types of information:

- data source type
- data source connection information specified in the data source page (for example, server, port, location of local files, and tables)
- groups
- sets
- calculated fields
- bins
- default field properties (for example, number formats, aggregation, and sort order)

**Packaged Data Source (.tdsx)** - contains all the information in the Data Source (.tds) file as well as any local file data sources (Excel, Access, text, and extracts). This file type is a single zipped file and is good for sharing a data source with people who may not have access to the original data that is stored locally on your computer.

### Export Data Source in Tableau Desktop on a Mac

You can export the data source on a Mac computer in either of the following two formats:

**Data Source (.tds)** - contains just the information needed to connect to the data sources such as data source type, location, and custom fields. If you connect to local file data sources (Excel, text, and extracts), the file path is stored in the data source file.

Data source files contain the following types of information:

- data source type
- data source connection information specified in the data source page (for example, server, port, location of local files, and tables)
- groups
- sets
- calculated fields
- bins
- default field properties (for example, number formats, aggregation, and sort order)

**Packaged Data Source (.tdsx)** - contains all the information in the Data Source (.tds) file as well as any local file data sources (Excel, text, and extracts). This file type is a single zipped file and is good for sharing a data source with people who may not have access to the original data that is stored locally on your computer.

After you export, the data sources are available on the **Connect** pane.

By default, the data source files are stored in the Datasources folder of the Tableau Repository. Data source files stored in another location do not display on the **Connect** pane. You can connect to data source files by selecting **File > Open** and navigating to the file. You can also connect by dragging the data source file onto Tableau Desktop icon or onto the running application.

**Note:** If you move a local file data source that is referenced by a .tds file, you will be prompted to locate or replace the original data source when you try to open the data source file. To avoid saving a specific file path, save the data source as a TDSX file, which packages a copy of the original local file data source with the .tds file. If you choose to replace the original data source, the replacement data source must be of the same type (for example, Excel or MySQL) as the original.

**To export a data source**

1. On the **Data** menu, select a data source, and then select **Add to Saved Data Sources**.
2. Complete the **Add to Saved Data Sources** dialog box by specifying a file name and selecting the type of data source file.

The new .tds or .tdsx file is listed in the Saved data sources section of the **Connect** pane.
Upgrade Data Sources

If you have workbooks that were created before Tableau Desktop 8.2 and that use Microsoft Excel or text file data sources, or you are using the Excel or text file legacy connection, you have the option to upgrade the data sources in your workbook. By upgrading your Excel and text file data sources you can take advantage of better data interpretation and compatibility on the Mac.

After upgrading these data sources, there may be changes to your workbook. For example, you may notice some fields have turned red. Also, some field names, field types, or field values may have changed. Resolve these changes before saving the workbook. Once the workbook is saved, the changes cannot be undone. If you encounter any of these types of changes, see Resolving Data Source Upgrade Issues in the Tableau Knowledge Base for specific examples of these changes and how to resolve them.

In some cases, the data source cannot be upgraded and you see a message indicating which data sources could not be upgraded. In these cases, do not save the workbook. See Resolving Data Source Upgrade Issues in the Tableau Knowledge Base to review alternative options that will allow you to continue using the workbook even when the Excel and text file data sources cannot be upgraded. Alternatively, close and reopen the workbook without upgrading the data sources.

Close Data Sources

You can close a data source at any time. Doing so does not modify the data source. Instead, it disconnects Tableau from the data so that you can no longer query it. Additionally, the data source is cleared from the Data pane and all open worksheets associated with the data source are cleared. If you accidentally close a data source, use the Undo button to reopen. Close a data source by doing one of the following:

- Right-click (control-click on a Mac) the data source at the top of the Data pane and select Close.
• Select a data source on the **Data** menu and then select **Close**.
Building Data Views

This section discusses the basics of using Tableau to build views of your data. You will learn how to build views manually or automatically. The section concludes with a set of build-it-yourself exercises that show how you can create basic views and then enhance them to add more information and generate insight.

Dragging Fields

You can build views of your data by dragging fields from the Data pane to the view. You can drag fields to a variety of active areas in the view or place them on the shelves and cards that are part of every worksheet.

The Basics

When you begin creating a new data view on a blank worksheet, you can drag a field from the Data pane and drop it directly into the view, rather than to a shelf.

While dragging fields you can hover over the different areas in the view to see how the field will be incorporated into the structure of the view. For example, dimensions typically add a row and column headers to the view, while measures add continuous axes. Below are some examples of how fields can be added to the view.

- Dimensions add head-
- Measures add axes
- Show Me automatically
For a more advanced discussion of dimensions and measures, see Dimensions and Measures on page 261.

When you drop a field on one of the active areas in the view, the field is added to the view and also to one of the shelves or cards. For example, in the view below the Segment dimension was added to the Rows shelf and the Profit measure was added to the Columns shelf—and automatically aggregated so that the values in the data are summed.

You can, of course, also drag fields directly to the shelves instead of to the active areas in the view. You can also drag fields from one shelf to another shelf. To remove a field from a shelf, drag it off the worksheet or select Remove from the field’s menu (available when you right-click (control-click on Mac) a field in the view. To quickly remove multiple fields from a shelf, right-click (control-click on Mac) the shelf and select Clear Shelf.

Adding More Fields

You can add as many fields as necessary by dragging and dropping them on the different areas of the view. Once there are more fields in the view there are some extra options available. For
example you can replace fields by dropping them on existing headers and axes in the view. Or, instead of replacing a field you can add measures to an existing axis. Finally, you can rearrange the rows and columns in the view.

**Adding Headers Using Dimensions**

You can add headers to a view by dragging a dimension and dropping it to either side of an existing header, or to the left of an axis. For example, in the view below you can add the `Region` dimension by dragging it and dropping it to the right of the Sub-Category names.

As you hover over the view, a dotted black line indicates active areas where you can add headers.

If you drop `Region` there, it adds a column for Region along the top of the table, and slices the data so that you see results for each region within each sub-category.
Adding Axes Using Measures

You can add axes by dragging a measure and dropping it on an active area in the view. If an axis already exists in the view you can replace the existing axis, blend the new measure with the existing axis, or add a secondary axis.

Replace the Existing Axis

Drag the new measure to the top left portion of the axis in the view. A small square drop zone appears and a single axis icon displays to indicate that a single axis will be left when you drop the measure. In this case you are replacing one measure (Sales) with another (Profit).
Blend the Measures on Single Axis

You can show multiple measures on a single axis by dragging the new measure directly on top of the existing axis. Blending measures uses the Measure Names and Measure Values fields. For more information, see Measure Values and Measure Names on page 295.

In the image below you are adding a second measure (Profit) to the existing measure (Sales) on the axis.
The result is a view with both measures plotted along a single axis. In this case, Sales is shown in orange and Profit is shown in blue.
Add a Dual Axis

Drag the field to the right side of the view to add the measure as a dual axis. Dual Axes are useful when you want to compare two fields that have different scales. In this case, blending the two axes would distort the view. Instead you can add a dual axis.

The result is a dual axis view where the Profit axis corresponds to the blue line and the Sales axis corresponds to the orange line.
You can add up to four axes to the view: two on the Columns shelf and two on the Rows shelf. To turn a measure into a dual axis, right-click (control-click on Mac) a field on the Rows or Columns shelf and select Dual Axis.

Rearrange the Rows and Columns

Finally, you can rearrange the rows and columns in the view by dragging the selection border for headers or an axis.
Sorting

In Tableau, sorting a data view means arranging dimension members in a specified order. Tableau supports computed sorting and manual sorting.

Computed Sorting

You might want to sort customers by alphabetical order, or sort a product line from lowest sales to highest sales. Both of these sorts are “computed sorts” because they use programmatic rules that you define to sort the field.

About Computed Sorting

Sorting dimensions in a computed manner follows these rules:

- You can sort any discrete field after it has been placed on a shelf (except the Filters shelf).
- Each dimension that appears on a worksheet can be sorted independently of any other dimension.
- The shelf location of the dimension determines the component of the data view that’s
sorted. For example, if the dimension resides on the Columns shelf, the columns of the data view are sorted for that field. If the dimension resides on the Color shelf, the color encodings are sorted.

- Sorts are computed based on the values of the filters and sets in the view. Refer to Groups on page 458 for more information.

- Sorted fields are identified by a sort icon on the right side of the field.

Continuous fields are automatically sorted from lowest number to highest number (as indicated by the axes) and you cannot manually change the sort. However, you can reverse the order of an axis using field specific formatting.

**How to Sort Data (Computed Sorts)**

Computed sorts can be applied either directly on an axis in the view or using the sort dialog box to apply computed sorts to specific fields in the view.

**Sorting on an Axis**

A quick way to create a computed sort is to use the sort buttons on an axis. The sort buttons on an axis will automatically create a sort that makes sense for the view you’ve created. The sort will be computed, which means it will update correctly if the underlying data changes. When you hover over an axis with your cursor, a sort icon displays. Click it once to sort Ascending, again to sort Descending, and a third time to clear the sort.
Sorting Specific Fields

You can sort a specific field using the Sort dialog box.

1. Open the Sort dialog box.

   Right-click (control-click on Mac) on the field that you want to sort and select Sort from the context menu.
2. Specify the sorting options.

Complete the **Sort** dialog box by specifying the following criteria:

- **Sort order** - Displays the sort results in ascending or descending order.
- **Sort by** – Sort by one of these three options:
  - **Data source order** - the order that the data source naturally orders the data. Generally for relational data sources, this tends to be in alphabetical order. If you are using a cube, this order is the defined hierarchal order of the members within a dimension.
  - **Alphabetic** - the order of the letters in the alphabet.
  - **Field** - order the data based on the associated values of another field. For example, you could order several products by their total sales values.

When working with a relational data source and sorting by another field, you must also specify the aggregation function to use. This option is not available for multidimensional data sources because aggregations are defined when the cube is created and cannot be modified in Tableau. In Tableau, multidimensional data sources are supported only in Windows.

A typical scenario is to sort one or more dimensions by a measure. For example, the **Sort** dialog box shown below is configured to sort the members of the Customer Segment field in descending order and by the sum of the Sales measure. The results will be displayed so that the member with the highest sales is displayed first, the member with the second highest sales is displayed second, and so on.
You should keep the following rules in mind when interpreting the sort results:

- Tableau computes the sort across the entire table using the specified criteria. Refer to **Example – Sorting a Text Table below** for an example.

- Sorts do not break the dimension hierarchy. Sorted fields are always displayed within the ordered context already set forth by the fields on the Rows and Columns shelves. This means that Tableau will not rearrange any of the headers of the fields that appear before (to the left of) the sorted field.

  If you want to break the dimension hierarchy when sorting a multidimensional data source, place only the hierarchy level that you want sorted on the Rows or Columns shelf.

**Example – Sorting a Text Table**

Using the **Sample-Superstore** data source, this example sorts the rows and columns of a text table to determine which products and years have the highest average discounts. To create the view, follow the steps below:
1. Place the **Order Date** dimension on the **Columns** shelf and the **Sub-Category** dimension on the **Rows** shelf.

   Complete the text table by placing **Discount** on **Text**. By default, the table is sorted in alphabetical order.

   ![Table Example](image)

2. Sort the fields.

   Right-click (control-click on Mac) **Order Date** on the Columns shelf and select **Sort** from the context menu. In the Sort dialog box, do the following:

   - For **Sort order**, select **Descending**.
   - For **Sort by**, select **Field**, and then select the following:
     - For **Field**, select **Discount**.
     - For **Aggregation**, select **Average**.
   - Click **OK**, and then apply the same sort to **Sub-Category**.
The view is shown below. Binders are the top row in the table because it has the largest average discount across all years, while Labels are at the bottom in the table because that sub-category has the smallest average discount across all years. Similarly, 2012 is the left most column because it has the largest average discount for all products, while 2014 is the right most column because it has the smallest average discount for all products.
At first glance, it’s not clear if the data has been correctly sorted, because Tableau computes the sort across the entire table using the specified criteria. By turning grand totals on for both columns and rows, using the Analysis > Totals menu, you can see that the sort was performed correctly. For more information about how to turn on grand totals, see **Totals on page 902**.
Example – Sorting a Hierarchy

This example uses a multidimensional data source to sort the rows of a bar chart in order to determine which beverages have the highest sales. To create the view, follow the steps below.

**Note:** In Tableau, multidimensional data sources are supported only in Windows.

1. Place the **Sales** measure on the Columns shelf and the **Gen2,Product** dimension on the Rows shelf.
   
   Drill down one level in the hierarchy to display **Gen3,Product**.
2. Sort Gen3,Product in descending order by the Sales measure.

Right-click (Control-click on Mac) on Gen3,Product and select Sort from the field’s context menu. In the Sort dialog box, select Descending as the Sort order and sort by the Sales field.
The view is shown below. Notice that the Gen3,Product members are sorted within each parent member. For example, Cola, Diet Cola, and Caffeine Free Cola are sorted only within the Colas level. Tableau does not rearrange headers that appear before the sorted field.
3. If you want to order dimension members without regard to its parent, you should remove Gen2,Product from the Rows shelf. The sorted data are shown below.
Manual Sorting

Manual sorting allows you to rearrange the order of dimension members in the table by dragging them in an ad-hoc fashion, giving precise control over how items appear next to one another in tables and in legends. It also gives you control over the order in which data is drawn on the screen. This control is useful when comparing specific pieces of data or interpreting overlapping data. Manual sorts can only be applied to discrete fields including a discrete measure.

There are two ways to manually sort the data in a view. You can either select items in the view and use the Sort toolbar buttons or you can drag and drop headers in the view.

Sorting Using the Toolbar and Tooltips

The two sort buttons on the toolbar and in tooltips manually sort a selection either in ascending or descending order based on the other fields in the view. For example, the view below shows sales by product category and customer segment. When you select the Corporate Market column, thus selecting all of the products in that segment, the quick sort buttons sorts the product field by SUM(Sales), which is the measure in the view.
An easy way to anticipate how a selection will be sorted is to make a selection in the view and hover over the ascending or descending sort buttons on the toolbar. The tooltip for each button describes how the selection will be sorted.

Using the quick sort buttons on the toolbar or in the tooltip creates a manual sort which you can always modify using the sort dialog box. Right-click (control-click on Mac) a sorted field (indicated with bold text) and select Sort to open the Sort dialog box.

**Sort by Drag and Drop**

1. Select the dimension member you want to move. This can be any dimension member that appears in a row or column header of a table, or in a legend like the color legend.

2. Drag the member to the desired location within that row, column or legend.

**Example- Manually Sorting Drawing Order**

Changing the drawing order of a field allows you to see obscured data in your views in cases where data of one color or shape obscure data of another color or shape. For instance, if you can’t see red marks in a scatter plot because they are obscured by green marks, you can change the drawing order so that the red points are drawn on top of the green points (and vice versa).

Change the drawing order of a field by re-arranging the order of dimension members in a legend. For instance, if you want to place red items in front of green items in a view, select the
red legend entry and move it higher on the list of items shown in the legend. The marks are
drawn in the view according to the order in the legend, from bottom to top. Also you can toggle
back and forth between layered field items by dragging any one of the fields from top to bottom
or from bottom to top.

![Legend Example](image)

Sorting the drawing order is not restricted to color legends. You can reorder shape legends as
well. If you have multiple valid legends, the drawing order is defined first by shape, then by
color. For example, suppose you have both a shape legend and a color legend. If you have a
red circle on top of a green square, moving the green above the red in the color legend will not
necessarily move the green square on top of the red circle. It depends on the order in the shape
legend first. If circles are above squares in the shape legend, no amount of reordering the color
legend will get that square on top of the circle. Instead, move the square shape above the circle
shape first and then reorder the color legend.

**Groups**

A group is a combination of dimension members that make higher level categories. For
example, if you are working with a view that shows average test scores by major, you may want
to group certain majors together to create major categories. English and History may be
combined into a group called Liberal Arts while Biology and Physics may be grouped as
Science Majors. Groups are useful for both correcting data errors (e.g., combining CA, Calif.,
and California into one) as well as answering "what if“ type questions (e.g., "What if we
combined the East and West regions?").

**Creating Groups**

You can create a group by selecting headers in the view or selecting marks. You can also
create a group from a dimension in the Data pane. Regardless of how you create a group, a
new group field is added to the Data pane. You can use the group field like other fields in the
view, adding it to the Columns or Rows shelves, to the Marks card, or to the Filters shelf. When
you create a group by selecting headers or marks in the view, the view is updated to use the
grouped field.

**Correct data errors or combine dimension members**

If you are using groups to correct data errors (for example, to combine "CA" and "California") or
to combine dimensions members (for example, to combine "East" and "West" regions), the
The easiest option is to select headers in the view.

1. Press and hold the **CTRL** or **Shift** key on the keyboard to multi-select headers in the view. On a Mac, press and hold the Command key.

2. Click the **Group** button on the toolbar.

   Alternatively, you can right-click and select **Group** or click the **Group** icon on the tooltip.

The selected members are combined into a single member. In this example, the view now shows the **SUM(Sales)** across all binders, envelopes and fasteners as a single mark. A default is automatically constructed using the combined member names. The dimension on the Rows or Columns shelf is replaced with the new grouped field.
Color a view using groups

In addition to correcting data errors and combining dimensions, you can visually identify groups of related marks by selecting marks directly. This technique is especially useful when working with a scatter plot or a view that doesn't have headers that you can select when defining the group.

1. Press and hold the **CTRL** or **Shift** key on the keyboard to select one or more marks in the view. On a Mac, use the **Shift** key.

2. Click the **Group** button on the toolbar.
Alternatively, you can right-click and select **Group** or click the **Group** icon on the tooltip.

The selected marks are grouped and all other members are combined into an "Other" category. The new group field is automatically added to Color. For more information about grouping fields using Other, see **Including an Other Group** on page 468.
Note: If there were already fields on Color, they are moved to Detail and replaced with the group field.

When you create groups by selecting marks, it’s possible that the marks will represent multiple dimensions. For example, you may have a scatter plot that shows the Sales vs. Profit by Region and Sub-Category. In this case, a selection of marks will represent members of both the Region and Sub-Category dimensions. When the selection represents multiple dimensions, the Group menu lets you choose to group on All Dimensions or on a particular dimension.

In the example above, the 5 selected marks represent a region and the following sub-category combinations.
- West, Copiers
- West, Binders
- West, Accessories
- East, Copiers
- Central, Copiers
- South, Art
- South, Envelopes
- South, Labels
- West, Envelopes
- West, Labels

The views below show the results of grouping these measures on All Dimensions, Sub-Category, and Region.

<table>
<thead>
<tr>
<th>All Dimensions</th>
<th>Sub-Category</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20,000</td>
<td>$15,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>$10,000</td>
<td>$5,000</td>
<td>$0</td>
</tr>
<tr>
<td>$5,000</td>
<td>$0</td>
<td>$-5,000</td>
</tr>
<tr>
<td>$0</td>
<td>$-10,000</td>
<td>$-15,000</td>
</tr>
</tbody>
</table>

The 5 marks are combined and the rest of the marks are added to an "Other" category.

All marks associated with any of the three sub-categories are combined and everything else is added to an "Other" category.

All marks associated with the four regions are combined and everything else is added to an "Other" category.
Create groups from a Dimension in the Data pane

Whenever you create a group, a group field is added to the Data pane. When you create a group by selecting headers or marks in the view, the new group field is also added to the view either on the Rows or Columns shelf or to Color on the Marks card. Instead of creating a group by selections in the view, you can create a group directly from a dimension in the Data pane.

1. Right-click (control-click on Mac) a dimension in the Data pane and select Create > Group.

2. In the Create Group dialog box, select several members that you want to group. Press and hold the CTRL key (the Command key on a Mac) on your keyboard to select multiple members.
3. Click the **Group** button at the bottom of the dialog box.

The selected members are combined into a single member. A default name is automatically constructed using the combined member names. Rename the group by selecting it in the list and clicking the **Rename** button at the bottom of the dialog box. You can search for members using the Find options. For more information, see **Finding Members in Group Dialog Box** on page 471.
Note: To add to or remove members from a group, right-click the grouped field in the Data pane and select Edit Group. In the Edit Group dialog box you can also change the default name of the group and combine fields into new groups. Refer to Editing an Existing Group below to learn more. Alternatively, you can ungroup members by selecting them in the view and clicking the Ungroup button on the toolbar or tooltip.

Editing an Existing Group

After you have created a grouped field, you can add and remove members from the groups, create new groups, change the default group names, and change the name of the grouped field. You can make some changes directly in the view, and others through the Edit Group dialog box.

Edit groups directly in the view

You can add and remove members from an existing group and create new groups by selecting marks directly in the view. Do one of the following:

- **Add to an existing group** - Select one or more marks you want to add to an existing group. Then hold **SHIFT** or **CTRL** on your keyboard (use the **⌘** key on a Mac) to also select at least one member of the group you want to add to. Click the **Group** button on the toolbar or tooltip.

- **Remove from an existing group** - Select one or more marks you want to ungroup. Then click the **Ungroup Members** button on the toolbar or tooltip. Make sure that the selection only contains members from one group at a time.

- **Create a new group** - Select one or more marks that you want to create a new group with. Then click the Group button on the toolbar or tooltip.

Open the Edit Group dialog box

While editing groups directly in the view is useful when rapidly defining ad hoc groups, you can more finely control the members of each group using the Edit Group dialog box. Right-click (control-click on Mac) the grouped field in the Data pane or in the view and select Edit Group.
Then do one of the following:

- Select one or more members and drag and drop them into the existing group. This method works best if you are working with a dimension that has few members.

- Select one or more members, right-click (control-click on Mac) and select Add To. In the
**Add to Group** dialog box, select the group you want to add the selected members to and click **OK**.

- Select one or more members and select the group in the **Add to** drop-down list at the top of the dialog box.

**Note:** Rename a group by selecting the group in the Edit Group dialog box and then click the Rename button.

**Including an Other Group**

When you create groups in Tableau, you have the option to **Include Other**. When you include an other category, the groups you have defined are shown and all other dimension members are combined into an "Other" category. This option is useful for highlighting certain groups or comparing specific groups against everything else. For example, you may have a grouped field that combines product categories based on their sales performance. You may want to highlight High Performers and Low Performers and group all the other categories into an "Other" category.

<table>
<thead>
<tr>
<th>Includes Other</th>
<th>Does not include Other</th>
</tr>
</thead>
</table>
Define whether to include the other category by selecting the **Include Other** option on the field menu.
Alternatively, you can right-click (control-click on Mac) the field in the Data pane or on the sheet and select **Edit Group**. Then select the **Include Other** option near the bottom of the Edit Group dialog box.
Finding Members in Group Dialog Box

When you create groups from a large dimension with many members, use the Find option to quickly select the members you are looking for and add them to an existing group.
1. Show the find options by clicking the **Find** button at the bottom of the dialog box.

![Find Options](image)

2. Type all or part of the member name into the text box and select an appropriate result criteria from the drop-down menu. You can select whether to find members that start with, contain, or are an exact match to the search term.

3. Select a Range to search in. You can select to search all members, or within specific groups.

4. Click **Find All** to select all the matching members or select **Find Next** to manually navigate through each of the search results.

5. When you have found and selected the members of interest, you can quickly add them to an existing group by selecting the group on the **Add to** drop-down menu at the top of the dialog box.
**Sets**

Sets are custom fields that define a subset of data based on some conditions. A set can be based on a computed condition, for example, a set may contain customers with sales over a certain threshold. Computed sets update as your data changes. Alternatively, a set can be based on specific data point in your view. You can use sets to compare and ask questions about a subset of data. For example, in a scatter plot showing product sales, you may select the products with the most sales and add them to a set. You may then create another set that contains the products with the highest return rates. With these two sets you can ask questions like "What percent of my total sales is from high returned products?" Or you may go further and compare the two sets to each other to create a new set that contains only high sales products that are also returned frequently.

Tableau displays sets at the bottom of the Data pane and labels them with the set icon 🔒.

---

**Sets**

- 🔒 State - High Sales & Profit
- 🔒 Top Customers by Profit

When you drag a set to the view, you can choose to aggregate the members using In/Out mode or to list all of the individual members of the set. See Using Sets on page 478 to learn more about these modes.

If you are connected to a multidimensional data source, you may see additional sets that were created in your data source. These sets are also listed in the Sets area of the Data pane but are indicated with the server named set icon 🗼. A server named set can be used in the same way as any other sets you create in Tableau.

Sets can be automatically generated as a result of an action. These sets are indicated by the action set icon 📘. See Actions on page 1018.

Finally, when working with workbooks connected to Tableau Server or Tableau Online, User Filters display in the Sets area of the Data pane using the user filter set icon user 🔥. See Control Who Can See What in a Published View on page 1109.

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If you are connected to a relational data source, creating a set that is based on a continuous date field will use the exact dates instead.
Creating a Set

There are many ways to create and edit sets in Tableau. To create a set, select marks or headers in the view or right-click (control-click on Mac) a field in the Data pane. You can also create a set that is based on a filter you've already defined. Regardless of how you create the set, it is either constant or computed. A constant set contains a specified list of members based on one or more dimensions. For example, a constant set might contain the specific names of products that you are keeping an eye on. A computed set is dynamic and the members change as the underlying data changes. For example, a computed set may contain the top 5 products by total sales. As the sales data changes, the companies included in the set will also change.

Constant sets

The members of a constant set are fixed and do not change. To create a constant set, you need to select the members you want to include. A constant set can be based on a single dimension or multiple dimensions.

1. Select one or more marks or headers in the view.
2. Right-click (control-click on Mac) and select Create Set or click the Create Set option on the tooltip.
3. In the Create Set dialog box, type a name for the set.
4. Optionally complete any of the following:
   - By default, the set includes the members listed in the dialog box. You can select the option to Exclude these members instead. When you exclude, the set will include all of the members you didn’t select.
   - Remove any dimensions that you don't want to be considered by clicking the red "x" icon that displays when you hover over a column heading.
- Remove any specific rows that you don't want to include in the set by clicking the red "x" icon that displays when you hover over the row.
- If the marks you selected represent multiple dimensions, each member of the set will be a combination of those dimensions. You can specify the character that separates the dimension values.
- Select Add to Filters shelf to automatically move the set to the Filters shelf once it is created.

5. Click OK.

**Computed sets**

The members of a computed set are dynamic and change when the underlying data changes. Computed sets can only be based on a single dimension.

1. Right-click (control-click on Mac) a dimension in the Data pane.
2. Select Create > Set.
3. In the Create Set dialog box, type a name for the set.
4. On the General tab, select one or more values that will be considered when computing the set. You can alternatively select the Use all option to always consider all members even when new members are added or removed.
5. Define how to compute the members by adding conditions and limits:

- **Condition**: Use the Condition tab to define rules that determine what members to include in the set. For example, you might specify a condition that is based on total sales that only includes products with sales over $100,000.
Set conditions work the same as filter conditions. See Filter Data from Your Views on page 630 to learn more.

- **Top**: Use the Top tab to define limits on what members to include in the set. For example, you might specify a limit that is based on total sales that only includes the top 5 products based on their sales.
6. Click **OK**.

**Using Sets**

After you create a set, it displays at the bottom of the Data pane in the Sets area. You can then drag sets into the view like any other field. For example, you can drag the set to the Filter shelf to quickly filter the view to only show the members of the set. Alternatively, you can drag the set to the Marks card or the Rows and Columns shelves. When you drag a set to the view, you can choose to show the members of the set or aggregate the members into In/Out categories.

Set limits work the same as Filter limits. See Filter Data from Your Views on page 630 to learn more.
**Show In/Out of Set**

In most cases, when you drag a set to the view, Tableau displays the set using the In/Out mode. This mode separates the set into two categories: In, which contains the members in the set; and Out, which contains any members that are not part of the set. For example, in a set defined as the top 25 customers, the top customers would be part of the In category and all other customers would be part of the Out category. Using the In/Out mode makes it easy to compare the members in the set to everything else. You can use this mode to answer questions like "What percent of my total revenue comes from members of this set?"

Switch a set to use In/Out mode by selecting Show In/Out of Set on the field menu.

When a set is in In/Out mode, the field on the shelf is prefaced by the text, "IN/OUT" followed by the set name.

**Note:** In/Out mode is not available in workbooks created before version 8.2 that use Microsoft Excel or text file data sources, workbooks that use the legacy connection, or workbooks that use Microsoft Access data sources.

**Show Members in Set**

As an alternative to showing the set using In/Out mode, you can list the members in the set. Showing the members in the set automatically adds a filter to the view that includes only the members of the set.

Switch a set to list the individual members by selecting Show Members in Set on the field menu.

**Note:** To display the fully qualified member names for cubes, right-click the set in the Data pane and select Qualify Member Names.

**Combining Sets**

You can combine two sets to compare the members. When you combine sets you create a new set containing either the combination of all members, just the members that exist in both, or members that exist in one set but not the other. Combining sets allows you to answer complex questions to understand cohorts of data. For example, to determine the percentage of customers who purchased both last year and this year, you can combine two sets containing the customers from each year and return only the customers that exist in both sets. Another example would be to determine what products sell the most but also have the highest return rate.

To combine two sets, they must be based on the same dimensions. That is, you can combine a set containing the top customers with another set containing the customers that purchased last year. However, you cannot combine the top customers set with a top products set. In the latter
case, the one set is based on the Customer dimension while the other is based on the Product dimension.

1. Select two sets in the Data pane that you want to combine.
2. Right-click (control-click on Mac) the sets and select Create Combined Set.
3. In the Create Set dialog box, type a name for the new combined set.
4. Verify that the two sets you want to combine are selected in the two drop-down menus.
5. Select one of the following options for how to combine the sets:
   - **All Members in Both Sets** - the combined set will contain all of the members from both sets.
   - **Shared Members in Both Sets** - the combined set will only contain members that exist in both sets.
   - **Except Shared Members** - the combined set will contain all members from the specified set that don't exist in the second set. These options are equivalent to subtracting one set from another. For example, if the first set contains Apples, Oranges, and Pears and the second set contains Pears and Nuts; combining the first set except the shared members would contain just Apples and Oranges. Pears is removed because it exists in the second set.
6. Optionally specify a character that will separate the members if the sets represent multiple dimensions.
7. When finished, click **OK**.

**Note:** This functionality is not available in workbooks created before version 8.2 that use Microsoft Excel or text file data sources, workbooks that use the legacy connection, or workbooks that use Microsoft Access data sources.

**Examples of Sets**

There are many ways you can use sets to answer complex questions and compare cohorts of data. Below are some examples of ways you can use sets to define and compare subsets of data.

**How do members of a set contribute to the total?**

You may have all kinds of questions surrounding how the members in a set contribute to the overall total. For example, what percent of total sales come from repeat customers? You can answer these types of questions using the IN/OUT mode for set. The example below uses sales data to calculate the percent of total sales from customers who have purchased at least 20 times.
1. Right-click (control-click on Mac) the Customer Name dimension in the Data pane and select Create > Set.

2. In the Create Set dialog box, type a name for the set. In this example, we'll call the set, "Customers"

3. Select the Use all option so the condition always applies to all values even when new customers are added.

4. On the Condition tab, click By field, and then define a condition that only includes customers when Sum of Sales is greater than or equal to 5,000.
5. Click **OK**.

6. Drag the new set from the **Sets** area at the bottom of the **Data** pane to the **Rows** shelf.

7. From Measures, drag **Sales** to the **Columns** shelf. The view now shows the total sales for customers who have purchased more than $5,000 dollars of product and the total sales for all other customers.

8. Finally, click on the drop-down arrow on the **Sum (Sales)** field on the Column shelf and select **Quick Table Calculation > Percent of Total** on the context menu.

The view now shows that customers with sales greater than or equal to 5,000 make up about 39% of the overall sales.
How many members of a set exist in another set?

Another common use of sets is to compare subsets of data or cohorts. For example, you may wonder how many customers that purchased last year also purchased this year. Or if a customer purchased a specific product, what other products did they buy? You can answer these types of questions by creating multiple sets and combining them. The example below uses sales data to determine how many customers who purchased in 2012 also purchased in 2013.

1. Drag the **Customer Name** field to the Rows shelf.
2. Drag the **Order Date** field to the Filters shelf.
3. In the Filter Field dialog box, select **Years** and click **Next**.
4. In the Filter dialog box, select **2012** and click **OK**.

5. Back in the view, press CTRL + A (Command-A on a Mac) on your keyboard to select all of the customers.
6. Right-click (control-click on Mac) the selection and select **Create Set**.
7. In the Create Set dialog box that opens, type a name for the set. In this example, we'll call the set "Customers (2012)".

8. Click OK.

9. On the Filters shelf, right-click (control-click on Mac) Order Date and select Edit Filter.

10. In the Filter dialog box, change the filter to only include 2013 instead of 2012, and then click OK.

11. Again, press CTRL + A (Command-A on a Mac) on your keyboard to select all of the customers.

12. In the view, right-click (control-click on Mac) the selection and select Create Set.

13. In the Create set dialog box that opens, type a name for the set. This set will be called
"Customers (2013)".

14. Click OK.

15. In the Data pane, select both the Customers 2012 and Customers 2013 by holding the Ctrl key (Command key on a Mac) on your keyboard as you select.

16. Right-click (control-click on Mac) the selection and select Create Combined Set.

17. In the Create Set dialog box, type a name for the new set. In this example, we'll call the set "Customers (2012 & 2013)".

18. Make sure the correct two sets are selected in the drop-down menus.

19. Select the option to include Shared Members in Both Sets.

20. Click OK.
21. At the bottom of the workbook, click the New Worksheet icon.

22. In the new worksheet, drag the **Customer Name** dimension to the **Rows** shelf.

23. Click the drop-down arrow on the Customer Name field on the Rows shelf and select **Measure > Count (Distinct)** from the context menu.

24. Finally, from the **Sets** area of the **Data** pane, drag the **Customers (2012 & 2013)** field to the **Filters** shelf. You can see that 437 customers purchased products in both 2012 and 2013.

---

**Hierarchical sets and descendants**

A hierarchical set filters data to the selected members and all of their descendants. They are
unique to multidimensional (cube) data sources and are defined within the data source prior to connecting to Tableau Desktop.

When you create sets in Tableau from a cube data source, descendants and any hierarchical structures are automatically included with the selected members.

For example, a set named Dairy is created from the Product hierarchy. As shown below, it includes only the Dairy product department.

Consider the following view. The Product Department dimension is placed on the Rows shelf and the Store Sales measure is placed on the Columns shelf.
If you place the **Dairy** set on the Filters shelf, you can see that the view is filtered to include only the Dairy product categories.

As shown below, you can drill down into **Product Department** to reveal the **Product Category**, **Product Subcategory**, and **Brand Name** levels. As these descendants are revealed, row headers are added to the view. This is because a set filter allows you to view the levels of detail contained within the filtered members.
<table>
<thead>
<tr>
<th>Product</th>
<th>Product Type</th>
<th>Brand Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy</td>
<td>Dairy</td>
<td>Milk</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Booker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carlson</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Club</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Even Better</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gorilla</td>
</tr>
<tr>
<td>Dairy</td>
<td>Dairy</td>
<td>Cheese</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Booker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carlson</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Club</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Even Better</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gorilla</td>
</tr>
<tr>
<td>Cottage</td>
<td>Cheese</td>
<td>Saturn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Club</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Even Better</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gorilla</td>
</tr>
<tr>
<td>Sour</td>
<td>Cream</td>
<td>Booker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carlson</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Club</td>
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<td></td>
<td></td>
<td>Even Better</td>
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<tr>
<td></td>
<td></td>
<td>Gorilla</td>
</tr>
<tr>
<td>Yogurt</td>
<td></td>
<td>Booker</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carlson</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Club</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Even Better</td>
</tr>
</tbody>
</table>

Store Sales

- $0.00
- $1,000.00
- $2,000.00
- $3,000.00
- $4,000.00
Annotations and Mark Labels

Annotations call attention to specific marks, points, or areas in a view. An annotation, sometimes called a call-out, is most commonly displayed as a text box with a line pointing to a specific point or mark. You can also add an area annotation, which calls out several marks or a region of the view. Additionally, you can use mark labels to call out marks of interest or more commonly to label the view to make it more understandable. You can show mark labels for all the marks in the view, or selectively show and hide individual labels.

Annotations

In Tableau there are three kinds of annotations: mark, point, and area. After you add an annotation, you can edit, re-position, format, and remove it.

Adding Annotations

Annotations are an important part of publishing and sharing a view. Use annotations to call out a specific mark, a specific point such as a value on the axis or a reference line, or an area such as a cluster of scatter marks.

To add an annotation:

1. Right-click (Control-click on Mac) the view where you want to add an annotation and select Annotate.
2. On the sub-menu select one of the following types of annotations:
   - **Mark** - select this option to add an annotation that is associated with the selected mark. This option is only available if a mark is selected.
   - **Point** - select this option to annotate a specific point in the view.
   - **Area** - select this option to annotate an area in the view such as a cluster of outliers or a targeted region of the view.

3. In the Edit Annotation dialog box, type the text you want to show in the annotation.

   Use the **Insert** menu to insert dynamic variables into the annotation text. For example, the annotation can display data values that update as the underlying data changes. The dynamic variables that are available are dependent on whether you are annotating a mark, point, or area. Only relevant variables are available for each of these types of annotations. For example, mark annotations can include dynamic data about that specific data point such as dimension and measure values. Point annotations don't refer to a specific data point but rather a place in the view. For that reason, point annotations can only include dynamic information about that point, such as measure values along the axes. Finally, when adding area annotations, only data relevant to the entire sheet is available, such as title and sheet name.

4. When finished, click **OK**.
Rearranging Annotations

After you add an annotation, you can move it around, resize it, adjust the line, and move the text. Each type of annotation can be rearranged and modified in different ways. This section discusses how to rearrange, resize, and modify each type of annotation.

Mark Annotations

When you select a mark annotation the body and line are selected and several resize handles display. Use these handles to resize the body and line.
To reposition the body

- Click and drag the body of the selected annotation to a new position.

To resize the body

- Click and drag the body resize handle left and right. The text and height are automatically adjusted to fit the width of the body.

To resize the line

- Click and drag the line resize handle.
Point Annotations

A point annotation marks a specific point in the view such as a reference line or a value on an axis. Point annotations display as text with a line. When you select a point annotation, several resize handles display. Use these handles to reposition and resize the body and line.

To reposition the body:

- Click and drag the body of the selected annotation to a new position. As you move the body, the line is automatically resized so that it continues to point at the specific point you
selected.

To resize the body:

- Click and drag the side resize handles left and right. The text and height are automatically adjusted to fit the width of the body.

To move the line end point:

- Click and drag the end point of the line so that it points at a new location.
Area Annotations

An area annotation is a way to highlight or call out an area in the view. Area annotations are not associated with any particular mark, in fact, these annotations are commonly used to call out several marks. When you select an area annotation, several resize handles and two text handles display. Use these handles to reposition and resize the box and text.

To reposition the box

- Click and drag the box of the selected annotation to a new position.
To resize the box

- Click and drag one of the box resize handles.

To reposition the text

- Click and drag the center text handle to a new position.

To resize the text width
• Click and drag the right text handle left and right. The text height is automatically adjusted to fit the width.

Formatting Annotations

For each annotation you can modify the text, body, and line. For example, you can specify whether the body should be a box, a single edge, or not shown at all. Additionally, you can specify whether the lines on mark and point annotations end with an arrow, dot, or a simple line.

To format annotations:

1. Select one or more annotations, right-click (control-click on Mac) one of the selected annotations, and select Format. The Format pane opens showing the relevant settings.
2. In the **Format** pane, use the drop-downs to specify font properties, text alignment, line style, and shading.
Example Formatting Options

<table>
<thead>
<tr>
<th>Annotation Style</th>
<th>Format Window Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Default format settings for point and mark annotations.</td>
</tr>
</tbody>
</table>

Profit: $21,181
Sales: $129,770
<table>
<thead>
<tr>
<th>Annotation Style</th>
<th>Format Window Settings</th>
</tr>
</thead>
</table>
| **Profit:** $21,181  
**Sales:** $129,776 | ![Format Annotation Window](image) |
|                  | Box: Four Sided  
**Shading:**  
**Border:**  
**Corners:** Square  
Line |
|                  | ![Format Annotation Window](image) |
|                  | Box: Four Sided  
**Shading:** None  
**Border:**  
**Corners:** More Rounded  
Line  
**Line End:** Dot  
End Size |
<table>
<thead>
<tr>
<th>Annotation Style</th>
<th>Format Window Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profit: $21,181</td>
<td></td>
</tr>
<tr>
<td>Sales: $129,770</td>
<td></td>
</tr>
</tbody>
</table>

### Format Annotation

**Box**
- **Box**: Single Edge

**Shading**
- **Shading**: None

**Border**
- **Border**: 

**Corners**
- **Corners**: More Rounded

**Line**
- **Line**: 
- **Line End**: Dot
- **End Size**: 

---

### Format Annotation

**Box**
- **Box**: Four Sided

**Shading**
- **Shading**: None

**Border**
- **Border**: 

**Corners**
- **Corners**: Square

**Line**
- **Line**: 
- **Line End**: Open Arrow
- **End Size**: 

---

Profit: $21,181  
Sales: $129,770
### Removing Annotations

At any time you can remove one or more annotations.

**To remove an annotation:**

1. Select one or more annotations to remove.

2. Right-click (Control-click on Mac) one of the selected annotations and select **Remove** or press the Delete key on your keyboard.
Mark Labels

Mark labels are values shown next to each data point in a view. For example, in a view that shows product category sales over time as a line, you can label sales next to each point along the lines. Or, you might label each product category.

You can turn on mark labels for marks, selected marks, highlighted marks, minimum and maximum values, or only the line ends in a line chart. You can turn on mark labels for an individual marks.

Show and Hide Mark Labels

To add context to your views, you can show mark labels.

To show or hide mark labels:
• Click **Label** on the **Marks** card, and then select **Show mark labels**.

![](image)

**Label only specific marks**

After you show mark labels in a worksheet, you can specify which marks to label.

**To specify which marks you want to label:**

• Click **Label** on the **Marks** card, and then make a selection from the following options under the **Marks to Label** section:

  **All**

  Label all marks in the view.
Min/Max

Label only the minimum and maximum values for a field in the view. When you select this option, you must specify a scope and field to label by.

For example, the image below shows the mark labels scoped to pane, and specifies to show the minimum and maximum sum of sales values. This means that the minimum and maximum sales are labeled for each pane in the view. In this case, there are four panes in the view.
Line Ends

You can label the start or the end of all lines in the view, or both.

Selected

Label only the selected marks in the view. Labels appear when you select one or more marks in the view.
Highlighted

Label only the highlighted marks in the view. Labels appear when you select a member in a legend (for example, Office Supplies, in the following image), when you select one or more marks in the view, or when you select marks using the Highlighter. For more information about how to use the Highlighter, see Highlight Data Points in Context on page 1027.
**Most Recent**

Label the most recent marks in the view. When there is a time or date field in the view, you can label all marks that correspond to the most recent date or time in the view. When you select this option, you can specify a scope for the labels in the view.

Marks labeled are determined by the level of detail of the view.

For example, the following image shows labels for each category, because the **Category** field is on **Color** on the **Marks** card. There is no label for the Furniture category, because the most recent mark in that category is excluded from the view.
Select to overlap other marks

By default, mark labels do not overlap other marks or labels in the view. You can show all labels in the view, even the ones that overlap other marks and labels.

To overlap other marks in the view:

- Click Label on the Marks card, and then select **Allow labels to overlap other marks** under the Options section.

Show and Hide Individual Mark Labels

Rather than showing all mark labels or dynamically showing labels based on the view, you might want to show labels for a selection of individual marks. You can use mark labels to call out the values of specific marks of interest, as well as hide overlapping mark labels.

To show or hide individual mark labels:

- Right-click (control-click on Mac) the mark you want to show or hide a mark label for, select **Mark Label**, and then select one of the following options:
  - **Automatic** - select this option to turn the label on and off depending on the view and the settings in the Label drop-down menu.
  - **Always Show** - select this option to show the mark label even when it would otherwise be hidden (based on the settings in the Label drop-down menu).
  - **Never Show** - select this option to hide the mark label even when it would otherwise be shown (based on the settings in the Label drop-down menu).
Move Mark Labels

After you show a mark label in a view, you can reposition it to best fit your view and presentation. For example, in a stacked bar chart, the mark labels are automatically placed in the center of each bar. However, you may want to stagger the labels so that the longer ones don’t overlap.

1. Select the mark whose mark label you want to move.
2. Click and drag the move handle to a new location.
Edit Mark Labels with Aliases

Another way to modify mark labels is to edit the aliases of a field. An alias is an alternative name assigned to a dimension member, or to a field name. Tableau gives you the ability to display and edit aliases for data sources that support this feature. When you edit the aliases you can change the names of the members in a field, thus modifying the mark labels displayed in the view.

Format Mark Labels

When you select to show mark labels in the view, there are several formatting options to help you adjust the appearance of the labels. These options are available in the Label drop-down menu.

You can use the Label drop-down menu to adjust the label appearance, as well as specify which labels appear in the view. You can customize the text, adjust the font properties, and set an alignment for all labels.

For more information about specifying which labels appear in the view, see Show and Hide Mark Labels on page 504.

1. On the Marks card, add a field to Label.
2. On the Marks card, click Label.
3. Change the text for all labels in the view.

   - On the **Label** drop-down menu, click the **Edit Text** icon. This opens the Edit Label dialog box where you can customize the label text.
4. Customize the appearance of the font for all labels in the view.
   - On the **Label** drop-down menu, click the **Font** drop-down arrow. This opens the **Font** drop-down menu.

   In the **Font** drop-down menu, you can choose a font type and size, select to bold, italicize, or underline the font, adjust the transparency of the labels, and select a
color for the labels. For more information, see Select Label Color.

5. Change the alignment, direction, and text wrap for all labels in the view.
   - On the Label drop-down menu, click the Alignment drop-down arrow. This opens the Alignment drop-down menu.
     In the Alignment drop-down menu, you can select a horizontal and vertical alignment, and a direction for all labels. You can also choose to wrap the text for all
6. Select label color.

By default, when you choose to show mark labels, the label colors automatically appear black or white in the view. However, you can choose to customize the color of the labels.

- On the Label drop-down menu, click the Font drop-down arrow. This opens the Font drop-down menu.

In the Font drop-down menu, you can select a specific color for all the mark labels in the view, or you can choose to closely match each label to the color of its mark.

- Select a specific color:

  To select a specific color, click a color in the Font drop-down menu.

  If you would like to create a custom color for the mark labels, click More Colors, and then create a color in the Select Color dialog box that opens.

- Match label colors to the mark colors:
To closely match each label to the color of its mark, click **Match Mark Color** in the font drop-down menu.
Inspecting Data

Once you have created a view, Tableau offers a selection of dynamic data inspection tools that help you isolate the data of interest and then continue to explore and analyze. For example, if you have a dense data view, you can focus on a particular region, select a group of outliers, view the underlying data source rows for each mark, and then view a summary of the selected marks including the average, minimum, and maximum values.

Marks and Data Analysis

Selecting marks in the view can help you gain insight into how a subset of your data compares to the overall data in your view. For example, you can view the underlying data of selected marks using tooltips, or compare the average sales of the selected marks to the overall average sales of the marks in the view using recalculated lines.

Data analysis options in Tooltips

When you select one or multiple marks in a view, several options for inspecting your data are available in the tooltip that appears. Tooltips provide additional information about the marks in your view, and provide the following data analysis options:

- Keep only the selected marks in the view. For more information, see Select to keep or exclude data points in your view on page 631.
- Exclude the selected marks from the view.
- Create a group based on the selected marks. For more information, see Groups on page 458.
- Create a set that contains the selected marks. For more information, see Sets on page 473.
- View the underlying data of the marks selected. For more information, see View Data on page 529.
Data comparison with recalculated lines

If there is an analytics object in your view, such as an average line, constant line, trend line, reference line or distribution line or band, selecting one or multiple marks in the view lets you instantly compare the analytical data for the selected marks to all data in the view.

For example, selecting marks in a view that contains a trend line creates a second, recalculated trend line, the value of which is determined by the selected marks only, so you can compare that trend to the overall trend.

Recalculated lines are displayed by default when you select marks in a view that already contains analytics objects. If you don't want recalculated lines to be created you can turn them off.

Turn off recalculated lines:

1. Select an analytics object in the view, such as a trend line, and click Edit.
2. In the Edit dialog box, clear Show recalculated line for highlighted or selected data points.
Alternatively, you can right-click (control-click on Mac) an analytics object in the view and clear **Show Recalculated Line**.

When you return to the view and select or highlight marks, recalculated lines will not appear. For more information about how to highlight marks, see **Selecting Marks to Highlight** on page 1024.

**Recalculated lines and highlight actions**

Recalculated lines also work with highlighting actions, both in worksheets and dashboards.

For example, if you create a highlight action in a dashboard, selecting marks in one sheet will highlight marks in the other sheets in the dashboard. If those other sheets have trend lines, reference lines, or other analytics objects, recalculated lines will appear as the views update.
View Toolbar

The view toolbar appears in the upper-left corner of the view and lets you select marks, zoom in and out, and pan in the view. By default, the view toolbar appears when you hover over a map view, but you can also show the view toolbar in other types of views, such as scatter plots or box plots.

For more information about showing and hiding the view toolbar in map views, see Customize How People Interact with your Map on page 722.
Show the view toolbar

- In a worksheet or dashboard, right-click (control-click on Mac) anywhere in the view, and then select **Show View Toolbar**.

Set when the view toolbar appears in the view

- Select **Worksheet > Show View Toolbar** (in a dashboard, select a view, then select **Worksheet > Show View Toolbar**), and then select one of the following options:
  - **Automatic** – The toolbar appears only when you hover over a map view.
  - **Show on hover** – The toolbar appears when you hover over the selected view. You can select this option for any type of view.
  - **Hide** – The toolbar does not appear in the selected view.

Hide the view toolbar

- In a worksheet or dashboard, right-click (control-click on Mac) anywhere in the view, and then select **Hide View Toolbar**.

**Note:** If the view toolbar is hidden, you can still use keyboard shortcuts to select marks, zoom, and pan. For more information, see **Keyboard Shortcuts** on page 1417.

**Select Marks**

You can select marks in the view to inspect your data. When you select a mark or a subset of marks in the view, you can see information about the marks in the tooltip that appears. You can also quickly filter the marks you select from the view, as well as view their underlying data. For more information, see **Tooltips** on page 244.

**Select marks**

Click an individual mark to select it. After you select a mark, hold down the Ctrl key (Command key on Mac) to add more marks to a selection.

To select multiple marks using the default selection tool, click and drag across the view. In most views, the Rectangular selection tool is the default tool.

You can also use the Radial, Rectangular, and Lasso tools on the view toolbar to select multiple marks. For more information about the view toolbar, see **View Toolbar** on the previous page.
Radial selection tool

The Radial tool selects marks within a circular area. To use the Radial tool, hover over the arrow on the view toolbar, click the Radial tool button, and then click and drag across the view.

You can also measure distance in a map view with the Radial tool. For more information, see Measure Distances Between Data Points and Locations in a Map on page 737.

Rectangular selection tool

The Rectangular tool selects marks within a rectangular shape. To use the Rectangular tool, hover over the arrow on the view toolbar, click the Rectangular tool button, and then click and drag across the view.
**Note:** The Rectangular tool is the default tool in most views, and may not appear in the view toolbar. In this case, you can drag across the view to use the rectangular tool.

**Lasso selection tool**

With the Lasso tool, you can select multiple marks by drawing a freehand shape around them. This tool is useful when you want to include only certain marks, and exclude others around them.

To use the Lasso tool, hover over the arrow on the view toolbar, click the Lasso tool button, and then draw a freehand shape around the marks you want to select.
**Pan and Zoom**

The pan tool and zoom controls help you interact with the view and inspect your data. They are located in the upper-left corner of the view, on the view toolbar. For more information, see [View Toolbar](#) on page 521.

You can use the zoom controls to zoom in and out, zoom to a specific area, and fix or reset the axes in the view. Use the pan tool to move quickly around the view.

**Zoom in and out**

On the view toolbar, click the Zoom In button ++ to zoom in and the Zoom Out button -- to zoom out. If the view toolbar is hidden, double-click the view to zoom in; to zoom out, hold down Shift, and then double-click the view.

**Zoom to a specific area**

To zoom in to a specific area of the view, click the Zoom Area tool button on the view toolbar, and then drag to create the zoom area. If the view toolbar is hidden, hold down Ctrl + Shift (Command-Shift on Mac) to use the Zoom Area tool.
**Reset the view**

After you zoom in or out, the axes in the view are fixed to a specific range. To quickly reset the axes so they automatically zoom the view to all of your data, click the Reset Axes button on the view toolbar.

**Pan**

To pan, do one of the following:

- Hold down Shift, and then drag across the view.

- On the view toolbar, hover over the arrow, select the Pan tool, and then click and drag across the view.

**Undo and Redo**

You can perform unlimited undo and redo of your actions. You can undo almost all actions in Tableau by pressing the *Undo* button on the toolbar. Likewise, you can redo almost all actions by pressing the *Redo* button on the toolbar.

In this regard, every workbook behaves like a web browser. You can quickly return to a previous view. Or you can browse all the views of a data source that you have created. Tableau saves the undo/redo history across all worksheets until you exit. The history is not saved between sessions.

**Drop Lines**

Use drop lines to distinguish marks and call out their position in the view. For example, in a view that is dense with scatter marks, you can turn on drop lines to show the position of a particular data point. When you add drop lines, a line is extended from the marks to one of the axes. You can show drop lines all the time or only when a mark is selected.
Note: Drop lines do not display when you publish a view to Tableau Server or Tableau Online.

To add drop lines to the view, right-click (control-click on Mac) the pane and select **Drop Lines > Show Drop Lines**.

By default, drop lines are set to only show when the mark is selected. You can change this setting and specify other options in the Drop Lines dialog box.

Right-click (Control-click on Mac) the pane and select **Drop Lines > Edit Drop Lines** to open the Drop Lines dialog box.

In the Drop Lines dialog box select an axis to draw the line to, whether to always show the drop lines, and whether to show labels.
Summary Card

The **Summary Card**, available on the **Show/Hide Cards** toolbar menu, provides a quick view of information about a selection or the entire data source.

When you select data in the view, the **Summary Card** updates to show you information only for the data within the selection:

By default, the **Summary Card** shows Sum, Average, Minimum, Maximum, and Median values for the data in the view. The summary card values update to show these values for the current selection of data points. (Average is computed by summing all relevant values and then dividing by the total number of values. Median is computed by sorting values from lowest to
highest and then selecting the middle value.) The Count value at the top of the card indicates the number of marks in the view or selection.

You can use the drop-down menu for the **Summary Card** to show additional statistics:

- **Standard Deviation**
  A measure of data spread around its average, measured in the same units as the data itself. The sample standard deviation is an unbiased estimate of the population standard deviation given a slight correction. This standard deviation includes the correction.

- **First Quartile**
  A measure of location that is commonly used with other quartiles to provide a robust measure of spread. Robust in this case means not as sensitive to outliers as the standard deviation. The first quartile is the 25th percentile, typically the lower line in a boxplot.

- **Third Quartile**
  A measure of location that is commonly used with other quartiles to provide a robust measure of spread. Robust in this case means not as sensitive to outliers as the standard deviation. The third quartile is the 75th percentile, typically the upper line in a boxplot.

- **Skewness**
  A measure of the tendency of your data to have extreme values to one side. Positive skewness means the extreme values are to the right, while negative skewness means the extreme values are to the left.

- **Excess Kurtosis**
  A measure of the tendency of your data to have more extreme or outlying values than a normal distribution. A normal distribution has a kurtosis of 3 so this value is kurtosis minus three.

**View Data**

The View Data command lets you display the values for all rows in the data source that underlie a set of marks in the view. It also shows you the summary data based on the aggregations in the view. You can view data to verify the aggregated value associated with a mark, or to isolate and export the individual rows associated with data of interest, such as outliers.

You can view data for a selection of marks, for the fields in the Data pane, and when you’re connecting to data.

The View Data command works with all relational and multi-dimensional databases except Oracle Essbase and SAP® Business Information Warehouse databases. While you can view data with the Microsoft Analysis Services and the Teradata OLAP connector multi-dimensional databases, the database must be drill-through enabled; in addition there are some restrictions.
to the data you can see. Multi-dimensional data sources are supported only in Tableau Desktop on Windows.

In the view below, sales for two product dimensions (Department and Container) are displayed as a bar chart. Suppose you wanted to view data for the largest marks in each pane. To do this, you would select those marks, right-click (control-click on Mac) in the table, and select View Data on the context menu. Alternatively, you could select the Analysis > View Data menu item.

Viewing data may not return any records if you are using a field that contains floating point values as a dimension. This is due to the precision of the data source and mainly occurs when you are connected to Microsoft Excel, Microsoft Access, or text files.

**Summary Data**

Summarized data is shown on the Summary tab. Summarized data is a text table of the aggregated data for the fields shown in the view.
Underlying Data

Underlying data for the selected marks are displayed on the Underlying tab. In the lower right of the dialog box you can see the number of rows in the underlying data.
Sort the data by clicking one or more column headers. To restore the original sort order, click the header repeatedly until it is no longer highlighted with a sort arrow.

By default, **Show all fields** is selected. Clear this option to only show the columns used on shelves (or fields referenced by a calculation used on a shelf) in the current worksheet.

If you want to export one or more data source rows, select the data points of interest by selecting the row and then clicking **Copy** to copy the selected data.

**View Data (Microsoft Analysis Services)**

View Data with a Microsoft Analysis Services database works almost the same way it does with relational data sources. The difference is that a Microsoft Analysis Services cube is generally set up and configured by an administrator who decides whether it is enabled for drill-through and the fields that a user is allowed to see. That means that when you try to view data using a database that is not enabled, you may get an error message alerting you that the cube is not enabled for drill-through.

In addition, Microsoft Analysis Services databases limit viewing data to a single mark at a time. More precisely, viewing the data (which uses MDX drill-through) is not an option when the selection of mark(s) is defined by more than one value of a dimension.

When you are viewing underlying data for a field, the **Show all fields** option is checked and disabled by default. With a Microsoft Analysis Services database, only the fields specified by the administrator are shown, so you cannot choose to include all data source fields in the dialog box.

**Describing the View**

Occasionally you may want to succinctly summarize an analysis you have completed on a worksheet. You might then want to remind yourself of what it shows (the filters that are applied, etc.), and finally, you may want to share a summary of the analysis with someone else.

When you choose **Worksheet > Describe Sheet**, you can view a description of the workbook, data source, fields and layout of the current worksheet. This summary includes the Caption in the first line, but provides other important summary information. This information can be copied and exported to other applications using the Clipboard.
Note: If you have Trend Lines turned on, the Describe Sheet dialog box includes information about the trend line model. For more information, see Assessing Trend Line Significance on page 621. If you have Forecasting turned on, the Describe Sheet dialog box includes information about estimated data. For more information, see Forecast Descriptions on page 607.

Multidimensional Hierarchies

Multidimensional data sources contain hierarchies. For example, your database might contain a Product dimension that includes members such as product family, product department, and so on organized into a hierarchy, or you might have a Time dimension that includes years, quarters, and months.
Note: In Tableau, multidimensional data sources are supported only in Windows.

Drilling Down and Up in a Hierarchy

One of the most useful ways to navigate hierarchies is to drill down or drill up. For example, if you are examining the sales totals for various years, you can then drill down and view sales for all of the months within each year. Alternatively, if you are examining sales totals for all months, you can then drill up and view the sales for each year.

You can drill down and drill up in Tableau by clicking on fields placed on shelves, or by selecting a hierarchy header in the table. These two methods are described below.

Using Fields on Shelves

You can drill down or drill up by clicking on a dimension that is placed on any shelf. If the dimension is on the Rows or Columns shelf, drilling down shows more data (more headers) in the table, while drilling up shows less data in the table.

You can click on the plus/minus control that appears on any hierarchical dimension on any shelf. If a dimension member shows the plus sign ☰, then its children are not already showing and you can drill down at least one level. If a dimension member shows the minus sign ☯, then its children are already showing and you can drill up.
The following figure demonstrates drilling down one level in the hierarchy for the Region dimension to expose the states within each region.

![Diagram showing drilling down in a hierarchy]

Using Headers

To drill down and drill up for individual dimension members in a hierarchy, right-click (control-click on Mac) a table header and select **Drill Down** or **Drill Up** from the context menu. This is often referred to as non-uniform drill down because you expose only the members of interest instead of exposing all the members of a given level.

For example, the following figure illustrates drilling down into the Root Beer member of the Gen2,Product dimension. Note that new row headers are displayed in the table and that Gen3,Product, which is the next generation in the hierarchy, is automatically displayed.

![Diagram showing drilling down into Root Beer]

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One reason to use non-uniform drill down is if your data source has a ragged hierarchy (asymmetric layout). You also might want to view the children for just the member of interest.

Drilling down and drilling up results in filtering the data.

**Building Views with Oracle Essbase**

When Tableau is connected to an Oracle Essbase data source, there are three important features that you should know about:

**Generations and Levels**

In Tableau, you can work with either the generations or the levels of a dimension. The generations of a dimension are all members that are an equal distance from the root of the dimension. The levels are all members that are an equal distance from the leaves of the dimension. For balanced dimensions, you'll typically want to work with generations. However, if your dimension is ragged, then it may make more sense to navigate using levels.

By default, the generations of each dimension are listed in the Data pane. When you drag a dimension to a shelf, all generations that are ancestors of the selected generation (all generations that are above it in the hierarchy) are automatically included in the placement.

If you would rather navigate using the levels of a dimension, right-click the name of the dimension and then select **Hierarchy > Levels**.

If you are using the same dimension in multiple worksheets, you can use levels in one worksheet and generations in another worksheet simultaneously. Furthermore, you can mix generations and levels from different dimensions in the same worksheet.

**Shared Members**

Shared members are dimension members that appear in more than one place in a hierarchy. For example, Diet Coke might be part of the product generation. But it might be shared by both the diet colas branch and the colas branch of the product hierarchy above it. In the database, however, the data about Diet Coke is stored just once.

By default, Tableau includes shared members in all generations (or levels) of a dimension. This means that a shared member might appear multiple times in a table. If you choose to exclude shared members, they will appear only once in a table. By default, shared members are included for all dimensions. To exclude shared members for a given dimension hierarchy, right-click the dimension name in the Data pane and select **Include Shared Members** from the menu.
The figure below shows part of a data view where shared members are included (left) and excluded (right). Notice that diet drinks are shared members.

**Includes Shared Members**

The diet drinks are listed in both the Diet Drinks hierarchy and their respective drink hierarchies.

**Does Not Include Shared Members**

The diet drinks are only listed once, in their respective drink hierarchies.
Setting the Default Member

All multidimensional data sources have default members that are set when the data source is first built. If you find that you are creating filters all the time to look at the same specific data, you may find it useful to change the default member. For example, if you are the regional manager for the Western region in a company and you only want to look at your region’s numbers, you can set the default member to the Western region.

To change the default member in Tableau, right-click a dimension hierarchy and select Set Default Member.

In the subsequent dialog box, select from the following options:

- Default member defined on cube – uses the default member that was defined when the cube was built. This is the default setting in Tableau.
- (All) member for the hierarchy – uses the ALL member for the selected hierarchy as the default member.
- Selected member – uses the member that you select in the bottom half of the dialog box as the default member.

The default member determines how you view the cube and so is much more powerful than applying filters. All fields will be calculated based on the default member you select. In addition, these default member settings are saved with the connection.
Building Views with Microsoft Analysis Services

When you build views in Tableau using a Microsoft Analysis Services Cube it is possible to have measures and dimensions that don’t make a lot of sense when placed in the view together. For example, you may have a measure for Sales Quota. It won’t make sense to place that measure against a dimension containing products if products don’t have sales quotas. Tableau helps you figure out the dimensions and measure that can be used together in meaningful ways by highlighting unrelated dimensions and measures in gray. So in the last example, when we place Sales Quota onto a shelf, the products dimensions are highlighted in gray. Highlighted dimensions are not disabled and can still be added to the view. When you add an incompatible measure to the view, the measure is marked with a caution symbol.

Perfect Pivoting

In Tableau, perfect pivoting refers to working with hierarchies in these ways:

- Using varying levels of detail including skipping levels (for example, Country and City, but not State).
- Using varying levels of detail on different worksheet shelves simultaneously (for example, Product Family on the Columns shelf and Product Department on Color).
- Using varying levels of detail out of order (for example, Quarter before Year).

For example, in the following view the Market hierarchy is broken up to show the State level as Rows and the Region level as Color.
Defining Unique Values

Sometimes, when you are building views in Tableau, a field will have multiple members with the same name. For example, you may have a view showing the average profit by month over several years. The month February appears multiple times (once for each year).
While the name, February, is repeated, each instance of February can either be considered similar or unique. If you consider them similar, they will appear in the same column if you decided to move the Year field to the Color. However, if you consider them unique, they will be treated as two different values.
It is generally okay to consider repeated names within date and time fields (like in the previous example) similar but if there are repeated names in the Customer Name field, you won’t want to consider the two customers as the same person.

To define how you want Tableau to determine whether repeated values are unique, right-click (control-click on Mac) on the dimension in the Data pane and select one of the following on the Unique Values context menu:

- By Key: each member is considered unique based on the key given to it by the system administrator when the database is set up. Members with the same name but different keys are treated as unique values.
- By Name: each member is considered unique based on the member name. Members with the same name (regardless of their keys) are treated as if they are the same.

By default, unique date and time values are determined by name and all other values are determined by key.

**Utility Dimensions**

Oracle Essbase databases sometimes have special dimensions used to model comparative values such as Actual vs. Budgeted or Current Year vs. Previous Years. These dimensions are the utility dimensions and are often set up as Scenario or Years. For example, the members of a Scenario dimension are shown below.
In the above view, you can see Actual Sales, Budgeted Sales, and so on. However, what if you wanted to compare Actual Sales to Budgeted Sales in a bullet graph? In that case, you need to set the Scenario dimension to be used as the utility dimension. When you set a dimension as the utility dimension, you can then specify which member of the utility dimension to use for each measure in the view. For example, below is a bullet graph showing actual sales to budgeted sales by region.

You can see that the Sales measure is used twice in the view: once to show actual and once to show budgeted.

To use a dimension as the utility dimension:
1. Right-click the dimension in the Data pane and select **Set as utility dimension**.

The dimension in the Data pane (in this example, Scenario) can no longer be used as a dimension field in the view. The Measures area of the Data pane indicates that there is a utility dimension (in this example, (by Scenario) indicates the utility dimension).
2. Drag a measure to the view.

3. Open the field menu for the measure in the view and select the member of the utility dimension you want to anchor the measure to.
To remove a utility dimension:
Open the drop-down menu at the top of the Data pane and select **Clear utility dimension**.

When you remove the utility dimension, measures that reference it in the view are no longer valid.

**Pause Updating to Work with Large Views**
If you are building a view that involves a large amount of data, you might find it easier to turn off automatic updates, build the view, and then resume updates. Turning off automatic updates queues the queries instead of sending a separate query to the database every time you drag a field.
If you are using filters in your views, you might also want to pause automatic updates for filters. This enables you to pause the query for filter changes until you are finished organizing your data. Otherwise every time you make a change to a filter, Tableau queries the data source, potentially slowing down performance.

For more information, see Turn off Automatic Updates to Boost Performance on page 1627.

Follow the steps below to pause automatic updates while building the view.

1. Click the Pause Auto Updates button on the toolbar to turn off automatic updates for worksheets.
2. Place all of the selected fields on the shelves.
3. Specify filters to restrict the data to view only the values that you are interested in.
   
   If you also want to pause automatic updates for filters, click the drop-down arrow on the Pause Auto Updates button on the toolbar and select Auto Update Filters to clear the check mark.

4. Click the Resume Auto Updates button on the toolbar to turn automatic updates back on for worksheets.
   
   To resume automatic updates for filters, click the drop-down arrow on the Pause Auto Updates button on the toolbar and select Auto Update Filters again.

Add to Sheet: Double-Click

Tableau supports an additional method for automatically generating views of data called Automatic Double-Click. To use this method, double-click fields in the Data pane you are interested in. Tableau automatically adds each field to the view. That is, each double-click results in an additional field added to a shelf in an intelligent way. Like Show Me!, this function leverages Tableau’s ability to make an intelligent “best guess” of how the data should be displayed. Double-clicking sometimes creates a view that you can use without further modification. More often, it can provide a starting point, which you can then modify to get the ideal result.

1. Double-clicking the Profit measure in the Data pane automatically adds that field to the view in an intelligent way.
2. Double-clicking the **Category** dimension in the **Data** pane automatically adds that field to the view based on the fact that Profit is already on the Rows shelf.
3. Double-clicking the **Order Date** dimension in the Data pane automatically adds that field to the **Columns** shelf based on the placement of other fields in the view. As you double-click fields they are successively added to the view. The order in which you click fields determines the type of view created.
The following table describes some of the rules used in creating automatic views by double-clicking fields in the **Data** pane.

<table>
<thead>
<tr>
<th>Text Table</th>
<th>Adding a dimension first produces a text table (or cross-tab). All subsequent clicks on fields result in refinement of the text table.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bars</td>
<td>Adding a measure first and then a dimension produces a bar view. All subsequent clicks result in refinement of the bar view, unless a date dimension is added, at which time the view is changed to a line.</td>
</tr>
<tr>
<td>Line</td>
<td>Adding a measure and then a date dimension produces a line view. All subsequent clicks result in refinement of the line view.</td>
</tr>
<tr>
<td>Continuous Line</td>
<td>Adding a continuous dimension and then a measure produces a continuous line view. Subsequent dimensions result in refinement of the continuous line view. Subsequent measures add quantitative axes to the view.</td>
</tr>
<tr>
<td>Scatter</td>
<td>Adding a measure and then another measure produces a scatter view. Subsequent dimensions result in refinement to the scatter view. Subsequent measures will create a scatter matrix.</td>
</tr>
<tr>
<td>Maps</td>
<td>Adding a geographic field produces a map view with latitude and longitude as axes and the geographic field on the Level of Detail shelf. Subsequent dimen-</td>
</tr>
</tbody>
</table>
Show Me

Show Me creates a view based on the fields already used in the view and any fields you’ve selected in the Data pane. Open Show Me by clicking Show Me on the toolbar.

When you use Show Me simply select fields you want to analyze in the Data pane and then select the type of view you want to create. Tableau automatically evaluates the selected fields and gives you the option of several types of views that would be appropriate for those fields. Further, Show Me highlights the visualization type that best matches the data.

1. Select fields in the Data pane that you want to analyze. Hold the Ctrl key (Command key on a Mac) to make multiple selections.
2. Click **Show Me** on the toolbar and then select the type of view you want to create.
Any view type that is not gray will generate a view of your data. As you hover over each view type, the description at the bottom shows the minimum requirements. In this example, Stacked Bars is selected.

3. View the Result. Tableau automatically creates a view of the data.
Create Bins from a Continuous Measure

Sometimes it's useful to convert a continuous measure (or a numeric dimension) into bins.

For example, suppose you create a view with Profit on Rows and State on Columns. You could consider the State field as a set of bins—each profit value is sorted into a bin corresponding to the state from which the value was recorded. But if you want to bin Profit values without reference to a dimension, you can create a numeric bin, with each bin corresponding to a range of values so that each profit value is sorted into a bin.

**Note:** You can bin data only for relational data sources. This feature is not supported for cube (multidimensional) data sources.

When you bin a measure you create a new dimension. That's because you are creating a field with a limited and discrete set of possible values out of a field with an unlimited, continuous range of values. However, once the dimension is created you can convert it to a continuous dimension. This can be useful if you want to create a histogram. See Create a Histogram from a Binned Dimension on page 557.

Create a Binned Dimension:
1. In the **Data** pane, right-click (control-click on Mac) a measure and select **Create > Bins**.

2. In the Create Bins dialog box, accept the proposed New field name or specify a different name for the new field.

3. Either enter a value in the **Size of bins** field or have Tableau calculate a value for you.
If Tableau can perform the optimizing calculation quickly enough (in less than 1.5 seconds), the value you see initially in **Size of bins** is Tableau’s estimate of the optimal bin size.

If Tableau cannot perform the optimizing calculation quickly, the **Size of bins** field defaults to 10. In this case you can click **Suggest Bin Size** to have Tableau perform the optimizing calculation.

The formula that Tableau uses to calculate an optimal bin size is

\[
\text{Number of Bins} = 3 + \log_2(n) \times \log(n)
\]

In the formula, \( n \) is the number of distinct rows in the table. The size of each bin is determined by dividing the difference between the smallest and the largest values by the number of bins.

The four read-only fields in the lower part of the Create Bins dialog box show you the data that Tableau uses to suggest a bin size. You can also consider these values if you want to set a bin size manually. The values are:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>The field's minimum value.</td>
</tr>
<tr>
<td>Max</td>
<td>The field's maximum value.</td>
</tr>
<tr>
<td>Diff</td>
<td>The difference between the field's minimum and maximum values.</td>
</tr>
<tr>
<td>CntD</td>
<td>The number of distinct values (rows) in the data.</td>
</tr>
</tbody>
</table>

After you click **OK** to dismiss the Create Bins dialog box, a new binned field appears in the **Dimensions** area of the **Data** pane.
When you add a binned dimension to the view, each bin acts as an equal-sized container that summarizes data for a specific range of values. Column or row headers are created, where each bin label designates the lower limit of the range of numbers that is assigned to the bin. Note that the lower limit is inclusive.

**Create a Histogram from a Binned Dimension**

If you create a binned dimension, you can use it as the starting point for creating a histogram. Using the Sales (bin) dimension created according to the instructions above, use the following steps to create a histogram.

**Note:** A quicker way to create a histogram is using Show Me. See Build a Histogram on page 85 in the Build-It-Yourself Exercises section for information on creating a histogram using Show Me.

1. Click the Sales (bin) dimension in the Data pane and choose Convert to continuous.
2. Drag the Sales (bin) dimension from the Data pane and drop it on the Columns shelf.
3. Drag the original Sales field from the Measures area of the Data pane and drop it on the Rows shelf.
4. Click SUM(Sales) on Rows and change the aggregation from Sum to Count.
The result is a histogram:
**Missing Values**

When you’re working with dates or numeric bins, Tableau only shows the values that are represented in your data. If your data does not contain the complete range of values, the missing values will not be shown. For example, your data may contain data for January through May and September through December. However, there was no data recorded for June, July, and August. If you create a line chart in Tableau, the missing months will not be shown. You can optionally show the missing months to make it clear that there was no data recorded during that time.

**Note**: You can replace missing values with a calculated field using the ZN() function. See [Logical Functions](#) on page 1380 for details.

**Missing Values Hidden (Default)**

By default, missing values in a date range or numeric bins are not shown.

**Missing Values Shown**

You can show the missing values to indicate incomplete data.
To show missing values in a range, right-click (control-click on Mac) the date or bin headers and select **Show Missing Values**.
Show and Hide Empty Rows and Columns

When you are working with fields that are not dates or numeric bins, Tableau hides missing values by default. For example, you may be showing workers and the number of hours worked in a particular month. If a worker didn’t work at all that month, there may not be a row in the database for that worker. When you drag the Worker field to the Rows shelf, the workers that didn’t work are hidden by default. You can show the empty rows by selecting Analysis > Table Layout > Show Empty Rows. Similarly, show the empty columns by selecting Analysis > Table Layout > Show Empty Columns.

Empty Rows Hidden (default)

Bob did not work in January so there are no records in the database for him. By default he is not listed.

Empty Rows Shown

Even though Bob did not work in January, he is listed but no marks are drawn.
Using Multiple Measures

There are lots of different ways to compare multiple measures in a single view. For example, you can create individual axes for each measure or you can blend the two measures to share an axis and finally, you can add dual axes where there are two independent axes layered in the same pane. In any of these cases you can customize the marks for each axis to use multiple mark types and add different levels of detail. Views that have customized marks are called combination charts.

Individual Axes

Add individual axes for each measure by dragging measures to the **Rows** and **Columns** shelves. Each measure on the Rows shelf adds an additional axis to the rows of the table. Each measure on the Columns shelf adds an additional axis to the columns of the table. For example, the view below shows quarterly sales and profit. The Sales and Profit axes are individual rows in the table and have independent scales.
**Blended Axes**

Measures can share a single axis so that all the marks are shown in a single pane. Instead of adding rows and columns to the view, when you blend measures there is a single row or column and all of the values for each measure is shown along one continuous axis. For example, the view below shows quarterly sales and profit on a shared axis.

To create this view and blend multiple measures, simply drag one measure or axis and drop it onto an existing axis.

*Note:* If you drag a measure on to the canvas and only see a single ruler indicator instead of the double ruler indicator shown below, Tableau creates dual axes instead of a blended axis. For more information about how to create dual axes, see Dual Axes on the next page.
Blending measures uses the **Measure Names** and **Measure Values** fields, which are generated fields that contain all of the measure names in your data source and all of the measure values. The shared axis is created using the **Measure Values** field. The **Measure Names** field is added to **Color** on the Marks card so that a line is drawn for each measure. Finally, the **Measure Names** field is filtered to only include the measures you want to blend.

**Note:** Blending axes is most appropriate when comparing measures that have a similar scale and units. If the scales of the two measures are drastically different, the trends may be distorted.

**Dual Axes**

You can compare multiple measures using dual axes, which are two independent axes that are layered on top of each other.

Dual axes are useful when you have two measures that have different scales. To add a measure as a dual axis, drag the field to the right side of the view and drop it when you see a black dashed line appear. You can also right-click (control-click on Mac) the measure on the Columns or Rows shelf and select **Dual Axis**.
The result is a dual axis view where the Profit axis corresponds to the red line and the Sales axis corresponds to the yellow line.

You can add up to four layered axes: two on the Columns shelf and two on the Rows shelf.
**Synchronize axes**

To align the two axes in a dual axis to have the same scale, right-click (control-click on Mac) the secondary axis, and select **Synchronize Axis**. This aligns the scale of the secondary axis to the scale of the primary axis.

In this example, the Sales axis is the secondary axis and the Profit axis is the primary axis.

**Note:** To synchronize axes, the data types for both measures must be the same. If the data types for your measures are different, see the section below.

If you would like to change which axis is the primary, and which axis is the secondary, select the field on the Columns or Rows shelf that is the secondary, and drag it in front of the primary field on the shelf until you see an orange triangle appear.

In this example, you can select the **SUM(Sales)** field on the Rows shelf, and drag it in front of the **SUM(Profit)** field. The Sales axis is now the primary and the Profit axis is the secondary.

**Synchronizing axes with measures that are different data types**

The **Synchronize Axis** option ensures that you make a scaled and correct comparison. However, sometimes this option may not be available (grayed out). This is because the data type of one of the axes is different from the other.

To resolve this issue, you must change the data type of one of the axes. Follow the example below to change the data type for an axis.

1. Click the new Worksheet icon to open a new worksheet.
2. Drag **Order Date** to Columns, then click the drop-down arrow on the field on the shelf and select **Month** from the context menu.
3. Drag **Sales** to Rows, then drag **Quantity** to the right side of the view and drop it when you see a black dashed line appear to create a dual axis.
   - If you right-click on the **Quantity** Axis, you can see that the **Synchronize Axis** option is grayed out.
4. In the Data pane, click on the drop-down arrow on the **Quantity** field, and select **Change**
**Data Type > Number (decimal)** in the context menu. This changes the data type for this field.

5. Replace the **Quantity** measure on the view.

6. Right-click the secondary axis, and then select **Synchronize Axis**.

**Combination Charts**

When working with multiple measures in a view, you can customize the mark type for each distinct measure. For example, you can create a view with a line showing a target amount across several months and a bar chart showing the actual attainment for the months. These measures can be displayed as individual axes, blended axes, or dual axes.

Because each measure can have customized marks, you can customize the level of detail, size, shape, and color encoding for each measure too.
Customize the marks for a measure:

1. Select the Marks card for the measure that you want to customize. There is a Marks card for each measure on the Rows and Columns shelves.

2. Select a new mark type for the measure. Any changes to the mark type, shape, size, color, detail and other mark properties will be applied to the selected measure. For example, in the view below the Sales Marks card is active. The Mark Type has been changed to Bar and when Product Type is placed on Color on the Sales Marks card,
the encoding and level of detail is only applied to the Sales marks. The Budget Sales mark is not broken down by Product Type.

Select the All Marks card to modify properties for all measures at once.
Work with Time

Many visualizations you create with Tableau will involve working with date and time fields. With Tableau, you can identify trends in your data over time, or forecast where your data will go in the future.
Dates and Times

How you work with dates in Tableau depends on whether you are using a relational or cube (multidimensional) data source. This section discusses the differences.

Dates in Cube (Multidimensional) Data Sources

In Tableau, cube (multidimensional) data sources are supported only in Windows.

For cube data sources, dates dimensions are usually organized into hierarchies that contain levels such as year, quarter, and month. In addition, some multidimensional data sources have time intelligence enabled, which makes it possible to look at data levels different ways, such as Months by Year, Months by Quarter, Weekends, etc. These levels are represented as attributes of the hierarchy. Hierarchies and attributes are defined when the cube is created and you cannot modify them in Tableau. For example, the Year dimension from an Oracle Essbase data source is shown below.

When you place a multidimensional date on a shelf, the field is treated like any other dimension. For example, you can drill down, drill up, and so on.

Dates in Relational Data Sources

For relational data sources, dates and times are automatically placed in the Dimensions area of the Data pane and are identified by the date or date-time icon. For example, the Order Date and Ship Date dimensions from an Excel data source are shown below.
When you place a relational date on a shelf, the field name is automatically modified to reflect the default date level. Tableau defines the default date level to be the level at which there are multiple instances. For example, if the date field includes multiple years, the default level is year. However, if the date field contains data for just one year but includes multiple months, then the default level is month.

If you don’t want Tableau to automatically select a date level and would rather have a date dimension be a continuous field, you can right-click (control-click on Mac) the field in the Data pane and select **Convert to Continuous**. The dimension then turns green in the Data pane; now when you use that dimension in a view, it will be continuous. You can easily revert back by selecting **Convert to Discrete** from the field’s context menu in the Data pane. You can also convert a field in the view to continuous while it is on a shelf by selecting **Continuous** on its context menu (which you can see when you right-click (control-click on Mac) the field). The field on the shelf turns green but the field in the Data pane is still discrete.

**Date Properties for a Data Source**

You can set date properties for a data source. To do so, right-click (control-click on Mac) a data source in the Data pane and choose Date Properties:
The options in the Date Properties dialog box are:

- **Week start** - Specifies which day is considered the first day of the week. You can override the Week start value you set at the data source level by including a `start_of_week` value with certain date functions (DATEDIFF, DATENAME, DATEPART, and DATETRUNC). See [Date Functions](#) on page 1374.

The initial value for this setting is in some cases determined by your data source. If the data source does not initialize the start-of-week day, then Tableau consults the system's locale settings. The day which is considered the first day of the week varies from region to region. For example, Sunday is the first day of the week in the US, while Monday is the first day in the EU.

This setting is disabled for multidimensional data sources because this information is defined when cube designer creates the date/time dimension.

After a data source is created, the Week start value does not automatically change if for any reason the default start-of-week setting changes in the host operating system (for example, if the data source is uploaded to Tableau Server in a different country). Calendar controls reflect the workbook locale rather than the data source's Week start setting. The exception is that a week trunc start of week that shows the week number in it will use the data source’s Week start setting in order to provide a consistent week number value in the calendar.

- **Fiscal year start** - Specifies which month is considered the first month of the fiscal year. To specify whether a date dimension uses the standard calendar (Jan. 1 - Dec. 31) or the fiscal calendar, right-click (control-click on Mac) the field in the Data pane and select Default Properties > Calendar Type and then select Standard Calendar or Fiscal Calendar. For any date field in the view, you can then specify whether to use the standard calendar or the fiscal calendar. For details, see [Fiscal Dates](#) on page 581.

- **Date format** - Specifies the default format for data dimensions, as displayed, for example, in tooltips. To override the default date format for a date dimension, right-click
(control-click on Mac) the field in the Data pane and select **Default Properties > Date Format** and then select one of the available formats.

**Day of the week sorting**

If you are working in a language for which Tableau does not provide a local version, set your workbook locale to ensure that Tableau can sort the days of the week in the correct chronological order. Otherwise, Tableau will sort the names of the days alphabetically. For information on setting the locale, see **Language and Locale** on page 248.

If none of the supported locales is appropriate, you can sort the days of the week manually. See **Manual Sorting** on page 456.

**Supported date formats**

When working with dates, Tableau retrieves date formats automatically from the data source.

For a list of supported date formats, see the table of supported date format symbols in **Custom Date Formats** on page 584.

**Changing Date Levels**

For both relational and multidimensional data sources, you can change the date level using the field’s context menu after dragging it to a shelf. For cube (multidimensional) dates, the levels available in the context menu are given by the levels defined in the date hierarchy. For relational dates, you can select between the discrete date levels at the top of the menu or the continuous date at the bottom. A preview of each date level is shown. Below is the field menu for a relational date with the discrete Year level selected.

In Tableau, cube (multidimensional) data sources are supported only in Windows.
When you select a particular level, Tableau asks the data source to perform a computation on the date field. For example, suppose a particular row in your data source has a date entry of 01/23/16. The year is 2016, the quarter is 1 because January falls in the first quarter, and the week number is 4 because January 23rd falls in the fourth week. How the date level is computed depends on the configured Date Properties for the data source. See Date Properties for a Data Source on page 572.
**Note:** Some date levels might not make sense for your relational data source. For example, if the date format does not include time information such as hour, minute, or second, then selecting one of these options will not add any data to your view.

You can work with dates at varying levels of detail simultaneously. You do this by clicking the control on a date field in the view. This is known as drilling into a date. For example, if you drill into a discrete (blue) date field \texttt{YEAR(Order Date)}, Tableau adds a second field to the right of the initial date, \texttt{QUARTER(Order Date)}, as in the image below. You can continue drilling down until you reach the finest available granularity for the date field.

You can also drag date fields to the **Rows** or **Columns** shelf multiple times in order to nest them and to drill down into them at varying levels of detail.

For example, the view shown below drills down from the year level to display the quarter level as well.

![View with date fields at different levels](image)

By removing one of the date fields from the **Columns** shelf, and then selecting **Month** from the remaining date field's context menu, you can display the data for each month across all years.
To display even finer granularity, select Month from the lower, continuous section of the field's context menu.
Tableau then displays the dates across the range of available years, at a month-by-month level of granularity.
**Custom Dates**

You might want to create a custom date if you always use a date at a specific level, or if you want to create calculations that rely on a binned or truncated date.

You can create a custom date by working in the **Data** pane or by using the **DATEPART** and **DATETRUNC** functions in a calculated field.

The custom date you create becomes a new field in the **Data** pane.

1. Right-click (Control-click on Mac) a date field in the **Data** pane and select **Create > Create Custom Date**.

2. In the Create Custom Date dialog box, type a name for the custom date, such as Date (Quarter, Year).

3. From the **Detail** list, select the level you want to show the date at.

4. Specify whether you want the custom date to be discrete (select **Date Parts**) or continuous (select **Date Value**).
5. When you are finished, click OK.

**Example - format column headers as Month, Day, Year**

To format column headers as Month, Day, Year (for example, January 1, 2011), follow the steps below. This example uses the Sample - Superstore data source provided with Tableau Desktop.

1. Drag [Order Date] to Columns.
2. Drag Sales to Rows.
3. Right-click (Control-click on a mac) [Order Date] on the Columns shelf and choose More > Custom.
4. In the Custom Date dialog box, choose Month / Day /Year from the Detail drop-down list.

The view now has the column headers in the correct format:
Fiscal Dates

In some situations, a date field needs to be expressed in terms of an organization's fiscal year. Calendar years run from January 1st until December 31st, but an organization’s fiscal year might start in a different month. For example, a company’s fiscal year might run from June 1st through May 31st. In such cases, it’s appropriate to display some date values in a view using fiscal equivalents (Fiscal Year, Fiscal Quarter, and Fiscal Week Number) rather than their calendar equivalents.

To set the fiscal year start month for a data source, follow these steps:

1. Right-click (Control-click on Mac) the data source in the Data pane to open the Date Properties dialog box.

2. Set the Fiscal year start field to the appropriate month.

This change sets the fiscal year for all date dimensions in the data source.

You can set the fiscal year start month for an individual date value to be different from the fiscal year start date for the data source. To do this, right-click (Control-click on Mac) the date dimension in the Data pane and select Default Properties > Fiscal Year Start.
Whether a given level of a date dimension is affected by the use of the Fiscal Calendar depends on the specific case.

<table>
<thead>
<tr>
<th>Date Level</th>
<th>When Converted to Fiscal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>Reflects the fiscal year. For example, if Fiscal year start is set to April, the year for the date June 1, 2004 would be shown as FY 2005.</td>
</tr>
<tr>
<td>Quarter</td>
<td>The Quarter reflects the fiscal quarter. For example, if Fiscal year start is set to April, the quarter for the date June 1, 2004 would be Q1.</td>
</tr>
<tr>
<td>Month</td>
<td>No change in behavior. The calendar month is the same as the fiscal month.</td>
</tr>
<tr>
<td>Day</td>
<td>No change in behavior. The calendar day is the same as the fiscal day.</td>
</tr>
<tr>
<td>Hour</td>
<td>No change in behavior. The calendar hour is the same as the fiscal hour.</td>
</tr>
<tr>
<td>Minute</td>
<td>No change in behavior. The calendar minute is the same as the fiscal minute.</td>
</tr>
<tr>
<td>Second</td>
<td>No change in behavior. The calendar second is the same as the fiscal second.</td>
</tr>
<tr>
<td>Week Number</td>
<td>The Week Number reflects the fiscal week number. For example, if Fiscal year start is set to April, the week number for the date April 1, 2004 would be 1.</td>
</tr>
<tr>
<td>Weekday</td>
<td>No change in behavior. The calendar weekday is the same as the fiscal weekday.</td>
</tr>
<tr>
<td>MM/YYYY</td>
<td>No change in behavior. This date format always displays calendar dates, even when a fiscal year has been assigned.</td>
</tr>
<tr>
<td>M/D/Y</td>
<td>This date format always displays Calendar dates, even when a fiscal year has been assigned.</td>
</tr>
</tbody>
</table>

The only date levels that explicitly indicate that the fiscal calendar is in use are the Year and Quarter level. Specifically, fiscal years and quarters are shown with the FY prefix. This is not true for fiscal quarters or week numbers, however, which are not shown with any special fiscal markings.

Fiscal year designations for any given date dimension are applied to all instances of the field in the Tableau workbook. Fiscal dates can only be applied to dimensions in a relational data source.
Fiscal year formatting is applied to all date formats that include a year, or a year and a quarter. In particular, if you apply a custom date format, and only use the “y” and “q” placeholders, then FY will be prepended to each year.

**Date Truncations**

When a date dimension is using a fiscal calendar, only the following date parts and truncations will reflect the fiscal calendar:

<table>
<thead>
<tr>
<th>Date part or truncation</th>
<th>When using a fiscal calendar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year date part</td>
<td>Reflects the fiscal year. For example, if Fiscal year start is set to April, the year for the date June 1, 2004 would be shown as FY 2005.</td>
</tr>
<tr>
<td>Quarter date part</td>
<td>Reflects the fiscal quarter. For example, if Fiscal year start is set to April, the quarter for the date June 1, 2004 would be Q1.</td>
</tr>
<tr>
<td>Week Number date part</td>
<td>Reflects the fiscal week number. For example, if Fiscal year start is set to April, the week number for the date April 1, 2004 would be 1.</td>
</tr>
<tr>
<td>Year date truncation</td>
<td>Truncates to the start of the fiscal year. For example, if Fiscal year start is set to May, the date June 1, 2004 would become May 1, 2004.</td>
</tr>
<tr>
<td>Quarter date truncation</td>
<td>Truncates to the start of the fiscal quarter. For example, if Fiscal year start is set to July, the date June 1, 2004 would become April 1, 2004.</td>
</tr>
</tbody>
</table>

**Perfect Pivoting with Dates**

You can perfect pivot dates by placing different date levels on different worksheet shelves simultaneously. Place the date field on a variety of shelves and then select the desired date level from the fields’ context menus.

For example, the following line chart displays years as column headers and then color-encodes the marks by quarter.
You can separate the marks by month and by quarter as shown below.

**Custom Date Formats**

There are different ways to format dates in Tableau.
To format a date field in the view, right-click (Control-click on a Mac) the field and choose **Format**.

To format a date field in the **Data** pane, right-click the field and choose **Default Properties > Date Format**.

To format date properties for a data source, right-click a data source in the **Data** pane and choose **Date Properties**. Then in the Date Properties dialog box, choose **Date format**.

When you format dates, Tableau presents a list of available formats. In most cases, the last item in the list is **Custom**. You specify a custom date using a set of format symbols, which are listed in the table below.

The date formats in the table are supported when your workbook is connected to a Tableau data extract or has a live connection to a data source that also supports the date format. (Refer to your data source’s documentation to verify that the date format you want is supported.)

Tableau retrieves date formats from the data source. Tableau Server can also retrieve date formats from the Run As user account on the server that is running Tableau Server.

**Note:** The following date formats might not be the same as those used with the DATEPARSE() function. See Understanding the DATEPARSE function for details.

**Supported Date Format Symbols**

Use the following symbols to construct a custom date format.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(: )</td>
<td>Time separator. In some locales, a different character is used to represent the time separator. The time separator separates hours, minutes, and seconds when time values are formatted. The actual character used as the time separator in formatted output is determined by your system settings.</td>
</tr>
<tr>
<td>(/ )</td>
<td>Date separator. In some locales, a different character is used to represent the date separator. The date separator separates the day, month, and year when date values are formatted. The actual character used as the date separator in formatted output is determined by your system settings.</td>
</tr>
<tr>
<td>c</td>
<td>Display the date as dddd and display the time as tttt, in that order. Display only date information if there is no fractional part to the date serial number; display only time information if there is no integer portion.</td>
</tr>
<tr>
<td>d</td>
<td>Display the day as a number without a leading zero (1 31).</td>
</tr>
<tr>
<td>dd</td>
<td>Display the day as a number with a leading zero (01 31).</td>
</tr>
<tr>
<td>Format</td>
<td>Description</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
</tr>
<tr>
<td>ddd</td>
<td>Display the day as an abbreviation (Sun Sat).</td>
</tr>
<tr>
<td>dddd</td>
<td>Display the day as a full name (Sunday Saturday).</td>
</tr>
<tr>
<td>dddddd</td>
<td>Display the date as a complete date (including day, month, and year), formatted according to your system's short date format setting. The default short date format is m/dd/yy.</td>
</tr>
<tr>
<td>ddddd</td>
<td>Display a date serial number as a complete date (including day, month, and year) formatted according to the long date setting recognized by your system. The default long date format is mmmm dd, yyyy.</td>
</tr>
<tr>
<td>aaaa</td>
<td>The same as ddd, only it's the localized version of the string.</td>
</tr>
<tr>
<td>w</td>
<td>Display the day of the week as a number (1 for Sunday through 7 for Saturday).</td>
</tr>
<tr>
<td>ww</td>
<td>Display the week of the year as a number (1 54).</td>
</tr>
<tr>
<td>m</td>
<td>Display the month as a number without a leading zero (1 12). If m immediately follows h or hh, the minute rather than the month is displayed.</td>
</tr>
<tr>
<td>mm</td>
<td>Display the month as a number with a leading zero (01 12). If m immediately follows h or hh, the minute rather than the month is displayed.</td>
</tr>
<tr>
<td>mmm</td>
<td>Display the month as an abbreviation (Jan Dec).</td>
</tr>
<tr>
<td>mmmm</td>
<td>Display the month as a full month name (January December).</td>
</tr>
<tr>
<td>oooo</td>
<td>The same as mmmm, but localized.</td>
</tr>
<tr>
<td>q</td>
<td>Display the quarter of the year as a number (1 4).</td>
</tr>
<tr>
<td>y</td>
<td>Display the day of the year as a number (1 366).</td>
</tr>
<tr>
<td>yy</td>
<td>Display the year as a 2-digit number (00 99).</td>
</tr>
<tr>
<td>yyyy</td>
<td>Display the year as a 4-digit number (100 9999).</td>
</tr>
<tr>
<td>h</td>
<td>Display the hour as a number without leading zeros (0 23).</td>
</tr>
<tr>
<td>Hh</td>
<td>Display the hour as a number with leading zeros (00 23).</td>
</tr>
<tr>
<td>N</td>
<td>Display the minute as a number without leading zeros (0 59).</td>
</tr>
<tr>
<td>Nn</td>
<td>Display the minute as a number with leading zeros (00 59).</td>
</tr>
<tr>
<td>S</td>
<td>Display the second as a number without leading zeros (0 59).</td>
</tr>
<tr>
<td>Ss</td>
<td>Display the second as a number with leading zeros (00 59).</td>
</tr>
</tbody>
</table>
| 000   | Display milliseconds. Use a period character as a separator before specifying mil-
Display a time as a complete time (including hour, minute, and second), formatted using the time separator defined by the time format recognized by your system. A leading zero is displayed if the leading zero option is selected and the time is before 10:00 A.M. or P.M. The default time format is \texttt{h:mm:ss}.

<table>
<thead>
<tr>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>t t t t</td>
<td>Use the 12-hour clock and display an uppercase AM with any hour before noon; display an uppercase PM with any hour between noon and 11:59 P.M.</td>
</tr>
<tr>
<td>AM/PM</td>
<td>Use the 12-hour clock and display an uppercase AM with any hour before noon; display an uppercase PM with any hour between noon and 11:59 P.M.</td>
</tr>
<tr>
<td>am/pm</td>
<td>Use the 12-hour clock and display a lowercase AM with any hour before noon; display a lowercase PM with any hour between noon and 11:59 P.M.</td>
</tr>
<tr>
<td>A/P</td>
<td>Use the 12-hour clock and display an uppercase A with any hour before noon; display an uppercase P with any hour between noon and 11:59 P.M.</td>
</tr>
<tr>
<td>a/p</td>
<td>Use the 12-hour clock and display a lowercase A with any hour before noon; display a lowercase P with any hour between noon and 11:59 P.M.</td>
</tr>
<tr>
<td>AMPM</td>
<td>Use the 12-hour clock and display the AM string literal as defined by your system with any hour before noon; display the PM string literal as defined by your system with any hour between noon and 11:59 P.M. AMPM can be either uppercase or lowercase, but the case of the string displayed matches the string as defined by your system settings. The default format is AM/PM.</td>
</tr>
</tbody>
</table>

**Custom Date Format Examples**

Specifying a custom format \texttt{yyyy-MM-dd HH:mm:ss.000} would produce dates in the format 2015-05-10 11:22:16.543. Such a format might be appropriate for scientific data.

Specifying a format \texttt{DDDD DD} would produce dates that show the Weekday and the Day, as shown below.
Support for Japanese era-based date formats

Starting with version 9.3, Tableau supports Japanese emperor-era-based date (Wareki) formats. Here’s how to apply an era-based date format to a field in your view:

1. Set your workbook locale to Japanese.
2. Right-click the field in the view for which you want to set a date format.
3. Choose Format.
4. In the Format pane, from the Dates drop-down list, select a format.

If the format that you want isn’t listed, you can construct your own date format. To do this, choose Custom format in the Dates box, then type your format using the Tableau date placeholders. The following era-based year placeholders are available:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>g</td>
<td>Short era name (such as H for the Heisei era).</td>
</tr>
<tr>
<td>gg</td>
<td>Era name (such as 平成).</td>
</tr>
<tr>
<td>ggg</td>
<td>Long era name (for Japanese, this is currently the same as the regular era name).</td>
</tr>
<tr>
<td>e</td>
<td>Era-based year, such as 1 for the first year of an era.</td>
</tr>
</tbody>
</table>
| ee     | Era-based year, such as 01 for the first year of an era. If there is only one digit,
then the era-based year will have a zero added to the front.

If your workbook locale is not Japanese, you can create a custom date format, then insert the language code !ja_JP! in front of your format, so that it looks like this:

!ja_JP! gg ee"年"mm"月"dd"日"

The language code forces the date to be treated as if it is a Japanese date.

Era-based dates are not fully supported by the Tableau Server browser view. In particular, if you publish a workbook that contains a quick filter, the e and g placeholders will not be filled in:

To avoid this issue, do not show era-based dates in quick filters if your workbook will be viewed in a browser.

**Using literal text in a date format**

You may want your date format to include some words or phrases, such as Fiscal Quarter q of yyyy. However, if you type that text directly into the Tableau format box, it may treat the letters like date parts:

To prevent Tableau from doing this, put double quotes around the letters and words that should not be treated as date parts: “Fiscal Quarter” q “of” yyyy.

If you want a literal quote inside of a quoted section, insert this code: “\”". For example, the format “Fiscal “ quarter” would be formatted as Fiscal “ Quarter.

**Using Week-Based Placeholders in Custom Date Formats**

If your workbook has a European locale, Tableau allows you to format dates using ISO-8601 weeks and years. The week and year numbering in an ISO-8601 calendar is different from a standard Gregorian calendar. Here’s how January 2nd, 2011 would be represented:

<table>
<thead>
<tr>
<th>Calendar System</th>
<th>Week Number</th>
<th>Year Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Gregorian</td>
<td>1</td>
<td>2011</td>
</tr>
<tr>
<td>ISO-8601</td>
<td>52</td>
<td>2010</td>
</tr>
</tbody>
</table>
When formatting dates, it’s important to ensure that your month, week and year numbers all come from the same calendar system. Otherwise, the date might not make sense. There are two ways to do this:

- Let Tableau guess which calendar system you want to use for each placeholder. For example, if you type \texttt{mm yyyy} (a month followed by a year), Tableau uses the standard Gregorian year. In this case, it makes sense to use that year with a month number.

- In your format string, place an annotation after each week (ww) or year (yyyy) placeholder, to indicate what kind of placeholder it should be:

<table>
<thead>
<tr>
<th>Annotation</th>
<th>Calendar to Use</th>
<th>Example Format String</th>
</tr>
</thead>
<tbody>
<tr>
<td>[y]</td>
<td>Standard Gregorian</td>
<td>ww[y] yyyy[y]</td>
</tr>
</tbody>
</table>

**Important:** To get correct ISO-8601 week numbering, you must set your data source start of week to Monday. (For information on how to do this, see Date Properties for a Data Source on page 572.) Otherwise, Tableau will number weeks using your data source start of week setting.

**Note:** ISO week numbering will not occur if you are using a fiscal year that doesn’t start in January, regardless of the locale you choose.

**Sample format strings for the date December 31, 2013**

Here are sample format strings for the date December 31, 2013, where \texttt{m} stands for a month or day-of-month placeholder. Time placeholders, such as hours, minutes, and seconds, don’t influence whether or not a year is week-based or year-based.

<table>
<thead>
<tr>
<th>Format string</th>
<th>Formatted output</th>
</tr>
</thead>
<tbody>
<tr>
<td>yyyy</td>
<td>2013</td>
</tr>
<tr>
<td>yyyy[Y]</td>
<td>2014</td>
</tr>
<tr>
<td>yyyy ww</td>
<td>2014 1</td>
</tr>
<tr>
<td>yyyy mm</td>
<td>2013 12</td>
</tr>
<tr>
<td>ww yyyy</td>
<td>1 2014</td>
</tr>
<tr>
<td>mm yyyy</td>
<td>12 2013</td>
</tr>
<tr>
<td>Format</td>
<td>Date</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------</td>
</tr>
<tr>
<td>ww yyyy[y]</td>
<td>1 2013</td>
</tr>
<tr>
<td>mm yyyy[Y]</td>
<td>12 2014</td>
</tr>
<tr>
<td>yyyy mm ww</td>
<td>2013 12 1</td>
</tr>
<tr>
<td>mm yyyy ww</td>
<td>12 2013 1</td>
</tr>
<tr>
<td>ww mm yyyy</td>
<td>1 12 2013</td>
</tr>
<tr>
<td>ww mm yyyy[Y]</td>
<td>1 12 2014</td>
</tr>
<tr>
<td>ww yyyy mm</td>
<td>1 2014 12</td>
</tr>
<tr>
<td>(format is ambiguous)</td>
<td></td>
</tr>
<tr>
<td>ww yyyy[yy] mm</td>
<td>1 2013 12</td>
</tr>
<tr>
<td>ww yyyy mm yyyy</td>
<td>1 2014 12 13</td>
</tr>
<tr>
<td>ww yyyy yyyy mm</td>
<td>1 2014 12 13</td>
</tr>
<tr>
<td>yyyy mm ww yyyy</td>
<td>2013 12 1 2014</td>
</tr>
</tbody>
</table>

**Continuous Dates**

You can treat a date as a continuous quantity after placing the field on a shelf. You do this by selecting one of the Continuous date options on the field’s context menu (lower list of date levels). Continuous dates draw a quantitative axis for the date values.

For example, the view below displays the sales as a function of a continuous order date and is color-encoded by category. As you can see, the color of the Order Date field changes from blue to green after it is converted to a continuous quantity.
Treating dates as a continuous quantity is particularly useful when you use Gantt bars or want to see trends using line charts as shown above.

By default, date dimensions are discrete fields for which Tableau automatically selects a date level when it is placed on a shelf. To make a date dimension continuous by default, right-click (control-click on Mac) the field in the Data pane and select Convert to Continuous. The field turns green and is automatically converted to a continuous field when you drag it to a shelf. To revert to discrete again, right-click (control-click on Mac) the field in the Data pane and select Convert to Discrete.

**Forecasting**

You can forecast quantitative time-series data using exponential smoothing models in Tableau Desktop. With exponential smoothing, recent observations are given relatively more weight than older observations. These models capture the evolving trend or seasonality of your data and extrapolate them into the future. Forecasting is fully automatic, yet configurable. Many forecast results can become fields in your visualizations.

You can add a forecast to a view when there is at least one date dimension and one measure in the view. Choose Analysis > Forecast > Show Forecast. When no date dimension is present, you can add a forecast if there is a dimension field in the view that has integer values. See Forecasting When No Date is in the View on page 602.

When a forecast is showing, future values for the measure are shown next to the actual values.
Forecasting Constraints

Forecasting is not supported for Multidimensional data sources. In Tableau, multidimensional data sources are supported only in Windows.

In addition, the view cannot contain any of the following:

- Table calculations
- Disaggregated measures
- Percent calculations
- Grand Totals or Subtotals
- Date values with aggregation set to Exact Date

How Forecasting Works in Tableau

Forecasting in Tableau uses a technique known as exponential smoothing. Forecast algorithms try to find a regular pattern in measures that can be continued into the future.

You typically add a forecast to a view that contains a date field and at least one measure. However, in the absence of a date, Tableau can create a forecast for a view that contains a dimension with integer values in addition to at least one measure. For details on forecasting using an integer dimension, see Forecasting When No Date is in the View on page 602.

All forecast algorithms are simple models of a real-world data generating process (DGP). For a high quality forecast, a simple pattern in the DGP must match the pattern described by the model reasonably well. Quality metrics measure how well the model matches the DGP. If the quality is low, the precision measured by the confidence bands is not important because it measures the precision of an inaccurate estimate.

Tableau automatically selects the best of up to eight models, the best being the one that generates the highest quality forecast. The smoothing parameters of each model are optimized before Tableau assesses forecast quality. The optimization method is global. Therefore, choosing locally optimal smoothing parameters that are not also globally optimal is not impossible. However, initial value parameters are selected according to best practices but are not further optimized. So it is possible for initial value parameters to be less than optimal. The eight models available in Tableau are among those described at the following location on the OTexts web site: A taxonomy of exponential smoothing methods.

When there is not enough data in the visualization, Tableau automatically tries to forecast at a finer temporal granularity, and then aggregates the forecast back to the granularity of the visualization. Tableau provides prediction bands which may be simulated or calculated from a closed form equation. All models with a multiplicative component or with aggregated forecasts have simulated bands, while all other models use the closed form equations.
Exponential Smoothing and Trend

*Exponential smoothing* models iteratively forecast future values of a regular time series of values from weighted averages of past values of the series. The simplest model, *Simple Exponential Smoothing*, computes the next level or smoothed value from a weighted average of the last actual value and the last level value. The method is exponential because the value of each level is influenced by every preceding actual value to an exponentially decreasing degree—more recent values are given greater weight.

Exponential smoothing models with trend or seasonal components are effective when the measure to be forecast exhibits trend or seasonality over the period of time on which the forecast is based. *Trend* is a tendency in the data to increase or decrease over time. *Seasonality* is a repeating, predictable variation in value, such as an annual fluctuation in temperature relative to the season.

In general, the more data points you have in your time series, the better the resulting forecast will be. Having enough data is particularly important if you want to model seasonality, because the model is more complicated and requires more proof in the form of data to achieve a reasonable level of precision. On the other hand, if you forecast using data generated by two or more different DGPs, you will get a lower quality forecast because a model can only match one.

Seasonality

Tableau tests for a seasonal cycle with the length most typical for the time aggregation of the time series for which the forecast is estimated. So if you aggregate by months, Tableau will look for a 12-month cycle; if you aggregate by quarters, Tableau will search for a four-quarter cycle; and if you aggregate by days, Tableau will search for weekly seasonality. Therefore, if there is a six-month cycle in your monthly time series, Tableau will probably find a 12-month pattern that contains two similar sub-patterns. However, if there is a seven-month cycle in your monthly time series, Tableau will probably find no cycle at all. Luckily, seven-month cycles are uncommon.

Tableau can use either of two methods for deriving season length. The original temporal method uses the natural season length of the temporal granularity (TG) of the view. Temporal granularity means the finest unit of time expressed by the view. For example, if the view contains either a continuous green date truncated to month or discrete blue year and month date parts, the temporal granularity of the view is month. The new non-temporal method, introduced with Tableau 9.3, uses periodic regression to check season lengths from 2 to 60 for candidate lengths.

Tableau automatically selects the most appropriate method for a given view. When Tableau is using a date to order the measures in a view, if the temporal granularity is quarterly, monthly, weekly, daily or hourly, the season lengths are almost certainly 4, 12, 13, 7 or 24, respectively. So only the length natural to the TG is used to construct the five seasonal exponential smoothing models supported by Tableau. The AIC of the five seasonal models and the three non-seasonal models are compared and the lowest returned. (For an explanation of the AIC metric, see Forecast Descriptions.)
When Tableau is using an integer dimension for forecasting, the second method is used. In this case there is no temporal granularity (TG), so potential season lengths must be derived from the data.

The second method is also used if the temporal granularity is yearly. Yearly series rarely have seasonality, but, if they do, it must also be derived from the data.

The second method is also used for views with temporal granularity of minute or second. If such series have seasonality, the season lengths are likely 60. However, when measuring a regular real world process, the process may have a regular repetition which does not correspond to the clock. So, for minutes and seconds, Tableau also checks for a length different from 60 in the data. This does not mean that Tableau can model two different season lengths at the same time. Rather, ten seasonal models are estimated, five with a season length of 60 and another five with the season length derived from the data. Whichever of the ten seasonal models or three non-seasonal models has the lowest AIC, that model is used to compute the forecast.

For series ordered by year, minute, or second, a single season length from the data is tested if the pattern is fairly clear. For integer ordered series, up to nine somewhat less clear potential season lengths are estimated for all five seasonal models, and the model with the lowest AIC is returned. If there are no likely season length candidates, only the non-seasonal models are estimated.

Since all selection is automatic when Tableau is deriving potential season lengths from the data, the default Model Type of “Automatic” in the Forecast Options Dialog Model Type menu does not change. Selecting “Automatic without seasonality” improves performance by eliminating all season length searching and estimation of seasonal models.

The heuristic that Tableau uses to decide when to use season lengths derived from the data depends on the distribution of errors for the periodic regression of each candidate season length. Since the assembly of season length candidates by periodic regression usually produces one or two clear winning lengths if seasonality actually exists in the data, the return of a single candidate indicates likely seasonality. In this case, Tableau estimates seasonal models with this candidate for year, minute and second granularity. The return of less than the maximum of ten candidates indicates possible seasonality. In this case, Tableau estimates seasonal models with all returned candidates for integer ordered views. The return of the maximum number of candidates indicates that errors for most length are similar. Therefore, the existence of any seasonality is unlikely. In this case, Tableau estimates only non-seasonal models for an integer-ordered or yearly ordered series, and only the seasonal models with a natural season length for other temporally ordered views.

For Model Type “Automatic” in integer-, year-, minute- and second-ordered views, candidate season lengths are always derived from the data whether or not they are used. Since model estimation is much more time consuming than periodic regression, the performance impact should be moderate.
Model Types

In the Forecast Options dialog box, you can choose the model type Tableau users for forecasting. The Automatic setting is typically optimal for most views. If you choose Custom, then you can specify the trend and season characteristics independently, choosing either None, Additive, or Multiplicative:

An additive model is one in which the contributions of the model components are summed, whereas a multiplicative model is one in which at least some component contributions are multiplied. Multiplicative models can significantly improve forecast quality for data where the trend or seasonality is affected by the level (magnitude) of the data:

Keep in mind that you do not need to create a custom model to generate a forecast that is multiplicative: the Automatic setting can determine if a multiplicative forecast is appropriate for your data. However, a multiplicative model cannot be computed when the measure to be forecast has one or more values that are less than or equal to zero.

Forecasting with Time

When you are forecasting with a date, there can be only one base date in the view. Part dates are supported, but all parts must refer to the same underlying field. Dates can be on Rows, Columns, or Marks (with the exception of the Tooltip target).

Tableau supports three types of dates, two of which can be used for forecasting:
- Truncated dates and reference a particular point in history with specific temporal granularity, such as February 2017. They are usually continuous, with a green background in the view. Truncated dates are valid for forecasting.

- Date parts refer to a particular member of a temporal measure such as February. Each date part is represented by a different, usually discrete field (with a blue background). Forecasting requires at least a Year date part. Specifically, it can use any of the following sets of date parts for forecasting:
  - Year
  - Year + quarter
  - Year + month
  - Year + quarter + month
  - Year + week
  - Custom: Month/Year, Month/Day/Year

Other date parts, such as Quarter or Quarter + month, are not valid for forecasting. See Convert Fields between Discrete and Continuous on page 277 for more details about different date types.

- Exact dates refer to a particular point in history with maximum temporal granularity such as February 1, 2012 at 14:23:45.0. Exact dates are invalid for forecasting.

It is also possible to forecast without a date. See Forecasting When No Date is in the View on page 602.

**Granularity and Trimming**

When you create a forecast, you select a date dimension that specifies a unit of time at which date values are to be measured. Tableau dates support a range of such time units, including Year, Quarter, Month, and Day. The unit you choose for the date value is known as the granularity of the date.

The data in your measure typically does not align precisely with your unit of granularity. You might set your date value to quarters, but your actual data may terminate in the middle of a quarter—for example, at the end of November. This can cause a problem because the value for this fractional quarter is treated by the forecasting model as a full quarter, which will typically have a lower value than a full quarter would. If the forecasting model is allowed to consider this data, the resulting forecast will be inaccurate. The solution is to trim the data, such that the trailing periods that could mislead the forecast are ignored. Use the Ignore Last option in the Forecast Options dialog box to remove—or trim—such partial periods. The default is to trim one period.
Getting More Data

Tableau requires at least five data points in the time series to estimate a trend, and enough data points for at least two seasons or one season plus five periods to estimate seasonality. For example, at least nine data points are required to estimate a model with a four quarter seasonal cycle (4 + 5), and at least 24 to estimate a model with a twelve month seasonal cycle (2 * 12). If you turn on forecasting for a view that does not have enough data points to support a good forecast, Tableau can sometimes retrieve enough data points to produce a valid forecast by querying the datasource for a finer level of granularity:

- If your view contains fewer than nine years of data, by default, Tableau will query the data source for quarterly data, estimate a quarterly forecast, and aggregate to a yearly forecast to display in your view. If there are still not enough data points, Tableau will estimate a monthly forecast and return the aggregated yearly forecast to your view.
- If your view contains fewer than nine quarters of data, by default Tableau will estimate a monthly forecast and return the aggregated quarterly forecast results to your view.
- If your view contains fewer than nine weeks of data, by default, Tableau will estimate a daily forecast and return the aggregated weekly forecast results to your view.
- If your view contains fewer than nine days of data, by default, Tableau will estimate an hourly forecast and return the aggregated daily forecast results to your view.
- If your view contains fewer than nine hours of data, by default, Tableau will estimate an minutely forecast and return the aggregated hourly forecast results to your view.
- If your view contains fewer than nine minutes of data, by default, Tableau will estimate an secondly forecast and return the aggregated minutely forecast results to your view.

These adjustments happen behind the scene and require no configuration. Tableau does not change the appearance of your visualization, and does not actually change your date value. However, the summary of the forecast time period in the Forecast Describe and Forecast Options dialog will reflect the actual granularity used.

Tableau can only get more data when the aggregation for the measure you are forecasting is SUM or COUNT. See Aggregations on page 322 for information on available aggregation types and information on how to change the aggregation type.

To Create a Forecast

Forecasting requires a view that uses at least one date dimension and one measure. For example:

- The field you want to forecast is on the Rows shelf and a continuous date field is on the Columns shelf.
- The field you want to forecast is on the Columns shelf and a continuous date field is on the Rows shelf.
• The field you want to forecast on either the Rows or Columns shelf, and discrete dates are on either the Rows or Columns shelf. At least one of the included date levels must be Year.

• The field you want to forecast is on the Marks card, and a continuous date or discrete date set is on Rows, Columns or Marks.

Note: You can also create a forecast when no date dimension is present if there is a dimension in the view that has integer values. See Forecasting When No Date is in the View on page 602.

To turn forecasting on, either right-click (control-click on Mac) on the visualization and choose Forecast > Show Forecast, or choose Analysis > Forecast > Show Forecast.

With forecasting on, Tableau visualizes estimated future values of the measure, in addition to actual historical values. The estimated values are shown by default in a lighter shade of the color used for the historical data:

Prediction Intervals

The shaded area in the image above shows the 95% prediction interval for the forecast. That is, the model has determined that there is a 95% likelihood that the value of sales will be within the shaded area for the forecast period. You can configure the confidence level percentile for the prediction bands, and whether prediction bands are included in the forecast, using the Show prediction intervals setting in the Forecast Options dialog box:
Clear the check box if you do not want to display prediction bands in forecasts. To set the prediction interval, select one of the values or enter a custom value. The lower the percentile you set for the confidence level, the narrower the prediction bands will be.

How your prediction intervals are displayed depends on the mark type of your forecasted marks:

<table>
<thead>
<tr>
<th>Forecast mark type</th>
<th>Prediction intervals displayed using</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line</td>
<td>Bands</td>
</tr>
<tr>
<td>Shape, square, circle, bar, or pie</td>
<td>Whiskers</td>
</tr>
</tbody>
</table>

In the following example, forecast data is indicated by lighter shaded circles, and the prediction intervals are indicated by lines ending in whiskers:

**Enhancing Forecasts**

For each forecast value, consider verifying the quality or precision of your forecast by dragging another instance of the forecast measure from the Data pane to the Detail shelf on the Marks card and then after right-clicking the field to open the content menu, choosing one of the available options:
For descriptions of these options, see **Forecast Field Results** on the next page.

You can repeat the process to add additional result types for each forecast value. See "Changing the Forecast Result" type in **Forecast Field Results** on the next page for information on changing the result type.

By adding such result types to the Details shelf, you add information about the forecast to tooltips for all marks that are based on forecasted data.
Forecasting When No Date is in the View

If a valid date is not in the view, Tableau will look for a dimension in the view that has integer values. If it finds such a dimension it will use that to forecast additional values for measures in the view. As with a date, when an integer dimension is selected to order the measures to be forecast, it is no longer used to partition the data. If there is more than one such integer dimension, Tableau will go in this order:

- An integer dimension on the Columns shelf. If there is more than one such dimension, it will use the first one (farthest to the left on the shelf).
- An integer dimension on the Rows shelf.
- An integer dimension on the Pages shelf.
- An integer dimension on the Marks card.

When Tableau is using an integer dimension to forecast, the Forecast Option and Forecast Description dialog boxes will automatically specify that forecasting is aggregating by periods:

![Forecast Options dialog box]

**Forecast Field Results**

Tableau provides several types of forecast results. To view these result types in the view, right-click (control-click on Mac) on the measure field, choose **Forecast Result**, and then choose one of the options.
The options are:

- **Actual & Forecast**—Show the actual data extended by forecasted data.
- **Trend**—Show the forecast value with the seasonal component removed.
- **Precision**—Show the prediction interval distance from the forecast value for the configured confidence level.
- **Precision %**—Show precision as a percentage of the forecast value.
- **Quality**—Show the quality of the forecast, on a scale of 0 (worst) to 100 (best). This metric is scaled MASE, based on the MASE (Mean Absolute Scaled Error) of the forecast, which is the ratio of forecast error to the errors of a naïve forecast which assumes that the value of the current period will be the same as the value of the next period. The actual equation used for quality is:

\[ 100 \times \max(1 - MASE, 0) \]

The Quality for a naïve forecast would be 0. The advantage of the MASE metric over the more common MAPE is that MASE is defined for time series which contain zero, whereas MAPE is not. In addition, MASE weights errors equally while MAPE weights positive and/or extreme errors more heavily.

- **Upper Prediction Interval**—Shows the value above which the true future value will lie confidence level percent of the time assuming a high quality model. The confidence level percentage is controlled by the Prediction Interval setting in the Forecast Options dialog box. See Configure Forecast Options on the next page.
- **Lower Prediction Interval**—Shows 90, 95, or 99 confidence level below the forecast value. The actual interval is controlled by the Prediction Interval setting in the Forecast Options dialog box.
- **Indicator**—Show the string *Actual* for rows that were already on the worksheet when forecasting was inactive and *Estimate* for rows that were added when forecasting was activated.
- **None**—Do not show forecast data for this measure.

Forecast description information is also included in the worksheet description. See Describing the View on page 532.

**Forecasting a New Measure**

When you add a new measure to a visualization that already has forecasting enabled, Tableau attempts to forecast future values.
Changing the Forecast Result Type

To change the forecast result type for a measure, right-click (control-click on Mac) on the measure field, select **Forecast Result**, and then choose a result type.

Configure Forecast Options

Use the Forecast Options dialog box to configure forecast options, including:

- The length of the forecast
- The range and temporal aggregation of source data from which to generate the forecast
The forecast model
Prediction intervals

When forecasting is enabled, you can open the Forecast Options dialog box by choosing **Analysis > Forecast > Forecast Options**.

### Forecast Length

The **Forecast Length** section determines how far into the future the forecast extends. Select one of the following:

- **Automatic**: Tableau determines the forecast length based on the data.
- **Exactly**: Extends the forecast for the specified number of units.
- **Until**: Extends the forecast to the specified point in the future.

### Source Data

Use the **Source Data** section to specify.

- **Aggregate by**: Specifies the temporal granularity of the time series. With the default value (**Automatic**), Tableau chooses the best granularity for estimation. This will typically match the temporal granularity of the visualization (that is, the date dimension that the forecast is based on). However, it is sometimes possible and desirable to estimate the forecast model at a finer granularity than the visualization when the time series in the visualization is too short to allow estimation.

**Note**: When you are using an integer dimension instead of a date dimension for forecasting, the Aggregate by value is always Periods. See **Forecasting When No Date is in the View** on page 602.

- **Ignore last**: Specifies the number of periods at the end of the actual data that should be ignored in estimating the forecast model. Forecast data is used instead of actual data for these time periods. Use this feature to trim off unreliable or partial trailing periods which could mislead the forecast. When the estimation granularity specified in the **Source Data** section is finer than in the visualization, the trimmed periods are estimation periods. As a result, the trailing actual visualization period may become a forecast period, which is an aggregate of both actual and forecast periods of estimation granularity. In contrast, null values are not filled with zeros and must be filtered to allow forecast.

- **Fill in missing values with zeros**: If there are missing values in the measure you are attempting to forecast, you can specify that Tableau fill in these missing values with zero.

### Forecast Model

The **Forecast Model** section specifies how the forecast model is to be produced.
Use the drop down to specify whether Tableau selects what it determines to be the best of all models (Automatic), the best of those with no seasonal component (Automatic without seasonality), or the model you specify (Custom).

When you choose the Custom option, two new fields appear in the Forecast Options dialog box, which you use to specify the trend and season characteristics for your model:

The choices are the same for both fields:

- **None**: When you select None for Trend, the model does not assess the data for trend. When you select None for Season, the model does not assess the data for seasonality.

- **Additive**: An additive model is one in which the combined effect of several independent factors is the sum of the isolated effects of each factor. You can assess the data in your view for additive trend, additive seasonality, or both.

- **Multiplicative**: A multiplicative model is one in which the combined effect of several independent factors is the product of the isolated effects of each factor. You can assess the data in your view for multiplicative trend, multiplicative seasonality, or both.

If there is more than one time series in your visualization, the Custom option forces them all to be forecast using the same custom model. Constraining the models in this way usually results in lower quality models than would be produced by automatic model selection.

**Constraints on Multiplicative Models**

- You cannot use a multiplicative model when the measure to be forecast has one or more values that are less than or equal to zero, or even when some of the data points are too close to zero, relative to other data points.

- You cannot specify a model with multiplicative trend and additive season because the result may be numerically unstable.

**Prediction Interval**

You can set the prediction interval to 90, 95, or 99 percent, or enter a custom value. This value is used in two locations:
• In the prediction bands displayed with a forecast.

• For the prediction interval options (Upper Prediction Interval and Lower Prediction Interval) that are available as forecast result types for a measure in the view:

![Forecast Options dialog box]

**Forecast Summary**

The text box at the bottom of the Forecast Options dialog box provides a description of the current forecast. The forecast summary updates whenever you change any of the forecast options above. If there is a problem with the forecast, the text box provides an error message that may help you resolve the issue. See Resolving Forecasting Errors on page 612.

**Forecast Descriptions**

The Describe Forecast dialog box describes the forecast models that Tableau computed for your visualization. When forecasting is enabled, you can open this dialog by selecting Analysis.
> **Forecast > Describe Forecast.** The information in the Describe Forecast dialog box is read-only, though you can click **Copy to Clipboard** and then paste the screen contents into a writeable document.

The **Describe Forecast** dialog box has two tabs: a **Summary** tab and a **Models** tab.

**Describe Forecast – Summary Tab**

The **Summary** tab describes the forecast models Tableau has created, as well as the general patterns Tableau discovered in the data.

**Options Used To Create Forecasts**

This section summarizes the options Tableau used to create forecasts. These options were either picked automatically by Tableau or specified in the Forecast Options dialog box.

- **Time series**—The continuous date field used to define the time series. In some cases this value might not actually be a date. See **Forecasting When No Date is in the View** on page 602.
- **Measures**—The measures for which values are estimated.
- **Forecast forward**—The length and date range of the forecast.
- **Forecast based on**—The date range of the actual data used to create the forecast.
- **Ignore last**—The number of periods at the end of the actual data that are disregarded--forecast data is displayed for these periods. This value is determined by the **Ignore Last** option in the Forecast Options dialog box.
- **Seasonal pattern**—The length of the seasonal cycle that Tableau found in the data, or None if no seasonal cycle was found in any forecast.

**Forecast Summary Tables**

For each measure that is forecasted, a summary table is displayed describing the forecast. If the view is broken into multiple panes using dimensions, a column is inserted into each table that identifies the dimensions. The fields in summary forecast tables are:

- **Initial**—The value and prediction interval of the first forecast period.
- **Change From Initial**—The difference between the first and the last forecast estimate points. The interval for those two points is shown in the column header. When values are shown as percentages, this field shows the percentage change from the first forecast period.
- **Seasonal Effect**—These fields are displayed for models identified as having seasonality--that is, a repeating pattern of variation over time. They show the high and low value of the seasonal component of the last full seasonal cycle in the combined time series of actual and forecast values. The seasonal component expresses the deviation from the trend and so varies around zero and sums to zero over the course of a season.
• **Contribution**—The extent to which Trend and Seasonality contribute to the forecast. These values are always expressed as percentages and add up to 100%.

• **Quality**—Indicates how well the forecast fits the actual data. Possible values are GOOD, OK, and POOR. A naïve forecast is defined as a forecast that estimates that the value of the next period will be identical to the value of the current period. Quality is expressed relative to a naïve forecast, such that OK means the forecast is likely to have less error than a naïve forecast, GOOD means that the forecast has less than half as much error, and POOR means that the forecast has more error.

### Describe Forecast – Models Tab

The **Models** tab provides more exhaustive statistics and smoothing coefficient values for the Holt-Winters exponential smoothing models underlying the forecasts. For each measure that is forecasted, a table is displayed describing the forecast models Tableau created for the measure. If the view is broken into multiple panes using dimensions, a column is inserted into each table that identifies the dimensions. The table is organized into the following sections:

**Model**

Specifies whether the components **Level**, **Trend**, or **Season** are part of the model used to generate the forecast. The value for each component is one of the following:

- **None**—The component is not present in the model.
- **Additive**—The component is present and is added to the other components to create the overall forecast value.
- **Multiplicative**—The component is present and is multiplied by the other components to create the overall forecast value.

**Quality Metrics**

This set of values provides statistical information about the quality of the model.

<table>
<thead>
<tr>
<th>Value</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMSE: Root mean squared error</td>
<td>$\sqrt{\left(\frac{1}{n}\right) \sum e(t)^2}$</td>
</tr>
<tr>
<td>MAE: Mean absolute error</td>
<td>$\frac{1}{n} \sum</td>
</tr>
<tr>
<td>MASE: Mean absolute scaled error.</td>
<td>$\frac{\frac{1}{n} \sum</td>
</tr>
</tbody>
</table>

MASE measures the magnitude of the error compared to the magnitude of the error of a naïve one-step ahead forecast as a ratio. A naïve forecast assumes that whatever the value is today will be same value tomorrow.
So, a MASE of 0.5 means that your forecast is likely to have half as much error as a naive forecast, which is better than a MASE of 1.0, which is no better than a naive forecast. Since this is a normalized statistic that is defined for all values and weighs errors evenly, it is an excellent metric for comparing the quality of different forecast methods.

The advantage of MASE over the more common MAPE metric is that MASE is defined for time series that contain zero, whereas MAPE is not. Also, MASE weights errors equally, whereas MAPE weights positive and/or extreme errors more heavily.

MAPE: Mean absolute percentage error. MAPE measures the magnitude of the error compared to the magnitude of your data, as a percentage. So, a MAPE of 20% is better than a MAPE of 60%. Errors are the differences between the response values, which the model estimates, and the actual response values for each explanatory value in your data. Since this is a normalized statistic, it can be used to compare the quality of different models computed in Tableau. However, it is unreliable for some comparisons because it weights some kinds of error more heavily than others. Also, it is undefined for data with values of zero.

AIC: Akaike information criterion. AIC is a model quality measure, developed by Hirotugu Akaike, that penalizes complex models to prevent overfitting. In this definition, \( k \) is the number of estimated parameters, including initial states, and \( SSE \) is the sum of the squared errors.

In the preceding definitions, the variables are as follow:

<table>
<thead>
<tr>
<th>Variable</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t )</td>
<td>Index of a period in a time series.</td>
</tr>
<tr>
<td>( n )</td>
<td>Time series length.</td>
</tr>
<tr>
<td>( m )</td>
<td>Number of periods in a season/cycle.</td>
</tr>
</tbody>
</table>
A(t) | Actual value of the time series at period t.
---|---
F(t) | Fitted or forecast value at period t.

Residuals are:  
\[ e(t) = F(t) - A(t) \]

**Smoothing Coefficients**

Depending on the rate of evolution in the level, trend, or seasonal components of the data, smoothing coefficients are optimized to weight more recent data values over older ones, such that within-sample one-step-ahead forecast errors are minimized. Alpha is the level smoothing coefficient, beta the trend smoothing coefficient, and gamma the seasonal smoothing coefficient. The closer a smoothing coefficient is to 1.00, the less smoothing is performed, allowing for rapid component changes and heavy reliance on recent data. The closer a smoothing coefficient is to 0.00, the more smoothing is performed, allowing for gradual component changes and less reliance on recent data.

**Troubleshooting Forecasting**

This topic discusses some issues that may arise as you use forecasting in Tableau.

**Null Forecasts**

A null forecast results when you are using forecasting and modify the view in a manner that is incompatible with forecasting. The most obvious indication that you have a null forecast is that no forecast data is displayed in your view and the text No Forecast is displayed. Hover the cursor over this message to see why Tableau is unable to create a forecast:

Another indication is that the **Forecast Indicator** field on the Marks card shows Actual values, but no Estimate values:
To diagnose a null forecast, open the Describe Forecast dialog box from the Analysis menu (Analysis > Forecast > Describe Forecast) to see the error message. Then see Resolving Forecasting Errors below for a suggested resolution.

Tableau also displays the error message in the Forecast Options dialog box (Analysis > Forecast > Forecast Options).

Because a forecast cannot be computed for a time series with null date values in the middle, actions that filter data, either explicitly or implicitly can trigger a null forecast. The Keep Only and Exclude commands on tooltips are examples of actions that can filter data implicitly—in some cases, these commands are removed when a forecast is shown. For example, if you have a time series of sales for each quarter from 2008 until 2012 and you exclude the Sales value for the second quarter of 2010, you will get a Null forecast because the time series is irregular. If, instead, you exclude the first quarter of 2008, you have shortened the time series but it remains regular. So, a valid forecast is still possible.

Resolving Forecasting Errors

If Tableau is unable to provide a forecast for your view, the problem can often be resolved by changing the Date value in the view (see Changing Date Levels on page 574).

Forecasting errors can result when the aggregation level of the time series (months, weeks, etc.) is either too fine or too coarse for the data to be forecast. This can lead to the "too much data" or "too little data" errors described below. Date aggregation can trigger a "too many Nulls" scenario when forecasting attempts to extract more data from the measure than is possible. For example, if the underlying granularity of the sales data is months but you aggregate by weeks, the result may be a significant number of Null values.

Other problems arise when the view's aggregation and the aggregation specified for the forecast (using the Aggregate by field in the Forecast Options dialog box) are not compatible. Tableau can create a forecast when the forecast aggregation is a finer level of detail than the view's aggregation, but not when it is at a coarser level of detail; even when it is finer, the two values are only compatible if there is a strict hierarchy that Tableau can use (for example, quarters can be evenly divided into three months, but months can't be evenly divided into weeks). Avoid these scenarios by setting Aggregate by to Automatic.

The following list shows errors that can result from invalid forecasts in Tableau, and provides advice on how to resolve them.

<table>
<thead>
<tr>
<th>Error message</th>
<th>Suggestion for Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>A continuous date cannot be derived from the date</td>
<td>Forecasting requires a date field that can be interpreted</td>
</tr>
<tr>
<td></td>
<td>continuously. If the date field is not explicitly continuous,</td>
</tr>
<tr>
<td></td>
<td>then</td>
</tr>
<tr>
<td>Message</td>
<td>Explanation</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>fields in the view.</td>
<td>one of the included date levels must be Year. This error is returned if there are no dates in the view, or if the dates in the view don’t constitute a full hierarchy (for example, the date includes Year and Day, but not Month), or if they constitute a hierarchy that is not supported (for example, Year, Week, Day).</td>
</tr>
<tr>
<td>The time series is too short to forecast.</td>
<td>Expand the time series in your view to include more date values. This error is returned if there are fewer than four data points after trimming off unreliable or partial trailing periods which could mislead the forecast.</td>
</tr>
<tr>
<td>A forecast cannot be computed for a time series with Null date values.</td>
<td>Eliminate any Null values from the date field or fields in the view, either by filtering the date field or by using a less detailed date granularity (for example, by switching from months to quarters).</td>
</tr>
<tr>
<td>A forecast cannot be computed when the view contains multiple distinct date fields.</td>
<td>This error is returned if there are multiple date fields in the view. For example, if both Order Date and Ship Date are in the same view, forecasting is not supported.</td>
</tr>
<tr>
<td>The selected 'Aggregate by' value in Forecast Options is not compatible with the visualization.</td>
<td>The date in the view must be compatible with the value of <strong>Aggregate by</strong> in the Forecast Options dialog box. For example, if <strong>Aggregate by</strong> is set to Weeks and the date in the view is set to Months, this error occurs. Change one of the dates so that the two are compatible, or set <strong>Aggregate by</strong> to Automatic.</td>
</tr>
<tr>
<td>A forecast cannot be computed because there are too many missing values.</td>
<td>This error is returned if more than 40% of the data is missing. Selecting <strong>Fill in missing values with zeros</strong> in the Forecast Options dialog box will not resolve this error. You must modify the source data or use data from a different source.</td>
</tr>
<tr>
<td>There is no measure to forecast.</td>
<td>This error is returned if no measure that can be forecast is present in the view. Forecast measures must be on the Rows or Columns shelf, or on the Marks card.</td>
</tr>
<tr>
<td>The measure to forecast must be a number.</td>
<td>Some measures cannot be interpreted numerically and therefore cannot be forecast.</td>
</tr>
<tr>
<td>A forecast cannot be computed.</td>
<td>The value to be forecast must be a measure, and not a dimension.</td>
</tr>
<tr>
<td>Issue</td>
<td>Resolution</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>There is too much data to compute a forecast.</td>
<td>Forecasting is not possible when the result set from the query is too large. The limit is about 10,000 rows. To fix the forecast, aggregate the time series value at a higher level (for example, Month instead of Week) or filter the data.</td>
</tr>
<tr>
<td>A forecast cannot be computed because the data is divided into too many rows, columns, or colors.</td>
<td>Simplify the view to resolve the error by filtering or removing some of the dimensions.</td>
</tr>
<tr>
<td>A forecast cannot be computed because the view contains table calculations.</td>
<td>Create a version of the view that does not contain table calculations.</td>
</tr>
<tr>
<td>A forecast cannot be computed because there is a measure on the Filters shelf.</td>
<td>Remove the measure from the Filters shelf.</td>
</tr>
<tr>
<td>A forecast cannot be computed because Aggregate Measures is not selected.</td>
<td>Aggregate Measures is an option on the Analysis menu. See Aggregating Data on page 328.</td>
</tr>
<tr>
<td>A forecast cannot be computed because the view contains percent calculations.</td>
<td>Percentage of is an option on the Analysis menu. See Percentages on page 866.</td>
</tr>
<tr>
<td>A forecast cannot be computed because Grand Totals or Subtotals is enabled.</td>
<td>These options are controlled from the Totals command in the Analysis menu. See Totals on page 902.</td>
</tr>
<tr>
<td>A multiplicative model cannot be computed because the measure to be forecast has one or more values that are less than or equal to zero.</td>
<td>You have created a custom model with Trend or Seasonality set to Multiplicative. Change this value, or set the Forecast Model to Automatic.</td>
</tr>
<tr>
<td>A model with multiplicative trend and additive season is not allowed because it is numerically unstable.</td>
<td>You have created a custom model configured as described in the error message. Change the settings for the custom model, or set the Forecast Model to Automatic.</td>
</tr>
</tbody>
</table>
A seasonal model cannot be computed because the time series is too short.

Expand the time series in your view to include more date values.

The selected multiplicative model cannot be computed because some of the data is too close to zero relative to the rest of the data.

You have created a custom model configured as described in the error message. Change the settings for the custom model, or set the Forecast Model to **Automatic**.

---

**Trend Lines**

Use the Tableau trend line feature to incrementally construct interactive models of behavior. With trend lines you can answer such questions as whether profit is predicted by sales, or whether average delays at an airport are significantly correlated with the month of the year.

**Adding Trend Lines**

When you add trend lines to the view, you can specify how you want them to look and behave.

**Add Trend Lines to the View**

1. Select **Analysis > Trend Lines > Show Trend Lines**, or right-click (Control-click on a Mac) on the pane and choose **Trend Lines > Show Trend Lines**.

   This command adds a linear trend line for each page, pane, and color on the worksheet. You can continue with the steps below to configure trend lines.

   You can also drag a trend line in from the Analytics pane. See **Analytics Pane on page 131**.

2. Select **Analysis > Trend Lines > Edit Trend Lines**, or right-click on the pane and choose **Trend Lines > Edit Trend Lines** to open the Trend Lines Options dialog box.

   a. Select either a Linear, Logarithmic, Exponential, or Polynomial model type.

   b. For trend models that are considering multiple fields, you can eliminate specific fields you want to exclude as factors in the trend line model. For example, on a view of sales across categories and regions, you may want to see the overall sales trend across all categories, rather than a different line for each region. In this case, you would exclude **Region** as a factor:
For more information on excluding factors, see Removing Factors from the Model on page 619.

c. Decide whether to exclude color, using the Allow a trend line per color option. When you have color encodings in your view, you can use this option to add a single trend line that models all of the data, ignoring the color encoding.

d. Decide whether to Show Confidence Bands. Tableau confidence bands show upper and lower 95% confidence lines by default when you add trend lines. Confidence lines are not supported for Exponential models.

e. Select whether to Force the y-intercept to zero. This option is useful when you know that you want your trend line to begin at zero. This option is available only when both the Rows shelf and the Columns shelf contain a continuous field, as with a scatterplot.

3. When finished, click OK.

When Can't You Add Trend Lines?

To add trend lines to a view, both axes must contain a field that can be interpreted as a number. For example, you cannot add a trend line to a view that has the Product Category dimension, which contains strings, on the Columns shelf and the Profit measure on the Rows shelf. However, you can add a trend line to a view of sales over time because both sales and time can be interpreted as numeric values.
For multidimensional data sources, the date hierarchies actually contain strings rather than numbers. Therefore, trend lines are not allowed. Additionally, the ‘m/d/yy’ and ‘mmmm yyyy’ date formats on all data sources do not allow trend lines.

If you have trend lines turned on and you modify the view in a way where trend lines are not allowed, the trend lines do not show. When you change the view back to a state that allows trend lines, they reappear.

Tableau automatically stacks bar marks in many cases. However, trend lines cannot be turned on for stacked bars. You can turn off stacked marks by clearing the Analysis > Stack Marks option.

Removing Trend Lines

The easiest way to remove a trend line from a view is just to drag it off. You can also click a trend line and select Remove.

To remove all trend lines from the view, choose Analysis > Trend Lines > Show Trend Lines to remove the check mark, or right-click (Control-click on a Mac) the pane and choose Trend Lines > Show Trend Lines to remove the check mark.

Trend line options are retained for the next time you turn on trend lines. However, if you close the workbook with trend lines turned off, trend line options revert to defaults.

Trend Line Model Types

When you add a trend line to a view, you are building a statistical model. You are answering a question: Do the factors in your view predict a specific value (measure)? More precisely, do the categorical factors in your view split your data into meaningful samples and does the data in those samples allow you to predict values of the response measure given values of the explanatory measure or date? For example, you might be asking whether profit is predicted by time in a view that shows the profit of a company over four years.

Each trend line in the view visually represents a linear regression statistical model. Each model is estimated using data in the same pane and of the same color as the corresponding trend line. Although trend lines may be of type linear, logarithmic, exponential, or polynomial, this does not indicate that any of these models is not a linear regression. These types just identify transformations of either the explanatory or response variable in the linear regression formula.

The word linear means that the formula is always of the form

\[ y = b_0 + b_1 \times x_1 + \ldots + b_n \times x_n \]

In other words, the formula is always linear in its coefficients: \( b_0 \ldots b_n \).
Model Types

Choose from the following model types. In the following formulas, X represents the explanatory variable, Y to response variable, and (e) (epsilon) represents random error. Random errors are uncorrelated with each other and with the explanatory variable, and have equal variance.

Linear

With the linear model type, no transformations are performed on either the explanatory or response variable. So the formula is

\[ Y = b_0 + b_1 \times X + e \]

Logarithmic

With the Logarithmic model type, the explanatory variable is transformed by the natural log before estimation of the model. So the formula is

\[ Y = b_0 + b_1 \times \ln(X) + e \]

Because a logarithm is not defined for number less than zero, any marks for which the explanatory variable is negative are filtered before estimation of the model. Avoid using a model that discards some data unless you know that the data being filtered out is invalid. The trend line description reports how many marks were filtered before model estimation.

Exponential

With the exponential model type, the response variable is transformed by the natural log before estimation of the model. So the formula is

\[ \ln(Y) = b_0 + b_1 \times X + e \]

With an exponential model, your response axis does not become logarithmic. Instead, the marks plotted in your view are found by plugging in various explanatory values to find values of \( \ln(Y) \). These values are then exponentiated to plot the trend line. What you see is the exponential model:

\[ Y = e^{(b_0 + b_1 \times X + e)} \]

Because a logarithm is not defined for numbers less than zero, any marks for which the response variable is negative are filtered before model estimation.

Polynomial

With the polynomial model type, the response variable is transformed into a polynomial series of the specified degree. So the formula is

\[ Y = b_0 + b_1 \times X + b_2 \times X^2 + \ldots + e \]

With a polynomial model type, you also select a Degree between 2 and 8. The higher polynomial degrees exaggerate the differences between the values of your data. So if your data increases very rapidly, the lower order terms may have almost no variation compared to the higher order terms, rendering the model impossible to estimate accurately. Also, more
complicated higher order polynomial models require more data to estimate. So check the model description of the individual trends line for a red warning message indicating that an accurate model of this type is not possible.

**Removing Factors from the Model**

You can remove factors from a trend line model in the Trend Lines Options dialog box. Often you will want to remove factors because you want the trend line model to be based on the entire row in the table rather than broken up by the members or values of a field. Consider the following example. The view below shows the monthly sales for various products categories, broken out by region.

You can see that a separate model is created for each region.

Now remove **Region** as a factor in the model by deselecting it in the Trend Lines Options dialog box.
You can see that the trend line model within a category is now the same across all regions. This allows you to compare actual sales against a trend line that is the same for all regions.
Assessing Trend Line Significance

To see relevant information for any trend line in the view, hover the cursor over it:

![Image of trend lines with tooltip]

The first line in the tooltip shows the equation used to compute a value of **Profit** from a value of **Year of Order Date**.

The second line, the R-Squared value, shows the ratio of variance in the data, as explained by the model, to the total variance in the data. For more details, see **Trend Line Model Terms on page 626**.

The third line, the P-value, reports the probability that the equation in the first line was a result of random chance. The smaller the p-value, the more significant the model is. A p-value of 0.05 or less is often considered sufficient.

**Entire Model Significance**

Once you’ve added a trend line to a view, you typically want to know the goodness of fit of the model, which is a measure of the quality of the model’s predictions. In addition, you may be interested in the significance of each factor contributing to the model. To view these numbers, open the Describe Trend Model dialog box, right-click (Control-click on a Mac) in the view and select **Trend Lines > Describe Trend Model**.

When you are testing significance, you are concerned with the p-values. The smaller the p-value, the more significant the model or factor is. It is possible to have a model that has statistical significance but which contains an individual trend line or a term of an individual trend line that does not contribute to the overall significance.

Under Trend Lines Model, look for the line that shows the p-value (significance) of the model: The smaller the p-value, the less likely it is that the difference in the unexplained variance between models with and without the relevant measure or measures was a result of random chance.
This p-value for a model compares the fit of the entire model to the fit of a model composed solely of the grand mean (the average of data in the data view). That is, it assesses the explanatory power of the quantitative term \( f(x) \) in the model formula, which can be linear, polynomial, exponential, or logarithmic with the factors fixed. It is common to assess significance using the "95% confidence" rule. Thus, as noted above, a p-value of 0.05 or less is considered good.

### Significance of Categorical Factors

In the Analysis of Variance table, sometimes referred to as the ANOVA table, each field that is used as a factor in the model is listed. For each field, among other values, you can see the p-value. In this case, the p-value indicates how much that field adds to the significance of the entire model. The smaller the p-value the less likely it is that the difference in the unexplained variance between models with and without the field was a result of random chance. The values displayed for each field are derived by comparing the entire model to a model that does not include the field in question.

The following image shows the Analysis of Variance table for a view of quarterly sales for the past two years of three different product categories.

As you can see, the p-values for **Category** and **Region** are both quite small. Both of these factors are statistically significant in this model.

For information on specific trend line terms, see [Trend Line Model Terms](#) on page 626.

For ANOVA models, trend lines are defined by the mathematical formula:
Y = factor1 * factor2 * ... * factorN * f(x) + e

The term Y is called the response variable and corresponds to the value you are trying to predict. The term X is the explanatory variable, and e (epsilon) is random error. The factors in the expression correspond to the categorical fields in the view. In addition, each factor is represented as a matrix. The * is a particular kind of matrix multiplication operator that takes two matrices with the same number of rows and returns a new matrix with the same number of rows. That means that in the expression factor1 * factor2, all combinations of the members of factor1 and factor2 are introduced. For example, if factor1 and factor2 both have three members, then a total of nine variables are introduced into the model formula by this operator.

Answering Questions with Trend Lines

We start with a question: what is causing high discount rates at a superstore? Using trend lines, we can find out which variables correlate with high discounts. The view below shows the average monthly discount rates for all stores over a four-year range.
Our first thought is that discount rates may be high for specific ship modes. When we put the **Ship Mode** field on the **Rows** shelf, we see that there was a spike in discount rates for items shipped by Delivery Truck in 2009.

However, in the description of the trend line mode, the Analysis of Variance list shows that the p-value for Ship Mode is 0.22. (To see the description, right-click (Control-click on a Mac) the trend line and choose **Describe Trend Model**). This number is too high to be significant, indicating that we cannot predict discount rates based on ship mode. (It is common to test significance by applying the “95% confidence” rule. This equates to a p-value of 0.05 or less.)

The next variable we test is supplier. Suppliers sometimes offer substantial discounts. So we remove **Ship Mode** and drag **Supplier** to the **Rows** shelf.
Now when we open the Describe Trend Model dialog box, we see that the p-value for Supplier is 0.0004, while the p-value for the entire model is less than 0.003. With that, we can be confident in concluding that changes in average discount rates over time are in fact quite different for different suppliers. In other words we can be statistically confident that the different trend lines slopes for each supplier isn’t just due to randomness, but rather to a real correlation between a supplier and the slope of this line.

<table>
<thead>
<tr>
<th>Supplier</th>
<th>2000</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fellows</td>
<td>5.0%</td>
<td>5.0%</td>
<td>5.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td></td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Hon</td>
<td>10.0%</td>
<td>10.0%</td>
<td>10.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td></td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Newell</td>
<td>6.0%</td>
<td>6.0%</td>
<td>6.0%</td>
<td>6.0%</td>
</tr>
<tr>
<td></td>
<td>10.0%</td>
<td>10.0%</td>
<td>10.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>Sony</td>
<td>5.0%</td>
<td>5.0%</td>
<td>5.0%</td>
<td>5.0%</td>
</tr>
<tr>
<td></td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

In addition to Supplier, we notice that the Year of Order Date field offers a statistically significant improvement to the model. See Assessing Trend Line Significance for more information.
Assumptions
The p-values reported in Tableau trend lines depend on some assumptions about the data.

The first assumption is that, whenever a test is performed, the model for the mean is (at least approximately) correct.

The second assumption is that the "random errors" referred to in the model formula (see Trend Line Model Types on page 617) are independent across different observations, and that they all have the same distribution. This constraint would be violated if the response variable had much more variability around the true trend line in one category than in another.

Assumptions Required to Compute Trend Lines
The Assumptions required to compute (using Ordinary Least Squares) each individual trend line are:

- Your model is an accurate functional simplification of the true data generating process (for example, no linear model for a log linear relationship).
- Your errors average to zero and are uncorrelated with your independent variable (for example, no error measuring the independent variable).
- Your errors have constant variance and are not correlated with each other (for example, no increase in error spread as your independent variable increases).
- Explanatory variables are not exact linear functions of each other (perfect multicollinearity).

Trend Line Model Terms
When you view the description for a trend line model, there are several values listed. This section discusses what each of these values means.

Model formula
This is the formula for the full trend line model. The formula reflects whether you have specified to exclude factors from the model.

Number of modeled observations
The number of rows used in the view.

Number of filtered observations
The number of observations excluded from the model.

Model degrees of freedom
The number of parameters needed to completely specify the model. Linear, logarithmic, and exponential trends have model degrees of freedom of 2. Polynomial trends have model degrees of freedom of 1 plus the degree of the polynomial. For example a cubic trend has
model degrees of freedom of 4, since we need parameters for the cubed, squared, linear and constant terms.

**Residual degrees of freedom (DF)**

For a fixed model, this value is defined as the number of observations minus the number of parameters estimated in the model.

**SSE (sum squared error)**

The errors are the difference between the observed value and the value predicted by the model. In the Analysis of Variance table, this column is actually the difference between the SSE of the simpler model in that particular row and the full model, which uses all the factors. This SSE also corresponds to the sum of the differences squared of the predicted values from the smaller model and the full model.

**MSE (mean squared error)**

The term MSE refers to "mean squared error" which is the SSE quantity divided by its corresponding degrees of freedom.

**R-Squared**

R-squared is a measure of how well the data fits the linear model. It is the ratio of the variance of the model's error, or unexplained variance, to the total variance of the data.

When the y-intercept is determined by the model, R-squared is derived using the following equation:

$$1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}(y_i - \bar{y})^2}$$

When the y-intercept is forced to 0, R-squared is derived using this equation instead:

$$1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}y_i^2}$$

In the latter case, the equation will not necessarily match Excel. This is because R-squared is not well defined in this case, and Tableau’s behavior matches that of R instead of that of Excel.

**Standard error**

The square root of the MSE of the full model. An estimate of the standard deviation (variability) of the "random errors" in the model formula.
p-value (significance)

The probability that an F random variable with the above degrees of freedom exceeds the observed F in this row of the Analysis of Variance table.

Analysis of Variance

This table, also known as the ANOVA table, lists information for each factor in the trend line model. The values are a comparison of the model without the factor in question to the entire model, which includes all factors.

Individual trend lines

This table provides information about each trend line in the view. Looking at the list you can see which, if any, are the most statistically significant. This table also lists coefficient statistics for each trend line. A row describes each coefficient in each trend line model. For example, a linear model with an intercept requires two rows for each trend line. In the Line column, the p-value and the DF for each line span all the coefficient rows. The DF column under the shows the residual degrees of freedom available during the estimation of each line.

Terms

The name of the independent term.

Value

The estimated value of the coefficient for the independent term.

StdErr

A measure of the spread of the sampling distribution of the coefficient estimate. This error shrinks as the quality and quantity of the information used in the estimate grows.

t-value

The statistic used to test the null hypothesis that the true value of the coefficient is zero.

p-value

The probability of observing a t-value that large or larger in magnitude if the true value of the coefficient is zero. So, a p-value of .05 gives us 95% confidence that the true value is not zero.

Commonly Asked Questions

This section describes some commonly asked questions regarding trend lines in Tableau.

How do I change the confidence level used in the model?

Tableau does not enforce a confidence level. It simply reports the significance of the whole model, or of a specific field, by showing the p-value. The p-value will measure the probability of obtaining the same trend result without taking the dimensions into account. For example, a
trend of sales per time p-value of 0.05 means that there is 5% chance that the same value could be obtained without taking the time into consideration.

**What does it mean if the p-value for the model is significant but the p-value for the specific field in the Analysis of Variance table is not significant?**

The p-value in the Analysis of Variance table indicates whether the field adds or detracts from the significance of the entire model. The smaller the p-value the less likely it is that the difference in the unexplained variance between models with and without the field was a result of random chance. The values displayed for each field are derived by comparing the entire model to a model that does not include the field in question. So, for the situation where the p-value for the model is significant but the p-value for the specific field is not, you know that the model is statistically significant, but you cannot be confident that the specific field in question adds anything to it. Consider whether you might not be better off removing the factor from the model.

**What does it mean if the p-value for the specific field in the Analysis of Variance table is significant but the p-value for the model is not significant?**

This could happen in a case when there is no "trend" within each pane. For example, the lines are flat, but the mean varies across a given factor.
Filter Data from Your Views

In this topic:

- **Filtering Order of Operations** below
- **Select to keep or exclude data points in your view** on the next page
- **Drag dimensions, measures, and date fields to the Filters shelf** on page 632
- **Display interactive filters in the view** on page 637
- **Set options for filter card interaction and appearance** on page 639
- **See Also:** on page 643 additional filtering resources

There are many different ways to filter certain values or a range of values from your view in Tableau. You can:

- Drag a field to the Filters shelf.
- Select to exclude or keep data points (marks) or headers in the view.
- Show an interactive filter in the view.

Other activities, including creating a level of detail expression or adding a table calculation can filter your data, even though these activities are not specifically about filtering.

**Filtering Order of Operations**

Before you begin filtering data in Tableau, it's important to understand the order in which Tableau executes filters in your workbook.

Tableau performs actions on your view in a very specific order; this is called the Order of Operations. When it comes to filtering, different types of filters are executed in the following order:

1. Extract filters
2. Data source filters
3. Context filters
4. Filters on dimensions (whether on the Filters shelf or in filter cards in the view)
5. Filters on measures (whether on the Filters shelf or in filter cards in the view)

To learn more about how you can change the order of operations, see **Tableau’s Order of Operations** on page 278.
Select to keep or exclude data points in your view

You can filter individual data points (marks), or a selection of data points from your view. For example, if you have a scatter plot with outliers, you can exclude them from the view so you can better focus on the rest of the data.

To filter marks from the view, select a single mark (data point) or click and drag in the view to select several marks. On the tooltip that appears, you can:

- Select **Keep Only** to keep only the selected marks in the view.

[Diagram of scatter plot with selected marks]

- Select **Exclude** to remove the selected marks from the view.

[Diagram of scatter plot with excluded marks]

**Note:** These filtering options are not available if a Wildcard Match filter is already specified for the same field. See Drag dimensions, measures, and date fields to the Filters shelf on the next page to learn more about Wildcard Match filters.
Select headers to filter data

You can also select headers to filter them from your view.

To filter entire rows or columns of data from your view, select the header in the view. On the tooltip that appears, select to Exclude or Keep Only the selected data.

When you select a table header that is part of a hierarchy, all of the next level headers are also selected. For example, the view shown below consists of two unrelated dimensions placed on the Columns shelf, and two levels of the same hierarchy placed on the Rows shelf.

The selected row headers include the Furniture member of the Category dimension, and the Binders and Labels members of the Sub-category dimension. When Furniture is selected, all members from the next (inner) level in the hierarchy are automatically selected. In this case, that means the Bookcases, Chairs, Furnishings, and Tables members.

<table>
<thead>
<tr>
<th>Region</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td></td>
</tr>
<tr>
<td>Illinois</td>
<td>$4,393</td>
</tr>
<tr>
<td>Indiana</td>
<td>$6,450</td>
</tr>
<tr>
<td>Iowa</td>
<td>$4,012</td>
</tr>
<tr>
<td>Kansas</td>
<td>$2,878</td>
</tr>
<tr>
<td>Michigan</td>
<td>$6,881</td>
</tr>
<tr>
<td>Minnesota</td>
<td>$1,093</td>
</tr>
<tr>
<td>Missouri</td>
<td>$1,058</td>
</tr>
<tr>
<td>Nebraska</td>
<td>$6,292</td>
</tr>
<tr>
<td>North Dakota</td>
<td>$5,615</td>
</tr>
</tbody>
</table>

Drag dimensions, measures, and date fields to the Filters shelf

Another way to create a filter is to drag a field directly from the Data pane to the Filters shelf.
When you add a field to the Filters shelf, the Filter dialog box opens so you can define the filter. The Filter dialog box differs depending on whether you are filtering categorical data (dimensions), quantitative data (measures), or date fields.

**Filter categorical data (dimensions)**

Dimensions contain discrete categorical data, so filtering this type of field generally involves selecting the values to include or exclude. You can also define conditions and limits to create a more complex filter definition.

When you drag a dimension from the Data pane to the Filters shelf, the following Filter dialog box appears:
There are four tabs in the dialog box:

- **General**: Use the General tab to select the values you want to include or exclude.

- **Wildcard**: Use the Wildcard tab to define a pattern to filter on. For example, when filtering on email addresses you might want to only include emails from a specific domain. You can define a wildcard filter that ends with "@gmail.com" to only include Google email addresses.

- **Condition**: Use the Condition tab in the Filter dialog box to define rules to filter by. For example, in a view showing the average Unit Price for a collection of products, you may want to only show the Products that have an average unit price that is greater than or equal to $25. You can use the built-in controls to write a condition or you can write a custom formula.

- **Top**: Use the Top tab in the Filter dialog box to define a formula that computes the data that will be included in the view. For example, in a view that shows the average Time to Ship for a collection of products, you can decide to only show the top 15 products by Sales. Rather then having to define a specific range for Sales (e.g., greater than...
$100,000), you can define a limit (top 15) that is relative to the other members in the field (products).

**Important Note:** Each tab adds additional definitions to your filter. For example, you can select to exclude values under the General tab, and also add limits under the Top tab. Selections and configurations from both tabs are applied to your filter.

At any time, you can see the definitions of your filter under Summary on the General tab.

**Filter quantitative data (measures)**

Measures contain quantitative data, so filtering this type of field generally involves selecting a range of values that you want to include. You can create four types of quantitative filters: Range of Values, At Least, At Most, and Special.

**Note:** If you have a large data source, filtering measures can lead to a significant degradation in performance. It is sometimes much more efficient to filter by creating a set containing the measure and then apply a filter to the set.

When you drag a measure from the Data pane to the Filters shelf, the following dialog box appears:
Select how you want to aggregate the field, and then click **Next**.

In the subsequent dialog box, you’re given the option to create the following types of quantitative filters:

**Range of Values**: Select the Range of Values option to specify the minimum and maximum values of the range to include in the view. The values you specify are included in the range.

**At Least**: Select the At Least option to include all values that are greater than or equal to a specified minimum value. This type of filter is useful when the data changes often so specifying an upper limit may not be possible.

**At Most**: Select the At Most option to include all values that are less than or equal to a specified maximum value. This type of filter is useful when the data changes often so specifying a lower limit may not be possible.

**Special**: Select the Special option to filter on Null values. Include only Null values, Non-null values, or All Values.

**Filter dates**

When you drag a date field from the Data pane to the Filters shelf, the following Filter Field dialog box appears:
You can select whether you want to filter on a relative date; filter between a range of dates; or select discrete dates or individual dates to filter from the view.

- **Filter relative dates:** Click Relative dates to define a range of dates that updates based on the date and time you open the view. For example, you may want to see Year to Date sales, all records from the past 30 days, or bugs closed last week. Relative date filters can also be relative to a specific anchor date rather than today.

- **Filter a range of dates:** Select Range of dates to define a fixed range of dates to filter. For example, you may want to see all orders placed between March 1, 2009 and June 12, 2009.

- **Filter discrete dates:** Select a discrete date value in the dialog box if you want to include entire date levels. For example, if you select Quarters, you can choose to filter specific quarters (e.g. Q1, Q2, Q3, Q4) from your view, regardless of the year.

- **Filter individual dates:** Select Individual dates to filter specific dates from your view.

- **Additional date filter options:** When you select Relative dates or Range of dates, the Filter dialog box opens. In that dialog box, you can define a Starting date or Ending date. You can also select Special to include null dates, non-null dates, or all dates.

---

### Display interactive filters in the view

You can quickly add and modify filters by showing them in the view. When you show a filter, an interactive filter card appears in the view. Use the card to quickly include or exclude data in the view.

**To show a filter in the view:**
1. In the view, click the field drop-down menu and select Show Filter.

The field is automatically added to the Filters shelf (if it is not already being filtered), and a filter card appears in the view. Interact with the card to filter your data.

**Note:** You can add a quick filter for a field that is not currently used in the view. To do so, In the Data pane, click the field drop-down menu, and then select Show Filter. The field is automatically added to the Filters shelf, and a filter card appears in the view.
Set options for filter card interaction and appearance

After you show a filter, there are many different options that let you control how the filter works and appears. You can access these options by clicking the drop-down menu in the upper right corner of the filter card in the view.

Some options are available for all types of filters, and others depend on whether you’re filtering a categorical field (dimension) or a quantitative field (measure).

Finally, you can customize how filters appear in the view, in dashboards, or when published to Tableau Server.

Here are some of the general filter card options:

- **Edit Filter** - This option opens the main Filter dialog box so you can further refine the filter by adding conditions and limits.
- **Remove Filter** - Removes the filter from the Filters shelf and removes the filter card from the view.
- **Apply to worksheets** - Allows you to specify whether the filter should apply to only the current worksheet or be shared across multiple worksheets. For more information, see **Apply Filters to Multiple Worksheets** on page 643.
- **Format Filters** - Customize the font and colors of all your filter cards in the view.
- **Only relevant values** - Specifies which values to show in the filter. When you select this option other filters are considered and only values that pass these filters are shown. For example, a filter on State will only show the Eastern states when a filter on Region is set. You can use the toggle at the top of the filter card to switch between this option and the All Values in Database option.
- **All values in database** - Specifies which values to show in the filter. When you select this option all values in the database are shown regardless of the other filters on the view.
- **All values in context** - When one of the filters in the view is a context filter, select this option on a different filter to only display values that pass through the context filter. For more information, see **Improve View Performance with Context Filters** on page 652.
- **Include values** - When this option is selected, the selections in the filter card are
included in the view.

- **Exclude values** - When this option is selected, the selections in the filter card are excluded from the view.

- **Hide Card** - Hides the filter card but does not remove the filter from the Filters shelf.

**Filter card modes**

You can control the appearance and interaction of your filter card in the view by selecting a filter card mode.

To select a filter card mode, in the view, click the drop-down menu on the filter card and then select a mode from the list.
The types of filter card modes you see in the list of options depend on whether your filter is on a dimension or a measure. Below you can find brief descriptions of the types of filter card modes available for dimensions and measures.

Give them all a try!

**For dimensions, you can choose from the following filter modes:**

- **Single Value (List):** Displays the values of the filter as a list of radio buttons where only a single value can be selected at a time.
- **Single Value (Dropdown):** Displays the values of the filter in a drop-down list where only a single value can be selected at a time.
- **Single Value (Slider):** Displays the values of the filter along the range of a slider. Only a single value can be selected at a time. This option is useful for dimensions that have an implicit order such as dates.
- **Multiple Values (List):** Displays the values in the filter as a list of check boxes where multiple values can be selected.
- **Multiple Values (Dropdown):** Displays the values of the filter in a drop-down list where multiple values can be selected.
- **Multiple Values (Custom List):** Displays a text box where you can type a few characters and search for the value. Alternatively, you can type or paste a list of values into the text box to create a custom list of values to include.
- **Wildcard Match:** Displays a text box where you can type a few characters. All values that match those characters are automatically selected. You can use the asterisk character as a wildcard character. For example, you can type “tab*” to select all values that begin with the letters “tab”. Pattern Match is not case sensitive. If you are using a multidimensional data source, this option is only available when filtering single level hierarchies and attributes.

**For measures, you can choose from the following filter modes:**

- **Range of Values/Dates:** shows the filtered values as a pair of sliders that you can adjust to include or exclude more values. Click on the upper and lower limit readouts to enter the values manually.

The darker area inside the slider range is called the data bar. It indicates the range in which data points actually lie in the view. Use this indicator to determine a filter that makes sense for the data in your data source. For example, you may filter the Sales field to only include values between $200,000 and $500,000 but your view only contains values between $250,000 and $320,000. The range of data you can see in the view is indicated by the data bar while the sliders show you the range of the filter.
Note: Data bars only show in filters where the filtered field is also used in the view (e.g., on Columns, Rows, or on the Marks card, and so on) and are at the same aggregation level as the field on the Filters shelf. For example, a filter on SUM (Sales) will only display data bars if the SUM(Sales) field is used in the view. It won't show if AVG(Sales) is used in the view. Even though in both scenarios, the filtered field, Sales is used in the view; in the latter case the aggregation is different than the aggregation of the filter.

- **At Least/Starting Date**: shows a single slider with a fixed minimum value. Use this option to create a filter using an open ended range.

- **At Most/Ending Date**: shows a slider with a fixed maximum value. Use this option to create a filter using an open ended range.

- **Relative to Now**: this option shows a control where you can define a dynamic date range that updates based on when you open the view. The option is only available for filters on continuous date fields.

- **Browse periods**: shows common date ranges such as past day, week, month, three months, one year, and five years. This option is only available for filters on continuous date fields.

Note: When you expose a filter for Measure Values or Measure Names as a single value list, selecting All will automatically convert the filter to a multiple values list. For information on Measure Values and Measure Names, see Measure Values and Measure Names on page 295.

**Customize filter cards**

In addition to the general filter options and the filter modes, you control how your filter appears in the worksheet, on dashboards, or when published to the web even further.

To customize filters, click the filter card drop-down menu and select Customize.

You can select from the following options:

- **Show “All” Value** - toggles whether to show the “All” option that displays by default in multiple values and single value lists.

- **Show Search Button** - toggles whether to show the search button at the top of the filter.

- **Show Include/Exclude** - toggles whether to show the Include Values and Exclude Values commands on the filter card menu. When shown, users can switch the filter between include and exclude modes.

- **Show Filter Types** - toggles whether to let users change the type of quick filter shown.
For example, when shown, a user can change a multiple values list to a compact list.

- **Show More/Fewer Button** - toggles whether to show the More/Fewer button at the top of the filter.

- **Show All Values Button** - toggles whether to display the Show All Values button on the filter card.

- **Show Apply Button** - toggles whether to show the Apply button at the bottom of the filter. When shown, changes to the filter are only applied after you click the button. Pending changes are indicated with a green color. This option is only available in multiple values lists and dropdowns.

- **Show Readouts** - controls whether the minimum and maximum values are displayed as text above a range of values. The readouts can be used to manually type a new value instead of using the sliders.

- **Show Slider** - controls whether the slider displays. When this option is cleared, the filter only displays the readouts.

- **Show Null Controls** - shows a drop-down list that lets you control how the filter handles null values. You can select from values in a range; values in a range and null values; null values only, non-null values, or all values.

  **Note**: Not all of the above options are available for views published to Tableau Server.

**See Also:**

- [Apply Filters to Multiple Worksheets](#)
- [Filter Data Across Multiple Data Sources](#)
- [Improve View Performance with Context Filters](#)
- [Filter Data from Data Sources](#)
- [Control Who Can See What in a Published View](#)

**Apply Filters to Multiple Worksheets**

When you add a filter to a worksheet, by default it applies to the current worksheet. Sometimes, however, you might want to apply the filter to other worksheets in the workbook.
You can select specific worksheets to apply the filter to or apply it globally to all worksheets that use the same data source or related data sources. For example, you might have a filter that only includes a specific region or product of interest. Rather than adding this filter every time you create a new worksheet, you can simply create the filter once and then apply it to multiple worksheets.

**Apply filters to all worksheets that use a related primary data source**

This option applies the filter to all worksheets that use related data sources as their primary data source. For more information, see Filter Data Across Multiple Data Sources on page 646.

To apply a filter to all worksheets using a related primary data source:

- On the Filters shelf, right-click the field and select **Apply to Worksheets > All Using Related Data Sources**.

Filters that use this option are global across the workbook.

Filters that apply to all related data sources are marked with an icon. The filter is automatically created on any existing worksheets, and on any new worksheets you create that use a related data source.

Any changes you make to the filter affects all of those worksheets.

**Apply filters to all worksheets that use the current primary data source**

This option applies the filter to all worksheets that use the current worksheet's primary data source as their primary data source.

To apply a filter to all worksheets using the current primary data source:

- On the Filters shelf, right-click the field and select **Apply to Worksheets > All Using This Data Source**.

Filters that use this option are global across the workbook.

Filters that apply to all worksheets are marked with a data source icon 🗂️. The filter is automatically created on any new worksheets you create after you drag a field to the view.

Any changes you make to the filter affects all of those worksheets.

**Note:** If blending multiple data sources in a view, the **All Using This Data Source** option applies to the filter if it is the primary data source.

**Apply filters to select worksheets**

This option opens a dialog box where you can select from a list of worksheets that use the same data source or related data sources.
To apply a filter to select worksheets:

- On the Filters shelf, right-click the field and select **Apply to Worksheets > Selected Worksheets**.
- In the Apply Filter to Worksheets dialog box, select the worksheets that you want to apply the filter. If any of the sheets already contain a filter on the same field, the dialog box will provide details about the filter.

  If you select the sheet, the current filter will override any existing filter selections.

Filters that apply to a selection of worksheets are marked with the worksheet icon 📒. Any changes you make to the filter affect all of the selected worksheets.

**Apply filters to the current worksheet only**

This option only applies to the current worksheet. This option is selected by default when you create new filters. Filters that are local to the current worksheet are shown without any additional icons.

To apply a filter to the current worksheet only:
• On the Filters shelf, right-click the field and select **Apply to Worksheets > Only This Worksheet**.

If you apply a filter to all worksheets or selected worksheets and then change the setting to apply the filter to just the current worksheet, the filters are not removed from all other worksheets. Rather, the filters are disconnected and they are all made local to their respective worksheets. You can go to each worksheet and remove the filter or modify selections.

**Filter all worksheets on a dashboard**

This option applies the filter to all worksheets in the dashboard that use the same data source or related data sources as their primary data source.

To filter all worksheets on a dashboard:

• In a dashboard, click the drop-down menu on a filter card and select **Apply to Worksheets > Selected worksheets.**
• In the Apply Filter to Worksheets dialog box, click **All on dashboard**, and then click **OK**.

**Note:** In previous versions of Tableau Desktop, the **All Using This Data Source** option was called Make Global and the **Only This Worksheet** option was Make Local.

**Filter Data Across Multiple Data Sources**

While working with multiple data sources in a workbook, you might want to compare the data between them using a field they have in common. To do so, you can apply a filter across multiple primary data sources.

For example, the following dashboard shows the order quantity, average sales, and average profit for customers. It has three views. Each of the views uses a different data source as its primary data source, and those data sources all have a field in common: Customer Name. There is also a filter card in the view for Customer Name.
This is an interesting dashboard with a lot of great information, but you might want to update all of the views in the dashboard at the same time by the customer you’re analyzing. For example, maybe you want to see the average sales, profit, and number of orders you’ve received from one of your customers, Aaron Riggs.

To do so, you can filter all three data sources on the Customer Name field.

Follow the steps below to learn how to filter data across multiple data sources.

**Before you start, you might want to know the following:**

In 10.0, you can only filter data across multiple primary data sources. You cannot filter data across secondary data sources. Filtering data across a worksheet’s secondary data source is not currently supported in Tableau Desktop.

If you want to filter data across secondary data sources, consider the following alternatives:

- Join tables that are in the same data source, instead of blending them. For more information, see [Join Your Data on page 349](#).
- Create a cross-database join if your tables are in different data sources. For more information, see [Join Your Data on page 349](#).
- Make the primary data source the secondary data source, and the secondary data source the primary. **Note:** This might not always be feasible given the level of detail you want in the final view.
For more FAQs about cross data-source filters, see the Cross data-source filtering FAQs forum post in the Tableau Community.

**Define relationships between your data sources**

Before you can create relationships between data sources, you must ensure that there is a common field between the data sources you're mapping. The fields do not need to be named the same in each data source, but they should have some data in common.

After you've identified the common fields, you must create relationships between them, or *map the fields* to one another.

If the fields happen to have the same name, Tableau might recognize them as related automatically. You can modify an existing relationship that was created automatically by Tableau, or create a new relationship between two fields in different data sources, by following the procedure below.

To define a relationship between your two data sources:

1. Select **Data > Edit Relationships**.
2. In the Edit Relationships dialog box, do the following:
   - Select a data source for **Primary data source**, and select a data source for **Secondary data source**.
   - Select **Custom**.
   - To define a relationship between fields that have different names, click **Add**.
     
     To edit an existing relationship, select the fields on the right, and then click **Edit**.
3. In the Add/Edit Field Mapping dialog box, do the following, and then click **OK**:
   - Under **Primary data source field**, select a field.
   - Under **Secondary data source field**, select a field with similar data to the field you selected for the primary data source.

For more information about editing relationships, see **Step 4: (Optional) Define or edit relationships** on page 368.

**Note:** After you define your relationships, you do not need to enable blends (that is, you do not have to click the link icon in the **Data** pane) to filter across your data sources.

For more information about the difference between primary and secondary data sources, see **Primary and secondary data sources** on page 365.

**Add a filter to the view**

After you have defined relationships between your data sources, go to one of your worksheets and drag a dimension to the **Filters** shelf. Then select to include or exclude data from the view.
For more information about filtering your data, see Filter Data from Your Views on page 630.

Optional Step: Display a filter card in the view. Right-click the field on the Filters shelf and select Show filter. A filter card for that field appears in the view.

For more information about filter cards (previously known as quick filters), see Display interactive filters in the view on page 637.

: **Apply the filter to your worksheets**

After you set up your filter, you can apply that filter to all the worksheets in your workbook that use related data sources, or you can apply it to selected worksheets.

- To apply the filter to all worksheets that use related data sources, right-click the field on the Filters shelf and select Apply to worksheets > All using related data sources.

The Customer Name field is added to the Filters shelf on every worksheet that uses a related data source. An icon is added next to the field on the Filters shelf, indicating that the filter is being applied to multiple data sources.

If you hover over the field on the Filters shelf in any worksheet, you can find details about the type of filter, the source field for the filter, and the other sheets the filter applies to.

- To apply the filter to selected worksheets, right-click the field on the Filters shelf and select Apply to worksheets > Selected worksheets.

The Customer Name field is added to the Filters shelf on the worksheets you selected. An icon is added next to the field on the Filters shelf to indicate that the filter is being
applied to select worksheets.

Now, on the dashboard, when you filter the view down to Aaron Riggs, all three views update and you can see that Aaron made orders in 2010, 2011, and 2013, and spent an average of 3,700 USD. The average profit for these orders was approximately 1,000 USD.

Source fields and target fields
When you apply a filter to multiple data sources, you create a source field and one or more target fields. Both source fields and target fields appear on the Filter shelf in their respective worksheets.

The source field is the field you're filtering with.

The target field on any given worksheet is a field from another data source that is related to the source field. This is the field that is actually being filtered on that worksheet.
The source field determines the data that is included or excluded from the target fields. For example, let's say you have three worksheets that use three separate data sources (A, B, and C) as their primary data source. Each of the data sources has a field in common (Fruit), and the data is as follows:

<table>
<thead>
<tr>
<th>Fruit from data source A</th>
<th>Fruit from data source B</th>
<th>Fruit from data source C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>Apples</td>
<td>Apples</td>
</tr>
<tr>
<td>Oranges</td>
<td>Grapefruit</td>
<td>Grapefruit</td>
</tr>
<tr>
<td>Bananas</td>
<td>Oranges</td>
<td>Oranges</td>
</tr>
<tr>
<td></td>
<td>Pears</td>
<td>Tomatoes</td>
</tr>
</tbody>
</table>

If the Fruit field from data source A is the source field for the cross data source filter, then the data that appears for the target fields is as follows:

<table>
<thead>
<tr>
<th>Fruit from data source A - Source field</th>
<th>Fruit from data source B - Target field</th>
<th>Fruit from data source C - Target field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>Apples</td>
<td>Apples</td>
</tr>
<tr>
<td>Oranges</td>
<td>Oranges</td>
<td>Oranges</td>
</tr>
<tr>
<td>Bananas</td>
<td></td>
<td>Bananas</td>
</tr>
</tbody>
</table>

Any data that does not match the data in the source field is excluded from the target fields, and will not appear in your worksheets or in your filter cards.

On the Filters shelf, source fields are indicated with either a 📊 icon when the source field applies to all worksheets with a related data source, or a 📊 icon when it applies to select worksheets. Target fields are indicated with a 📊 icon on the field on the Filters shelf. They are also indicated with a 📊 or 📊 icon next to the field on the Filters shelf.
**Improve View Performance with Context Filters**

By default, all filters that you set in Tableau are computed independently. That is, each filter accesses all rows in your data source without regard to other filters. However, you can set one or more categorical filters as context filters for the view. You can think of a context filter as being an independent filter. Any other filters that you set are defined as dependent filters because they process only the data that passes through the context filter.

You may create a context filter to:

- Improve performance – If you set a lot of filters or have a large data source, the queries can be slow. You can set one or more context filters to improve performance.
- Create a dependent numerical or top N filter – You can set a context filter to include only the data of interest, and then set a numerical or a top N filter.

For example, suppose you’re in charge of breakfast products for a large grocery chain. Your task is to find the top 10 breakfast products by profitability for all stores. If the data source is very large, you can set a context filter to include only breakfast products. Then you can create a top 10 filter by profit as a dependent filter, which would process only the data that passes through the context filter.

**Note:** As of Tableau 9.0, context filters no longer create temporary tables, except for generic ODBC data sources and customized data sources.

**Create Context Filters**

To create a context filter, select **Add to Context** from the context menu of an existing categorical filter. The context is computed once to generate the view. All other filters are then computed relative to the context. Context filters:

- Appear at the top of the Filters shelf.
- Are identified by a gray color on the Filters shelf.
- Cannot be rearranged on the shelf.

As shown below, the **Ship Mode** dimension is set to be the context for a view. The **Region** filter is computed using only the data that passes through **Ship Mode**.
You can modify a context filter by:

- Removing the field from the Filters shelf – If other context filters remain on the shelf, a new context is computed.
- Editing the filter – A new context is computed each time you edit a context filter.
- Selecting **Remove from Context** – The filter remains on the shelf as a standard filter. If other context filters remain on the shelf, a new context is computed.

**Speed up Context Filters**

To improve performance of context filters, especially on large data sources, follow these general rules.

- Using a single context filter that significantly reduces the size of the data set is much better than applying many context filters. In fact, if a filter does not reduce the size of the data set by one-tenth or more, it is actually worse to add it to the context because of the performance cost of computing the context.
- Complete all of your data modeling before creating a context. Changes in the data model, such as converting dimensions to measures, require recomputing the context.
Set the necessary filters for the context and create the context before adding fields to other shelves. Doing this work first makes the queries that are run when you drop fields on other shelves much faster.

If you want to set a context filter on a date you can use a continuous date. However, using date bins like YEAR(date) or context filters on discrete dates are very effective.

If your data set is heavily indexed, context filters may not provide performance improvement and may actually cause slower query performance.

Context filters can adversely affect any query performance improvements when using the Include joined tables only when referenced option in the Tables dialog box. See the note at the bottom of Join Your Data on page 349.

Example – Create Context Filters

This example walks you through how to create a context filter. First you’ll filter a view to show the top 10 products by sales. Then you’ll create a context filter on product category so you can see the top 10 furniture products.

1. Use the Sample - Superstore data source to create the initial view shown below. The view shows the sales for all sub-categories, sorted with the highest sale at the top.

2. Now create a Top 10 filter to just show the top selling products. You can create this filter by dragging the Sub-Category field to the Filters shelf. In the Filter dialog box, switch to
the Top tab and define a filter that is Top 10 by Sum of Sales. See Filter Data from Your Views on page 630 to learn more about defining a Top N filter.

3. When you click OK, you’ll see that the view is filtered to show the top 10 product sub-categories in terms of sales.

4. Now, let’s add another filter to show only furniture products. Drag the Category field to the Filters shelf and select only Furniture. When finished, click OK.

The view is filtered but instead of 10 products, it now shows 3. This is because by default all filters are evaluated separately and the view shows the intersection of the results. So this view shows that three of the top 10 overall products are furniture products.
5. To find out what the top 10 furniture products are we need to make the Category filter a context filter. Right-click the field on the Filters shelf and select Add to Context.

6. The filter is marked as a context filter and the view updates to show the top four furniture products. Why not 10? Because only four of the sub-categories contain furniture. But we now know that the Top 10 filter is being evaluated on the results of that context.

Create Slicing Filters

Slicing filters, also known as slicers or calculation filters, are dimension filters that behave differently for multidimensional data sources than they do for relational data sources.

In Tableau, multidimensional data sources are supported only in Windows.

A slicing filter exists when:

- The dimension that you place on the Filters shelf is not also on any other shelf in the view.
The filter is defined to include multiple values. For example:

For relational data sources, there is nothing remarkable about a slicing filter. Tableau recalculates values for each measure in the view using the configured aggregations.

But because multidimensional data sources contain data that is aggregated in the data source, no aggregation can be defined for the "slice" that the dimension filter cuts through the values of individual measures. Tableau therefore automatically performs a summation. And because multiple values are defined, the result is the sum of a group of sums.

For example, consider the view shown below, which shows profit by region and state.
A slicing filter that includes the Q3 and Q4 members of the Quarter dimension is then applied to the data.

In the resulting view, the profit for Oregon in the West region is 2,567. This number was calculated by summing data values for Qtr3 and Qtr4.

The summation symbol ($\Sigma$) you see on the Filters shelf in the view above indicates that this is a slicing filter. If the original aggregation for a field is non-additive (for example, Count Distinct) the values you see after applying a slicing filter may be unexpected.
Build and Use Maps

Authoring maps in Tableau is as easy as dragging and dropping a field onto the view. Whether you’re plotting disease outbreaks, tracking bird migrations, or analyzing public transportation usage, you can put your data on a map in Tableau.

All you need is some location data.

Here are some resources to help you bring that data into Tableau and plot it on a map view:

**Bring location data into Tableau**
- Convert shapefile data for use in Tableau
- Custom geocode your data
- Blend geographic data

**Build a map view**
- Format geographic fields in Tableau
- Build a map view

**Customize your map view**
- Create custom territories
- Customize the appearance of your map
- Customize how people interact with your map
- Use WMS (Web Map Service) Servers
- Use Mapbox Maps

**Interact with Maps**
- Explore data in maps
- Search for locations in your map
- Measure distances in your map

For a complete list of all topics about maps, see below:
Create Tableau Maps from Shapefiles

If you work with shapefile data, you can use a Geographic Information System (GIS) such as QGIS or ArcGIS to convert the data into a text file that you can import into Tableau Desktop. You can then connect to that text file and build a map view in Tableau.

In this topic:

- Create Tableau polygons from shapefiles using QGIS below
- Add point data from shapefiles using QGIS on page 671
- Create Tableau polygons from shapefiles using ArcGIS on page 673

Create Tableau polygons from shapefiles using QGIS

If you have shapefile data, you can use QGIS Desktop to convert it to a CSV file for use in Tableau Desktop.

For example, if you have shapefile data for U.S. counties, you can use QGIS Desktop to convert the shapefile to CSV files that you can then connect to in Tableau Desktop. You can create Tableau polygons for all the counties in the United States using the data in the CSV files.

Follow the steps below to learn how to use QGIS Desktop to convert shapefile data to text files and then create Tableau polygons.

Before you start

Before you follow the steps in this section, the coordinates in your shapefile should already be in the form of decimal latitude and longitude units, specifically using EPSG: 4326, WGS 84.

Additionally, this procedure requires you to use QGIS Desktop, an open source GIS that supports many different shapefile formats. To download this software, go to the QGIS website.

Note: If you are using Windows, install QGIS Standalone Installer Version 2.14 (64-bit).

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Download shapefile data

1. Go to the United States Census Bureau website and click cb_2015_us_county_500k.zip to download the file.
2. Extract the shapefiles to a folder on your computer. In this example, the folder is named US Counties and is saved on the Desktop.

: Use QGIS Desktop to convert shapefiles to CSV file format

1. Open QGIS Desktop.
2. Select Plugins > Manage and Install Plugins.
3. In the Plugins dialog box, do the following:
   - In the search bar at the top, search for mmqgis.
   - Select the mmqgis plugin that appears, and click Install plugin.

   - Click Close.
4. On the left side of the workspace, click the Add Vector Layer icon.
5. In the Add vector layer dialog box, do the following:
   
   - Under **Source type**, click **Directory**.
   
   - Under **Source**, click **Browse**, and then navigate to and select the **US Counties** folder.
   
   - Click **Open**.

6. If the Select vector layers to add dialog box appears, select **cb_2015_us_county_500k**, and then click **OK**.

   The polygons in the shapefile are plotted on the canvas and a layer is added to the Layers Panel.
7. Select Vector > Geometry Tools > Multipart to Singleparts.

This breaks any multiple polygons in the shapefile into single polygons so that Tableau can read and plot them properly on a map view. If you skip this step, certain locations in your map view might not plot correctly because Tableau does not recognize that they might be separate polygons. For example, in the image below, some of the Wisconsin counties along Lake Superior are not plotted properly.

8. In the Multipart to singleparts dialog box, do the following:
- For Input line or polygon vector layer, make sure US Counties cb_2015_us_county_500k any is selected.
- For Output shapefile, click Browse.
  In the new dialog box that opens, name the file Single Polygons and save it on your computer.
- Click OK, and then click Close to return to the QGIS workspace.

The Single Polygons layer is added to the Layers Panel.

10. In the Export Geometry to CSV dialog box, do the following:

   - For Source Layer, make sure that Single Polygons is selected.
   - For Output Nodes CSV File, click Browse.
     In the subsequent dialog box that opens, name the file nodes.csv and save it to a location on your computer.
   - For Output Attributes CSV File, click Browse.
     In the subsequent dialog box that opens, name the file attributes.csv and save it in the same location that you saved the nodes.csv file.
   - For Line Terminator, select LF. This ensures that any spaces are removed from cells in the CSV file.
   - Click OK.

The two CSV files, nodes.csv and attributes.csv, are saved to the location you chose.
Prepare the Nodes CSV file for Tableau

1. Open the `nodes.csv` file you saved.

   **Note:** The CSV file used in this example contains approximately 1,037,335 rows of data. Due to worksheet size limits, you might not be able to open this file in older versions of Microsoft Excel.

2. Add a new column called **Path**, which lists a sequence of numbers from 1 to however many records are in the file.

   For this example, there are 1048575 records. For shortcuts on adding a sequence of numbers in Microsoft Excel, see the Microsoft Office Support website.

   ![CSV file with Path column](image)

3. Save and close the file.

Connect to CSV files in Tableau and prepare your fields for creating map views

1. Open Tableau Desktop.

2. On the **Connect** section of the start page, click **Text File**.

3. Select the `nodes.csv` file that you created with QGIS.
The nodes.csv file is added to the top of the canvas on the data source page. If you saved the nodes.csv and attributes.csv files in the same place, they both appear in the left pane.

4. From the left pane, drag attributes.csv to the top of the canvas, to the right of the nodes.csv file. Tableau creates an inner join between the two data sources because they have a field in common: Shapeid.

5. In the grid on the bottom half of the workspace, click Update Now to view your data.

6. In the grid, for the Shapeid (Attributes) and Shapeid columns, click the data type icon and select String.
Important: If you do not change both Shapeid columns to be string data types, the join between the two data sources breaks.

7. In the grid, for the X column, click the data type icon and select Geographic role > Longitude.

8. For the Y column, click the data type icon and select Geographic role > Latitude.

9. Click Sheet 1.

: Build the map view

1. From the Measures pane, under nodes#csv, drag Shapeid(Count) and Path up to the Dimensions part of the Data pane.

   This converts the two fields from measures to dimensions and ensures that Tableau treats these fields as discrete locations.
2. From Measures, under nodes#csv, drag the **X** field to the **Columns** shelf, and the **Y** field to the **Rows** shelf.

   Tableau adds an aggregation to each field on the **Columns** and **Rows** shelves and creates a map view with one mark.
3. On the **Marks** card, click the **Mark Type** drop-down arrow and select **Polygon**. This ensures that you can create a polygon map, instead of a point data map.

4. From **Dimensions**, drag **Shapeid** to **Detail** on the **Marks** card.
The view temporarily updates to look like the following. Next, you tell Tableau where and in which order to plot each of the polygons.

5. From **Dimensions**, drag the **Path** field to **Path** on the **Marks** card.

   **Note:** If you do not see the Path option on the Marks card, check that the mark-type is set to **Polygon**, not Automatic or Filled Map. See **step 3**.

   The view updates to a legible map of the United States, with a separate polygon for every county. By adding the field **Path**, which is the column you manually created in the **nodes.csv** file, you tell Tableau which order to draw the polygons on the map.
You can zoom in and out of the map view, adjust the color of the marks, and even customize the background map. You can also blend additional data, such as sales data, to one of the CSV files to perform additional analyses on your location data. For more information about blending geographic data, see Data Blending vs. Custom Geocoding on page 683.

**Add point data from shapefiles using QGIS**

You can also use QGIS Desktop to convert point data from shapefile to CSV file format, and then add that point data on a map in Tableau.

Follow the steps below to learn how to use QGIS Desktop to convert shapefile data to text files and then use that data to create a point data map in Tableau. For information on how to download QGIS Desktop, see the Before you start on page 660 section.

**Download shapefile data**

1. Go to the Natural Earth website and download the Airports data.
2. Extract the shapefiles to a folder on your computer. In this example, the folder is named Airports and is saved on the Desktop.

**Use QGIS Desktop to convert shapefiles to CSV file format**

1. Open QGIS Desktop.
2. On the left side of the workspace, click the Add Vector Layer icon.
3. In the Add vector layer dialog box, do the following:
   - Under **Source type**, click **Directory**.
   - Under **Source**, click **Browse**, and then navigate to and select the airports folder.
   - Click **Open**.

The points in the shapefile are plotted on the canvas and a layer is added to the Layers Panel (highlighted in blue).

4. In the Layers Panel, right-click the airports layer, then click **Save As**.
5. In the Save vector layer as dialog box, do the following:
   - For **Format**: Select **Comma Separated Value**.
   - Click **Browse** to select the location where you want to save the file, and then click **OK**.

**Connect to the CSV file in Tableau and build the map view**

1. Open Tableau Desktop.
2. On the **Connect** section of the start page, click **Text File**.
3. Select the airports CSV file that you created with QGIS.

The **airports.csv** file is added to the top of the canvas on the Data Source page.

4. In the grid, for the **X** column, click the data type icon and select **Geographic role > Longitude**.
5. For the Y column, click the data type icon and select **Geographic role > Latitude**.

6. Click **Sheet 1**.

7. On **Measures**, double-click the X (Longitude) and Y (Longitude) fields to add them to the **Columns** and **Rows** shelves.

   A map with a single point appears.

8. From **Dimensions**, drag **Name** to **Detail** on the **Marks** card.

   Every airport listed in the **Name** field is displayed as a point on the map because each airport corresponds to a latitudinal and longitudinal value.

Create Tableau polygons from shapefiles using ArcGIS

You can also use ArcGIS to convert shapefiles to a text file format that can be imported into Tableau Desktop as a polygon layer.

**Note:** The ArcGIS method requires a licensed version of ArcGIS (ArcView, ArcEditor, or ArcInfo) and the **ET GeoWizards tool for ArcGIS**. The software installs as a toolbar in ArcMap and the functionality required for preparing the shapefile is covered under their free features.

**Prepare the shapefile**

1. In an ArcMap view that contains the polygon shapefile layer of interest, verify that the polygon is in a geographic coordinate system using decimal latitude and longitude units,
such as GCS NAD 1983. If it is in a projected coordinate system, use ArcToolbox to project the shapefile to a geographic coordinate system.

2. Launch the ET GeoWizards tool in ArcMap and follow the step-by-step wizard to output a Polygon to Point feature. Be sure that the output points are the Vertices only.

: Prepare the Tableau data source

1. Open the .DBF of the output shapefile into a program such as Excel. At a minimum, the file must contain the following fields for correct import into Tableau:
   - **[ID]** or **[ET_ID]** Either of these two fields can be used for the Level of Detail shelf.
   - **[ET_X]** This field corresponds to the longitude coordinate of the record.
   - **[ET_Y]** This field corresponds to the latitude coordinate of the record.
   - **[ET_ORDER]** This field contains the draw order of the points and is used in the Path shelf for the polygon.

You can change the header names here to be more informative to the Tableau user.

Save the updated file to a data source supported in Tableau, such as in Excel or Access format.
2. Refer to the remaining steps in the Creating Polygon-Shaded Maps article to complete the view you want in Tableau.

<table>
<thead>
<tr>
<th>ET_ID</th>
<th>ET_X</th>
<th>ET_Y</th>
<th>ET_ORDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>-122.75632</td>
<td>48.99688</td>
<td>0.9938</td>
</tr>
<tr>
<td>2</td>
<td>-122.75604</td>
<td>48.99951</td>
<td>0.9965</td>
</tr>
<tr>
<td>3</td>
<td>-123.09055</td>
<td>49.00198</td>
<td>0.0000</td>
</tr>
<tr>
<td>3</td>
<td>-123.03539</td>
<td>49.00215</td>
<td>0.3163</td>
</tr>
<tr>
<td>3</td>
<td>-123.03018</td>
<td>48.99286</td>
<td>0.3774</td>
</tr>
<tr>
<td>3</td>
<td>-123.02784</td>
<td>48.98869</td>
<td>0.4049</td>
</tr>
<tr>
<td>3</td>
<td>-123.02236</td>
<td>48.97890</td>
<td>0.4692</td>
</tr>
<tr>
<td>3</td>
<td>-123.02158</td>
<td>48.97752</td>
<td>0.4783</td>
</tr>
<tr>
<td>3</td>
<td>-123.02146</td>
<td>48.97730</td>
<td>0.4797</td>
</tr>
<tr>
<td>3</td>
<td>-123.02152</td>
<td>48.97727</td>
<td>0.4801</td>
</tr>
<tr>
<td>3</td>
<td>-123.02809</td>
<td>48.97394</td>
<td>0.5224</td>
</tr>
<tr>
<td>3</td>
<td>-123.04097</td>
<td>48.97731</td>
<td>0.5987</td>
</tr>
<tr>
<td>3</td>
<td>-123.05199</td>
<td>48.97623</td>
<td>0.6622</td>
</tr>
<tr>
<td>3</td>
<td>-123.06072</td>
<td>48.97539</td>
<td>0.7125</td>
</tr>
<tr>
<td>3</td>
<td>-123.06295</td>
<td>48.97546</td>
<td>0.7253</td>
</tr>
<tr>
<td>3</td>
<td>-123.06400</td>
<td>48.97549</td>
<td>0.7313</td>
</tr>
<tr>
<td>3</td>
<td>-123.08383</td>
<td>48.97614</td>
<td>0.8451</td>
</tr>
<tr>
<td>3</td>
<td>-123.08395</td>
<td>48.97790</td>
<td>0.8553</td>
</tr>
<tr>
<td>3</td>
<td>-123.08450</td>
<td>48.98654</td>
<td>0.9049</td>
</tr>
<tr>
<td>3</td>
<td>-123.08814</td>
<td>48.99583</td>
<td>0.9523</td>
</tr>
<tr>
<td>4</td>
<td>-121.52410</td>
<td>48.99896</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>-121.39554</td>
<td>48.99985</td>
<td></td>
</tr>
</tbody>
</table>
Disclaimer: This information refers to a third-party product as an example. This example is not an endorsement of this product over any other competing products.

Please note that while we make every effort to keep references to third-party content accurate and up to date, the information we provide here might change without notice as the third-party product changes.

Custom Geocode Your Data

Tableau recognizes country names, state/province names, city names, and area codes for many countries worldwide. However, there are some locations that Tableau does not recognize immediately.

If you have location data that Tableau doesn't recognize, you can custom geocode your data so that you can use it to create map views in Tableau with ease. Custom geocoding your data allows you to create custom geographic roles that you can use as you create map views in Tableau.

For example, if your data contains country, state/province, and street address data, Tableau Desktop will geocode your data to the country and state/province level, but will not recognize the street address data. In this case, you can create a custom geographic role for the street address data so that you can plot it on a map view in Tableau.

Follow the steps below to learn how to custom geocode your data.
Here's what you need to do:

1. Create one or more CSV files with your location data
2. Create a schema.ini file (optional)
3. Import the files into Tableau
4. Assign geographic roles to your fields

Before you start: Custom geocoding your data can be tricky. We recommend that you check out the Prepare Your Geographic Fields on page 693 topic to learn more about geographic roles and the type of data Tableau recognizes before you get started.

: Create a CSV file with your location data

The first step to custom geocoding your data is creating a CSV file to import into Tableau. The contents of this file differ depending on whether you are extending an existing geographic hierarchy, adding a new geographic role, or adding a new hierarchy to Tableau.

However, the following applies to all custom geocoding files:

- The .csv file must contain Latitude and Longitude columns.
- The latitude and longitude values you add must be real numbers. Make sure to include at least one decimal place when specifying these values.

Extend an Existing Role

The built-in geographic roles in Tableau contain hierarchies that can be extended to include locations relevant to your data. For example, the existing hierarchy of Country > State/Province may not contain all of the states or provinces in your data. You can extend this level to include missing states or provinces.

The import file for this type of geocoding should contain every level of the hierarchy above the level you are extending. For example, if you are extending (adding data to) the State/Province geographic role, the existing State/Province hierarchy has a column for Country and State/Province, along with Latitude and Longitude.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Country (Name) State/Province Latitude Longitude</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 England United Kingdom 51.5000 0.1167</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Scotland United Kingdom 55.9500 3.1833</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Wales United Kingdom 51.4833 3.1833</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Northern Ireland United Kingdom 54.6000 5.9167</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In the import file, the names of the columns define the geographic roles. When extending an existing role, the column names must match the existing geographic roles in the hierarchy that you are extending. This will ensure that the new locations are added to the proper roles and hierarchies.

See the table below for information on how to organize hierarchies in your import file.

<table>
<thead>
<tr>
<th>Built-In Hierarchy</th>
<th>Columns to include in the .csv file (in order; left to right)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country (Name)</td>
<td>Country (Name)</td>
</tr>
<tr>
<td></td>
<td>Latitude</td>
</tr>
<tr>
<td></td>
<td>Longitude</td>
</tr>
<tr>
<td>Country (Name), State/Province</td>
<td>Country (Name)</td>
</tr>
<tr>
<td></td>
<td>State/Province</td>
</tr>
<tr>
<td></td>
<td>Latitude</td>
</tr>
<tr>
<td></td>
<td>Longitude</td>
</tr>
<tr>
<td>Country (Name), State/Province, City</td>
<td>Country (Name)</td>
</tr>
<tr>
<td></td>
<td>State/Province</td>
</tr>
<tr>
<td></td>
<td>City</td>
</tr>
<tr>
<td></td>
<td>Latitude</td>
</tr>
<tr>
<td></td>
<td>Longitude</td>
</tr>
<tr>
<td>Country (Name), State/Province, County</td>
<td>Country (Name)</td>
</tr>
<tr>
<td></td>
<td>State/Province</td>
</tr>
<tr>
<td></td>
<td>County</td>
</tr>
<tr>
<td></td>
<td>Latitude</td>
</tr>
<tr>
<td></td>
<td>Longitude</td>
</tr>
<tr>
<td>Country (Name), ZIP Code/Postcode</td>
<td>Country (Name)</td>
</tr>
<tr>
<td></td>
<td>ZIP Code/Postcode</td>
</tr>
<tr>
<td></td>
<td>Latitude</td>
</tr>
<tr>
<td></td>
<td>Longitude</td>
</tr>
<tr>
<td>Country (Name), Area Code</td>
<td>Country (Name)</td>
</tr>
<tr>
<td></td>
<td>Area Code</td>
</tr>
</tbody>
</table>
In addition to the Country (Name) column, you can optionally include the following columns: Country 2 char (ISO 3166-1), Country 3 char (ISO 3166-1), and Country (FIPS 10). If you include these columns, they should be just to the right of the Country (Name) column in any order.

**Note:** The highest level in the hierarchy is Country and cannot be extended to include higher levels such as Continent, etc.

### Add New Roles

To add new geographic roles to the existing geographic hierarchy in Tableau, format your import file to include the new roles along with their parent roles.

When adding new roles to an existing hierarchy, the import file for those roles needs to contain the columns for each level in the existing hierarchy. For more information on the columns to include in each geographic hierarchy, see the [built in hierarchy table](#) in the Extend An Existing Role section.

Below is an example of an import file containing airport codes. Importing the file below would add the geographic roles Airport (ICAO), Airport (IATA), and Airport (City) to the existing Country (Name) hierarchy. Notice that the column name for country matches the existing Country (Name) geographic role.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Airport (ICAO)</strong></td>
<td><strong>Airport (IATA)</strong></td>
<td><strong>Airport (City)</strong></td>
<td><strong>Country (Name)</strong></td>
<td><strong>Latitude</strong></td>
</tr>
<tr>
<td>2</td>
<td>AYGA</td>
<td>GKA</td>
<td>GOROKA</td>
<td>PAPUA NEW GUINEA</td>
<td>-6.08167</td>
</tr>
<tr>
<td>3</td>
<td>AYLA</td>
<td>LAE</td>
<td>LAE</td>
<td>PAPUA NEW GUINEA</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>AYMD</td>
<td>MAG</td>
<td>MADANG</td>
<td>PAPUA NEW GUINEA</td>
<td>-5.20694</td>
</tr>
<tr>
<td>5</td>
<td>AYMH</td>
<td>HGU</td>
<td>MOUNT HAGEN</td>
<td>PAPUA NEW GUINEA</td>
<td>-5.82611</td>
</tr>
<tr>
<td>6</td>
<td>AYNZ</td>
<td>LAE</td>
<td>NADZAB</td>
<td>PAPUA NEW GUINEA</td>
<td>-6.56972</td>
</tr>
<tr>
<td>7</td>
<td>AYPY</td>
<td>POM</td>
<td>PORT MORESBY</td>
<td>PAPUA NEW GUINEA</td>
<td>-9.44333</td>
</tr>
<tr>
<td>8</td>
<td>AYRB</td>
<td>RAB</td>
<td>RABAUL</td>
<td>PAPUA NEW GUINEA</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>AYWK</td>
<td>WWK</td>
<td>WEWAK</td>
<td>PAPUA NEW GUINEA</td>
<td>-3.38361</td>
</tr>
<tr>
<td>10</td>
<td>BGAM</td>
<td>N/A</td>
<td>ANGMAGSALIK</td>
<td>GREENLAND</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>BGAS</td>
<td>N/A</td>
<td>ANGISSOQ</td>
<td>GREENLAND</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>BGAT</td>
<td>N/A</td>
<td>APITTEQ</td>
<td>GREENLAND</td>
<td>0</td>
</tr>
</tbody>
</table>
Once you have created your import file, save the file as a Comma Delimited (.csv) file (Windows Comma Separated if on a Mac) in a folder on your computer.

(Optional): Create a schema.ini file

Sometimes when you attempt to import custom geographic information in Tableau using a .csv file, you may see a "csv could not be used because it does not contain a unique column" error message.

This is because your .csv file might contain numerical data, such as numeric postcodes. Tableau will only accept text fields for new geographic roles. However, you can create a schema.ini file to tell Tableau that the numeric field you want to import should be treated as a text field.

To learn how to create a schema.ini file, see Create a schema.ini File on page 691.

: Import custom geocoding file(s) into Tableau Desktop

Once you have created a .csv file with custom geocoding you can import that file into Tableau.

1. Open Tableau Desktop and navigate to a new or existing worksheet.
2. Select Map > Geocoding > Import Custom Geocoding.
3. In the Import Custom Geocoding dialog box, click the button to the right of the text field to browse to the folder your import file is saved in. All files in the folder will be imported into Tableau.
4. Click **Import**.

The custom geocoding data is imported into the workbook and the new geographic roles become available.

**Where does Tableau store my custom geocoding data?**

When you import custom geocoding, the data is stored in the Local Data folder in your Tableau Repository. To import custom geocoding, your Tableau Repository must be on a local hard drive. The custom geocoding is then available for all workbooks.

Save custom geocoding files in a separate folder on your local computer. If you have several different sets of custom geocoding files, save each of them under their own folder names.

You can remove the custom geocoding stored in your Tableau Repository by clicking **Map > Geocoding > Remove Custom Geocoding**. This will not remove the geocoding from a packaged workbook, but it will remove it from the Local Data folder in your Tableau Repository.

**What happens to my custom geocoding data when I save my workbook?**

When you save your workbook as a packaged workbook, the custom geocoding data is packaged with the workbook. When you open a packaged workbook you can import the custom geocoding from that workbook into your own Tableau Repository.
Note: Importing a new custom geocoding file will replace any custom geographic roles previously imported into Tableau.

Assign geographic roles to your fields

Once you import custom geocoding into your workbook, the custom geographic roles become available. The next step is to assign those geographic roles to fields in your data source.

For example, if you decided to add a new geographic role that lists the latitude and longitude coordinates of airports around the world, you can assign that geographic role to a field in your data source that lists the names of airports so when you create a map view with that field, the airports are plotted in the correct locations on the map view.

To assign a custom geographic role to a field, in the Data pane, click the data type icon next to the field and select Geographic Role. Next, select a custom geographic role from the list.
You’re now ready to start building a map view with your custom geographic roles. For more information on how to build a map view, see Build a Map View on page 703.

See also:
Data Blending vs. Custom Geocoding below
Example–Blend Geographic Data on page 685

Data Blending vs. Custom Geocoding
If you have geographic locations in your data that are not automatically geocoded in Tableau, there are two ways to plot them on a map view—data blending and custom geocoding. Both data
blending and custom geocoding allow you to plot your own locations on a map. Data blending is easier to set up and you can work with data from any data source. Custom geocoding lets you add to existing roles, and create hierarchies. Custom geocoding can be easier to use once it is set up and imported.

This topic explains the difference between blending geographic information with another data source and importing custom geocoding data into Tableau.

The following is a quick comparison of data blending and custom geocoding.

<table>
<thead>
<tr>
<th>Capability</th>
<th>Data Blending</th>
<th>Custom Geocoding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot your own locations on a map view</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Use any data</td>
<td>Yes</td>
<td>No, text files only</td>
</tr>
<tr>
<td>Add new geographic roles</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Add to an existing geographic role</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Create new geographic hierarchies</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Can be reused for other workbooks</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Data Blending**

Data blending is the easiest way to plot your data on a map view. Data blending works great if you are adding a single level of geographic information with a latitude and longitude. You can use any data source, unlike Custom geocoding where you can only use text files. You can share the geographic data source with other workbooks on Tableau Server. You can also speed up your map performance by creating an extract that contains only your geocoding data.

The following is a high-level procedure for blending geographic data. For a more detailed example, see Example–Blend Geographic Data on the next page.

**To blend geographic data**

1. Create a data source that defines your geographic data.
2. In Tableau Desktop, connect to the original data you want to map, and then connect to the data source that defines your geographic data.
3. Blend the two data sources together. For more information, see Blend Your Data on page 363.
4. Plot the data on a map view.
Custom Geocoding

Custom geocoding is a more flexible way to plot your data on a map. Custom geocoding is available for all workbooks on a computer once the custom geocoding data is imported. The custom geocoding data will be copied into any packaged workbook (.twbx) or published workbook that uses a custom geographic role. This will make the workbooks about 40 MB larger.

If you upgrade Tableau Desktop, you may need to refresh your custom geocoding to take advantage of any fixes made to the geocoding data in Tableau.

In custom geocoding, you can use additional columns to define larger geographic locations. For instance, if you are creating a set of US census tracts, you may need to define which US county they fall in. You can include additional columns to define larger geographic locations in the import file.

You can also use multiple files for multiple geographic roles that have a matching relationship, meaning they share larger geographic data, such as country or state/province. Once the custom geocoding data is imported, you will see additional geographic roles that can be assigned to your geographic data.

Finally, custom geocoding lets you add additional places to an existing geographic role, such as adding new cities to the city role. It also allows you to define a hierarchy of geographic roles that extends the built-in hierarchies (e.g. census tracts in counties) or defines a new hierarchy (e.g. sub-territories in territories).

For more information about custom geocoding, see Custom Geocode Your Data on page 676. Additionally, you can learn how to custom geocode data by watching the Custom Geocoding training video on the Tableau website.

See also:

Prepare Your Geographic Fields on page 693
Create a schema.ini File on page 691

Example—Blend Geographic Data

This example demonstrates how to blend geographic data in Tableau using two small sample data sources. Follow the steps in this topic to learn how to create a file that defines your geographic data, blend two data sources, and build the map view below using the two data sources.

The embedded view below shows famous theaters around the world, and was created by blending geographic data with another data source. Hover over the marks in the view to see information about each theater. If you would like to follow along with the steps in this topic, click Download in the view below, and then select Tableau Workbook. This will open the view in Tableau Desktop.
**Step 1: Create a file that defines your geographic data**

When you have a data source that contains geographic information that is not automatically geocoded in Tableau, the first step is to create a second data source that defines the latitudinal and longitudinal values for that information. You will later connect to this file in Tableau Desktop and blend it with your original data source.

Create a second data source with the following information:

- **Geographic name column**: This column includes any geographic information you want to plot on a map view and typically matches a geographic column name in your original data. For example, if your original data source has a column called Street Address, your second data source should also have a column called Street Address. The data in this column would then be all of the street addresses you want to plot on a map view.

  If the column does not match a geographic column name in your original data source, you may need to edit the relationships between your two data sources in Tableau Desktop. For more information, see Step 3.

  Finally, this column should not match the names of any geographic roles already in Tableau, such as County, Area Code, or CBSA/MSA.
Note: The data in these columns can be strings or numbers. However, if your locations are numbers, especially numbers with leading zeros (for example, 00501), make sure the data type of the field is set to String in Tableau. For more information, see Data Types on page 256.

- **Latitude and Longitude columns**: The values in these columns need to be in decimal degrees (for example, 47.651808, -122.356881).

Below is an example of an original data source with geographic locations, and a second data source that defines those geographic locations.

<table>
<thead>
<tr>
<th>Original data source</th>
<th>Second data source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td><strong>B</strong></td>
</tr>
<tr>
<td>Name</td>
<td>Estimated Seats</td>
</tr>
<tr>
<td>La Scala</td>
<td>3,000</td>
</tr>
<tr>
<td>Teatro di San Carlo</td>
<td>1,397</td>
</tr>
<tr>
<td>Teatro Colon</td>
<td>2,500</td>
</tr>
<tr>
<td>The Royal Opera House</td>
<td>2,256</td>
</tr>
<tr>
<td>The Bolshoi</td>
<td>2,200</td>
</tr>
</tbody>
</table>

**Step 2: Connect to the data sources**
1. Connect to the original data source.
2. Connect to the data source that defines your geographic data.
**Step 3: Edit Relationships**

(Optional) If the two data sources share the same column names, your data should blend automatically when you add fields to the view. However, if the file you created to define your geographic data does not share the same column name as the geographic data in your original data source, you will need to create a relationship between those two fields using the **Edit Relationships** option. For information about how to edit relationships, see **Step 4: (Optional) Define or edit relationships** on page 368.

**Step 4: Plot the data on a map view**

1. In the **Data** pane, select the second data source that defines your geographic data. Under **Measures**, assign the **Latitude** geographic role to the **Latitude** field and the **Longitude** geographic role to the **Longitude** field. For more information, see **Prepare Your Geographic Fields** on page 693.
2. In the Data pane, select the original data source, and then drag the field you want to plot on a map to Detail on the Marks card.
Note: This field should have a data type of String, and should be a dimension. For more information on how to change the data type of a field, see Data Types on page 256.

3. In the Data pane, select the second data source, and then double-click Latitude and Longitude to add them to the Columns and Rows shelves.

The link icon $\leftrightarrow$ indicates that the Street Address field is blended with the Street Address field in the original data source. A broken link icon $\sim$ indicates that the Street Address field is not blended with the Street Address field in the original data source.
The view is now complete. Each mark represents an address from the original data source.

See also:
Data Blending vs. Custom Geocoding on page 683

Create a schema.ini File

Sometimes when you attempt to import custom geographic information in Tableau using a .csv file, you may see a "*.csv could not be used because it does not contain a unique column" error message.
This is because your .csv file might contain numerical data, such as numeric postcodes. Tableau will only accept text fields for new geographic roles. However, you can create a schema.ini file to tell Tableau that the numeric field you want to import should be treated as a text field.

A schema.ini file is a Microsoft configuration file associated with the Microsoft JET engine. It tells JET how to interpret the contents of text files, including data structure, date formats, and other settings. For example, creating a schema.ini file that specifies that the numeric postcodes in your import file should be treated as text will allow you to plot the postcodes on a map.

**To create a schema.ini file:**

1. Open a text file.
2. In the text file, using the following syntax, specify the names and data types for each column in your import file:

   ```plaintext
   [YOURCSVFILENAME.csv]
   ColNameHeader=True
   Format=CSVDelimited
   Col1="Name of 1st Column Header in your .csv file"
   Dataype
   Col2="Name of 2nd Column Header in your .csv file"
   Dataype
   Col3="Name of 3rd Column Header in your .csv file"
   Dataype
   Col4="Name of 4th Column Header in your .csv file"
   Dataype
   
   For example, if your import (.csv) file contained the columns **German Post Code**, **Latitude**, and **Longitude**, and was named **German Postal Codes.csv**, your schema.ini file would look like the following:

   ```plaintext
   [German Postal Codes.csv]
   ColNameHeader=True
   Format=CSVDelimited
   Col1="German Post Code" Text
   Col2="Latitude" Double
   Col3="Longitude" Double
   
   3. Save the file as **schema.ini** in the same folder as your .csv file.

   You’re now ready to import your .csv and schema.ini files into Tableau.
See also:

*Custom Geocode Your Data* on page 676

**Prepare Your Geographic Fields**

In this topic, you'll learn:

- What to do if Tableau cannot map your location data
- How to geocode your location data in Tableau (assign geographic roles)
- What county-equivalents (districts, municipalities, etc.) Tableau recognizes
- What zip codes and postcodes Tableau recognizes

When you connect to location data in Tableau, there are two things that might happen:

1. Tableau recognizes your location data and assigns geographic roles to your geographic fields (e.g. Country, State, City).
2. Tableau *does not* recognize your location data and formats your geographic fields as either numbers or strings.

If Tableau recognizes your location data and automatically assigns geographic roles to your fields (you'll know this has happened because there will be a globe icon 🌍 next to them in the Data pane), then you're ready to build a map view. Congratulations! Just double-click one of those geographic fields and you've got a map.

**If Tableau doesn’t recognize your location data, here’s what you can do:**

If Tableau does not immediately recognize your location data, and you can't build a map view, you'll need to assign geographic roles to your fields. See the *Assign a geographic role to a field* on the next page section below to learn how.

**Note:** This procedure only works if your location data is built in to Tableau.

**How do you know if your location data is built in to Tableau?**

Tableau recognizes a lot of standard geographic data for many countries, such as state and city names, ZIP codes and postcodes, country borders, and second-level administrative divisions, such as U.S. counties.

For a complete list of location data that's built in to Tableau, see the following sections:

- *Types of geographic roles* on page 696
- *County-equivalents recognized by Tableau* on page 698
Why doesn't Tableau recognize your location data?

Often times Tableau doesn't recognize your location data because it's not built in to the Tableau map server (Tableau Map Service).

The good news is that more and more location data is built-in with every new release of Tableau.

But if your data isn't built-in yet, there are a couple of things you can try in the meantime to map that data in Tableau:

- Custom geocode your data
- Blend your geographic data
- Use shapefile data to build a map view

Assign a geographic role to a field

A *geographic role* associates each value in a field with a latitude and longitude value. When you assign a geographic role to a field, Tableau assigns latitude and longitude values to each location in your data based on data that is already built in to the Tableau map server.

Assigning a geographic role based on the type of location (such as state versus postcode) helps insure that your data is plotted correctly on your map view. For example, you can assign the City geographic role to a field that contains a list of city names.

When a field is assigned a geographic role, Tableau creates a map view when you add the field to Detail on the Marks card. In other words, Tableau *geocodes* the information in that field.

To assign a geographic role to a field:

- In the Data pane, click the data type icon next to the field, select *Geographic Role*, and then select the geographic role you want to assign to the field.
When you assign a geographic role to a field, Tableau adds two fields to the Measures area of the Data pane: Latitude (generated) and Longitude (generated).

These fields contain latitude and longitude values and are assigned the Latitude and Longitude geographic roles. If you double-click each of these fields, Tableau adds them to the Columns and Rows shelves and creates a map view using the Tableau background map.
Types of geographic roles

The following table describes the geographic roles available in Tableau. Many of the roles are international, but some are limited to the U.S. only.

If your location data does not fit into one of these roles, you may have to import custom geocoding to plot the data on a map.

For more information, see Custom Geocode Your Data on page 676.

<table>
<thead>
<tr>
<th>Geographic Role</th>
<th>Assign this role to a field if it contains:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Code (U.S.)</td>
<td>U.S. telephone area codes; numbers only.</td>
</tr>
<tr>
<td>CBSA/MSA (U.S.)</td>
<td>U.S. Core Based Statistical Areas, which includes Metropolitan Statistical Areas, as defined by the U.S. Office of Management and Budget.</td>
</tr>
<tr>
<td>City</td>
<td>Worldwide cities with population of 15,000 or more. Names are in English, French, German, Spanish, Brazilian-Portuguese, Japanese, Korean, and Chinese.</td>
</tr>
<tr>
<td>Congressional District (U.S.)</td>
<td>U.S. congressional districts.</td>
</tr>
<tr>
<td>Country/Region</td>
<td>Worldwide countries, regions, and territories. Names are in English, French, German, Spanish, Brazilian-Portuguese, Japanese, Korean, and Chinese. Tableau also recognizes, FIPS 10, ISO 3166-1 alpha 2, and ISO 3166-1 alpha 3. Names are included in various forms, including long, short, and various abbreviations.</td>
</tr>
</tbody>
</table>
| County               | Second-level administrative divisions for select countries. For example, U.S. counties, French départements, German kriese, etc.

**Note:** Second-level administrative division definitions vary by country.
In Tableau, all second-level administrative divisions are geocoded with the County geographic role. For more information, see the County-equivalents recognized by Tableau on the next page section.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude</td>
<td>Latitude in decimal degrees. Only available for numeric fields.</td>
</tr>
<tr>
<td>Longitude</td>
<td>Longitude in decimal degrees. Only available for numeric fields.</td>
</tr>
<tr>
<td>State/Province</td>
<td>Worldwide state, province, and other first-level administrative divisions. Names are in English, French, German, Spanish, Brazilian-Portuguese, Japanese, Korean, and Chinese. Note: Some names are available only in their local form.</td>
</tr>
<tr>
<td>ZIP Code/Post-code</td>
<td>ZIP codes and postcodes for select countries. For example, U.S. five-digit zip codes, Australian four-digit postcodes, German five-digit postcodes, etc. For more information, see the ZIP codes and postcodes recognized by Tableau on page 699 section.</td>
</tr>
</tbody>
</table>

For Tableau Desktop version 8.1 and earlier

<table>
<thead>
<tr>
<th>Role Name</th>
<th>Assign this role to a field if it contains:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area Code</td>
<td>U.S. telephone area codes; numbers only.</td>
</tr>
<tr>
<td>CBSA/MSA</td>
<td>U.S. Core Based Statistical Areas, which includes Metropolitan Statistical Areas, as defined by the U.S. Office of Management and Budget.</td>
</tr>
<tr>
<td>City</td>
<td>Worldwide cities with population of 15,000 or more. Names are in English, French, and German.</td>
</tr>
<tr>
<td>Congressional District</td>
<td>U.S. congressional districts.</td>
</tr>
<tr>
<td>Country/Region</td>
<td>Worldwide countries, regions, and territories. Names are in English, French, and German. Tableau also recognizes, FIPS 10, ISO 3166-1 alpha 2, and ISO 3166-1 alpha 3. Names are included in various forms, including long, short, and various abbreviations.</td>
</tr>
<tr>
<td>County</td>
<td>U.S. counties and county-equivalents by name. Independent cities are included with their names followed by city.</td>
</tr>
</tbody>
</table>
Latitude | Latitude in decimal degrees. Only available for numeric fields.
Longitude | Longitude in decimal degrees. Only available for numeric fields.
State/Province | Worldwide state, province, and other first-level administrative divisions. Names are in English, French, and German. Official abbreviations available for the following countries: Australia, Brazil, Canada, Germany, Poland, Switzerland, U.K., and U.S.

**Note:** Some names are available only in their local form.

ZIP Code/Postcode | ZIP codes and postcodes for select countries. For example, U.S. five-digit zip codes, Australian four-digit postcodes, German five-digit postcodes, etc.

For information about map data providers and status, see About Tableau Maps on the Tableau website.

**County-equivalents recognized by Tableau**

The following table lists second level administrative divisions (county-equivalents) from several countries that Tableau recognizes.

If your data source contains a field with any of these county-equivalents, you can assign the **County** geographic role to it.

<table>
<thead>
<tr>
<th>Country</th>
<th>County-equivalent</th>
<th>Version Added</th>
<th>Version Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Departamentos.</td>
<td>8.2.3</td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>Local Government Authorities (LGAs).</td>
<td>8.2.2</td>
<td>8.3.1</td>
</tr>
<tr>
<td>Belgium</td>
<td>Arrondissements.</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>Municipios.</td>
<td>8.2.3</td>
<td></td>
</tr>
<tr>
<td>Chile</td>
<td>Departamentos.</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>China</td>
<td>Prefectures, Counties, Leagues, County-level Cities, Prefecture-level Cities and Divi-</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>Country</td>
<td>Geographic Role</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>Denmark</td>
<td>Kommunes.</td>
<td>8.3.1</td>
<td></td>
</tr>
<tr>
<td>Finland</td>
<td>Seutakanta - sub-regions.</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>France</td>
<td>Départements.</td>
<td>8.2</td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>Kreise, including Landkreise and Kreisefrei Städte.</td>
<td>8.2.4</td>
<td></td>
</tr>
<tr>
<td>Hong Kong</td>
<td>Districts.</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>Districts.</td>
<td>9.3</td>
<td></td>
</tr>
<tr>
<td>Italy</td>
<td>Provinces and metropolitan cities.</td>
<td>9.0</td>
<td></td>
</tr>
<tr>
<td>Singapore</td>
<td>URA Subzones</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>Municipalities.</td>
<td>8.3.1</td>
<td></td>
</tr>
<tr>
<td>South Korea</td>
<td>Sigungu (Metropolitan Areas)</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>Provincias.</td>
<td>8.2</td>
<td></td>
</tr>
<tr>
<td>Sweden</td>
<td>Sveriges kommuner - municipalities (including LAU level 2 codes).</td>
<td>9.1</td>
<td></td>
</tr>
<tr>
<td>Taiwan</td>
<td>Cities and districts.</td>
<td>10.0</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>Counties, Unitary Authorities and Local Authority Districts, including ONS and GSS codes.</td>
<td>8.2</td>
<td></td>
</tr>
<tr>
<td>U.S</td>
<td>County, including five-digit county codes.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ZIP codes and postcodes recognized by Tableau**

The following table lists zip codes and postcodes from several countries that Tableau recognizes. If your data source contains a field with any of these postcodes, you can assign the Zip code/Postcode geographic role to it.
<table>
<thead>
<tr>
<th>Country</th>
<th>Available in Tableau versions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>7.0 and later</td>
</tr>
<tr>
<td>Albania</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Andorra</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Argentina</td>
<td>10.0 and later</td>
</tr>
<tr>
<td><em>Four-digit post codes.</em></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Belarus</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Belgium</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Brazil</td>
<td>10.0 and later</td>
</tr>
<tr>
<td><em>Five-digit post codes.</em></td>
<td></td>
</tr>
<tr>
<td>Bulgaria</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Canada</td>
<td>7.0 and later</td>
</tr>
<tr>
<td><em>Forward Sortation Area; first three characters of the six-character Canadian postal code.</em></td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>10.0 and later</td>
</tr>
<tr>
<td>Croatia</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Cyprus</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Denmark</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Estonia</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Finland</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Country</td>
<td>Code</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Former Yugoslav Republic of Macedonia</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>France</td>
<td>7.0 and later</td>
</tr>
<tr>
<td>Germany</td>
<td>7.0 and later</td>
</tr>
<tr>
<td>Gibraltar</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Greece</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Hungary</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Iceland</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Italy</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>India</td>
<td>10.0 and later</td>
</tr>
<tr>
<td>Japan</td>
<td>9.2 and later</td>
</tr>
<tr>
<td>Latvia</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Liechtenstein</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Lithuania</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Malta</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Mexico</td>
<td>10.0 and later</td>
</tr>
<tr>
<td>Monaco</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Montenegro</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Netherlands</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>New Zealand</td>
<td>7.0 and later</td>
</tr>
<tr>
<td>Norway</td>
<td>9.3 and later</td>
</tr>
</tbody>
</table>

Three-digit post codes.

**Note:** Japanese seven-digit postcodes are not supported.
<table>
<thead>
<tr>
<th>Country</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poland</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Portugal</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>San Marino</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Serbia</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Singapore</td>
<td>10.0 and later</td>
</tr>
<tr>
<td>Slovakia</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Slovenia</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Spain</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Sweden</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Switzerland</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>Taiwan</td>
<td>10.0 and later</td>
</tr>
<tr>
<td><strong>Three-digit post codes</strong></td>
<td></td>
</tr>
<tr>
<td>Turkey</td>
<td>9.3 and later</td>
</tr>
<tr>
<td>U.K.</td>
<td>7.0 and later</td>
</tr>
<tr>
<td><strong>Outcodes; first segment of the five- to seven-character U.K. postcode.</strong></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td>7.0 and later</td>
</tr>
<tr>
<td>Vatican City</td>
<td>9.3 and later</td>
</tr>
</tbody>
</table>

**See also:**
- Custom Geocode Your Data on page 676
- Example–Blend Geographic Data on page 685
- Create Tableau Maps from Shapefiles on page 660
- Edit Locations on page 705
Build a Map View

When creating a map view, Tableau automatically adds the generated Latitude and Longitude fields to the Rows and Columns shelves and places a selected geographic field on Detail on the Marks card.

The marks in the view correspond to the field on Detail. For example, if the State field is used in the view, there is a single mark for each state in your data. As you add more geographic fields to Detail on the Marks card, the marks in the view will be broken down by the members of those fields.

To Build a Map View

To create map views, add geographic fields to the view, and then add measures or continuous dimensions to the Marks card. To follow a step by step example of how to create map views using sample data that comes with Tableau, see Build a Map View on page 114.

Add geographic fields to the view

To add geographic fields to the view, do one of the following:

- Double-click a geographic field in the Data pane. A globe icon indicates fields that have been geocoded. For more information, see Prepare Your Geographic Fields on page 693.
- Select a geographic field in the Data pane, and then select one of the map views in Show Me.
From the **Data** pane, drag a geographic field to **Detail** on the **Marks** card.

---

**Add fields to the marks card**

To complete a map view, from the **Data** pane, drag measures or continuous dimensions to the **Marks** card.

For example, the following map shows the sum of sales for each state. The **Sales** field has been placed on **Color** on the **Marks** card, so each state is colored based on the sum of its sales. When creating a map view, placing a measure on **Color** on the **Marks** card causes the mark type to automatically update to the Filled Map mark type. For more information, see [Filled Map Mark](#) on page 179.
See also:

Build-It-Yourself: Build a map view

Prepare Your Geographic Fields on page 693

Customize How Your Map Looks on page 708

Edit Locations

Sometimes Tableau will not recognize one or more of the location names in your data. When this happens those values are marked as **unknown** in the lower right corner of the view. This often happens because your data values may be spelled incorrectly or use an abbreviation that Tableau does not recognize. When this happens, you can edit the unknown location names to map to known locations.

To edit unknown location names

1. In the bottom right corner of the view, click the special values indicator. This opens the Special Values dialog box.
2. In the Special Values dialog box, select **Edit Locations**.

3. In the Edit Locations dialog box, click on one of the **Unrecognized** cells to match a known location to your unknown data. When you click on an unrecognized cell, a search box appears. As you begin typing in the search box, Tableau generates a list of possible locations. Select a location from the list.

**Note:** If the special values indicator is not visible, you can also select **Map > Edit Locations**.
Alternatively, you can select **Enter Latitude and Longitude** from the drop-down menu to manually map the value to a location on the map.

**Note:** When you type a latitude and longitude, enter the values in decimal format.

**Ambiguous Locations**

Both unrecognized and ambiguous locations can be listed in the Edit Locations dialog box. You can usually fix ambiguous locations by specifying the **Country/Region** and/or **State/Province** options in the **Geographic Roles** section of the Edit Locations dialog box. For example, if you have several cities that are ambiguous, you can specify a State/Province to fix them.
Restrict Locations in the List

By default, all possible locations are listed in the drop-down menu. To restrict the list to locations that have not yet been matched to your data, select the Show only unmatched locations in drop-down list option in the bottom left corner of the Edit Locations dialog box.

See also:
Prepare Your Geographic Fields on page 693

Customize How Your Map Looks

When you create a map view there are several options to help you control the appearance of the map. These options are available in the Map Layers pane.

To open the Map Layers pane:

- Select Map > Map Layers.

Use the Map Layers pane to modify how the map appears. You can change the map background style, hide and show map layers, such as street names and country borders, and add data layers.

Note: In previous versions of Tableau, the Map Layers pane was called the Map Options pane.

Select a background style

When you are connected to the Tableau background map, you can choose between three background styles (Normal, Light, or Dark) to customize the appearance of your map. You can see the three styles below:
To change the map background style:

1. Select **Map > Map Layers**.
2. Under Background, click the **Style** drop-down menu, and then select a background style.

### Change the map intensity

In addition to the background map style, you can use the **Washout** slider to control the intensity, or luminance, of the background map.
1. Select Map > Map Layers.
2. Under Background, move the washout slider to the left or right to change the intensity of the background map.

The farther the slider moves to the right, the more faded the map becomes.

Repeat the map background

You can select whether to repeat the background. When the Repeat Background option is selected, the background map may show the same area multiple times depending on where the map is centered.

Add or Remove Map Layers

Tableau maps provide several layers that can mark points of interest on the map. For example, you can overlay streets and highways, county boundaries, and more on the map to give your data context.

To add or subtract map layers from your map view:
1. Select **Map > Map Layers**.

2. Under Map Layers, select one or multiple map layers to add to the view.

**Note:** Some map layers are only visible at specific zoom levels. If a map layer is unavailable at your current level of zoom, it will appear grayed out.

To use layers that are not available, zoom further in to the view.

The map layers that come automatically with the Tableau background map are described in the table below.
<table>
<thead>
<tr>
<th>Layer Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>Shows the base map including water and land areas.</td>
</tr>
<tr>
<td>Land Cover</td>
<td>Shades wilderness areas and parks to give the map more depth.</td>
</tr>
<tr>
<td>Coastlines</td>
<td>Displays coastlines.</td>
</tr>
<tr>
<td>Streets and Highways</td>
<td>Marks freeways and highways as well as small city streets. This layer includes the highway and street names as well.</td>
</tr>
<tr>
<td>Light Country/Region Borders</td>
<td>Shows a light gray outline of country/region borders and names.</td>
</tr>
<tr>
<td>Light Country/Region Names</td>
<td>Shows country and region names in a light gray.</td>
</tr>
<tr>
<td>Country/Region Borders</td>
<td>Highlights country and region borders in a darker gray.</td>
</tr>
<tr>
<td>Country/Region Names</td>
<td>Highlights country and region names in a darker gray.</td>
</tr>
<tr>
<td>Light State/Province Borders</td>
<td>Shows a light gray outline of state borders and names.</td>
</tr>
<tr>
<td>Light State/Province Names</td>
<td>Shows state and province names in a light gray.</td>
</tr>
<tr>
<td>State/Province Borders</td>
<td>Highlights state and province borders in a darker gray.</td>
</tr>
<tr>
<td>State/Province Names</td>
<td>Highlights state and province names in a darker gray.</td>
</tr>
<tr>
<td>US County Borders</td>
<td>Highlights U.S. county borders.</td>
</tr>
<tr>
<td>US County Names</td>
<td>Highlights U.S. county names.</td>
</tr>
<tr>
<td>Zip Code Boundaries</td>
<td>Marks U.S. zip code boundaries. You must zoom in to see this layer.</td>
</tr>
<tr>
<td>Zip Code Labels</td>
<td>Shows labels for U.S. zip codes. You must zoom in to see this layer.</td>
</tr>
<tr>
<td>Area Code Boundaries</td>
<td>Marks the U.S. area code boundaries. You must zoom in to see this layer.</td>
</tr>
<tr>
<td>Layer Name</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Area Code Labels</td>
<td>Shows labels for the U.S. area codes. You must zoom in to see this layer.</td>
</tr>
<tr>
<td>US Metro Boundaries (CBSA)</td>
<td>Marks U.S. Metropolitan Statistical Areas and Micropolitan area boundaries.</td>
</tr>
<tr>
<td>US Metro Labels (CBSA)</td>
<td>Shows labels for the U.S. Metropolitan Statistical Areas and Micropolitan areas.</td>
</tr>
<tr>
<td>Place Names</td>
<td>Displays the names of places from country/region names and borders to city names, bodies of water, parks, universities, and more. This layer is dependent on the zoom level.</td>
</tr>
</tbody>
</table>

**Add Data Layers**

In addition to map layers, you can turn on a variety of predefined data layers that show U.S. census information.

**Note:** Map data layers are only available for locations in the U.S.

If you would like to add data layers for locations outside the U.S. you can connect to a WMS server that contains the desired demographic information. For more information, see Use Web Map Service (WMS) Servers on page 724.

**To add a data layer to your map view:**

1. Select Map > Map Layers
2. In the Data Layer section at the bottom of the Map Layers pane, do the following:
   - Click the Layer drop-down menu and select a data layer.
   - Click the By drop-down menu to layer the data by State, County, Zip Code or Block Group.
   - Click the Using drop-down menu to select a color scheme.
Once you select a data layer, it is added as shading to the map and a legend is shown to explain the colors of the layers.

**To hide or show the map legend in a worksheet:**

- Select **Map > Map Legend**.

**Set Default Map Layer Options**

If you find that you have a set of map or data layers you would always like to show, or that you always want a certain background map style when you create new workbooks or sheets, you can set the selected map layer options as the default.

**To set default map layer options:**

1. Select **Map > Map Layers**.
2. In the Map Layers pane, select the options you want to show by default every time you create a new map view.
3. At the bottom of the Map Layers pane, click **Make Default**.

**Reset Map Layer Options**

If you find that you want to reset the map layer options to their default settings, you can clear any selected map layer options.

**To reset map layer options:**
Select **Map > Map Layers**, and then, at the bottom of the Map Layers pane, click **Reset**.

**Note:** Resetting map layer options returns the Map Layers pane to the default settings you configured. If you have not configured any default settings, the Map Layers pane will return to the original settings.

**See also:**

- [Build a Map View](#) on page 703
- [Use Web Map Service (WMS) Servers](#) on page 724
- [Use Mapbox Maps](#) on page 730
- [Select Background Maps](#) on page 742

**Create Territories on a Map**

When you’re analyzing data on a map view, you might want to group *existing* locations together to create your own territories or regions, such as sales territories for your organization.

In Tableau, there are several ways to create territories:

- **Option 1:** Select and group locations on a map  below
- **Option 2:** Create a territory from a geographic field  on page 719
- **Option 3:** Geocode a territory field using another geographic field  on page 719

**Option 1: Select and group locations on a map**

If you have created a map view, you can select and group locations (marks) on the map to create your territories.

For example, the following map view shows the total sales by postcode for a company with sales across Australia.
The first thing you might be thinking is: That's a lot of postcodes! In fact, there is a mark in this map view for every single 4-digit postcode in Australia, and each of those marks has an aggregation for SUM of Sales. If you're looking for sales information for every single postcode in Australia, than this is the view for you.

However, you might not want to analyze every individual location in your map view. Instead you might have your own areas, regions, or territories that you want to analyze as a whole. For example, maybe your organization splits Australia into five different sales territories, and you want to analyze the total sales for each of them.

In this case, because you've already created a map view, you can select locations directly on the map and group them to create your own territories. Follow the steps below to learn how.

: **Select locations on the map to group into a territory**

On the map view, select the locations (marks) that you want to group into your own territory. For more information about how to select marks, see Select Marks on page 522.

: **Create the first group (your first territory)**

When you select marks in the view, or hover over a selection, a tooltip appears. On that tooltip, click the Group icon, and then select the level of detail you want to group the locations by.
A new group field is added in the Data pane with a group icon next to it. To change the locations within the group at any time, right-click the group field in the Data pane and select Edit group.

The new field is also added to Color on the Marks card.
Notice that the marks you selected are now all the same color.

**Continue grouping data to add territories**

Repeat steps 1 and 2 to create additional territories. Each territory is added as a group within the group field you created in step 2. You can create as many territories as you want.

**Add the group field to the view**

From the Data pane, drag the newly created group field to Detail on the Marks card. Next, to make each territory appear as a single mark, you must also remove the related geographic field(s) from the view.

For example, if you grouped postcodes at the Post Code, Country level, you must remove the Post Code and Country fields from the view.

In the image below, notice that the Post Code and Country fields are no longer on Detail on the Marks card because they have been replaced by the Post Code & Country (group) field.

In this example, there are five groups within the Post Code & Country (group) field, so five territories appear on the map. Aggregations, such as SUM (Sales), are computed at the level of the territory, rather than separately for each location within the territory.

You can now see the SUM (Sales) for each territory by color. Territory 5 has the most sales.
Option 2: Create a territory from a geographic field

You can also create territories by creating groups in the Data pane.

1. In the Data pane, right-click a geographic field (such as City or State) and select Create > Group.
2. In the Create Group dialog box, select the locations you want in your first territory and click Group. Each group you create represents a territory.
3. Repeat step 2 until you've created all of your territories, and then click OK.
   The new group field is added to the Data pane.
4. From the Data pane, drag the newly created group field to Detail on the Marks card.
   You can also drag the field to Color or Label on the Marks card to help differentiate between each territory.

Change locations in your territory groups

If you want to change the locations in your territory groups at any time, right-click the group field in the Data pane and select Edit group.

Option 3: Geocode a territory field using another geographic field

If your data source already contains a custom territory field, you can quickly geocode it to make a map in Tableau using an existing geographic field in your data source.

For example, the following data source contains a custom territory field for geographic areas called Zone géographique. It contains the values, North, Central and South.
If you were to bring this field into Tableau by itself, Tableau would not be able to recognize it as geographic data.

However, this data source also contains three geographic fields that Tableau does recognize: **Country, Region, and City**.

Each row in this data source contains a value for country, region, city and geographic zone. Therefore, each location is assigned a value from the custom territory field.

Because the Zone géographique field is included in the workbook with other geographic fields that contain locations that Tableau recognizes, you can geocode it at the level of detail of one of those fields.

Follow the steps below to geocode a territory field using another geographic field:

1. **Assign a geographic role to the territory field**

   On the data source page, click the data type icon for the custom territory field and select **Geographic Role > Create from**, and then select a level of detail to aggregate the field.
The options you see are based on the available geographic fields in your data source. Choose the level of aggregation you want in the view. If you’re unsure how they will affect your view, try several different levels of detail. You can always undo and try again.

After you assign a geographic role to the territory field, it’s added to its respective place in the location hierarchy. You can see it in the Data pane when you go to any worksheet.

**Note:** You can also click the data type icon next to the field in the Data pane to geocode a territory field using the above procedure.
Add the territory field to the view

Create a map view and add the newly geocoded territory field to the Marks card. You can place it on Detail, Color, Label, or Tooltip. Note that fields on Detail determine the level of aggregation in the view.

The custom territory field functions similar to your other geographic fields.

In the example below, the custom territory field (Zone géographique) is on Detail and Color on the Marks card. The average profit is shown for each territory (since the lowest level of detail is the territory field).

If you add another geographic field to Detail on the Marks card, such as the country field (Pays), the aggregation will update to show information for that level of detail.

Blend custom territory data

If your data source does not contain a territory field, you can blend a territory field with another geographic field in your data source. For more information, see Example–Blend Geographic Data on page 685. After you have blended your custom territory field with another field, follow the procedure in Step 1: Assign a geographic role to the custom territory field to geocode your territory field.

Customize How People Interact with your Map

When you create a map view, there are several default ways you can explore and interact with the view. You can zoom in and out of the view, pan, select marks, and even search for locations worldwide with map search.
However, sometimes you want to limit some of the ways your audience can interact with your map.

You can customize how your audience interacts with your view in the following ways using the Map Options dialog box.

**Hide map search**

You can hide the map search icon so your audience cannot search for locations in your map view.

To hide the map search icon:

1. Select Map > Map Options.
2. In the Map Options dialog box that appears in the view, clear Show Map Search.

**Note:** When you hide the map search icon, you also hide the locate me button for views published on the web. For more information about the locate me button, see Interact with Maps in the Tableau Online Help.

**Hide the view toolbar**

You can hide the view toolbar in a map view so your audience cannot lock the map in place or zoom the map to all of your data.

To hide the view toolbar:

1. Select Map > Map Options.
2. In the Map Options dialog box that appears in the view, clear Show View Toolbar.

**Note:** When you hide the view toolbar, you can still use keyboard shortcuts to zoom in and out of the view, pan, and select marks. For more information, see View Toolbar on page 521.

**Turn off pan and zoom**

You can turn off pan and zoom in your map view, as well as in background images, so your audience cannot pan, or zoom in or out of the view.

To turn off pan and zoom:

1. Select Map > Map Options.
2. In the Map Options dialog box that appears in the view, clear Allow Pan and Zoom.
When you turn off pan and zoom, the pan tool and all zoom controls are removed from the view toolbar, and the rectangular tool becomes the default tool. Keyboard shortcuts for zooming in and out of the view, or panning, no longer work. If the map search icon is not hidden, you can still navigate the view by searching for locations with the map search box.

See also:

Search for Locations in Your Map on page 735
View Toolbar on page 521
Select Marks on page 522
Pan and Zoom on page 525

Use Web Map Service (WMS) Servers

Tableau can connect to map servers with the Web Map Service (WMS) protocol. WMS is a standard protocol for requesting and receiving geographically referenced imagery.

In Tableau Desktop, you can connect to any WMS server that supports the WMS 1.0.0, 1.1.0, or 1.1.1 standards.

In this topic

- Connect to a WMS server in Tableau Desktop
- Use a WMS background map to build a map view in Tableau
- Save a WMS server as a Tableau map source
- Performance considerations for WMS servers in Tableau
- Supported Spatial Reference Systems for WMS servers

Connect to a WMS server

1. Select Map > Background Maps > Map Services.
2. In the Map Services dialog box, click Add > WMS Servers.
3. In the Add WMS Servers dialog box, type the URL for the server you want to connect to in Tableau, and then click OK.
You can add as many map servers as you want to a workbook. Each WMS server you add appears as a background map in the **Background Maps** menu.

**Save a WMS server as a Tableau map source**

After you add a WMS server to your workbook, it is saved with the workbook and available to anyone you share the workbook with. You can also save a WMS server as a Tableau Map Source (.tms) file, which you can share with others so they can quickly connect to it and use it in their own workbooks.

For more information about how to save a map as a Tableau map source, see [Save a Map Source](#) on page 741.

**Use a WMS background map**

After you connect to a WMS server, you can create a map view using the WMS background map that Tableau creates.

**To create a map view using a WMS server:**

1. In Tableau, select **Map > Background Maps**, and then select a WMS background map to use in the view.
2. Add a geographic field to the view.
   For more information, see **Build a Map View** on page 703.

3. Select **Map > Map Layers**, and then select the map layers you want to show in the view.
   For more information, see **Customize How Your Map Looks** on page 708.
Performance considerations

The content, speed, and performance of a WMS server is reliant on the network and WMS provider. If your Internet connection is interrupted or if you’re working behind a restrictive firewall, you can use the Offline background map that comes installed with Tableau Desktop to avoid any performance issues while you build your map view. You can switch back to your WMS server at any time.

**Note:** With the offline background map, you might only be able to access up to four levels of zoom. For more information, see Select Background Maps on page 742.

Supported Spatial Reference Systems

Tableau automatically supports the following list of Spatial Reference Systems (SRS) / European Petroleum Survey Group (EPSG) codes. WMS servers must support at least one of the following spatial reference systems to be compatible with Tableau mapping features.

**Supported SRS/EPGS Codes in Tableau:**

- 3857 - WGS 84 / Pseudo-Mercator [DEFAULT]
- 4326 - WGS 84
- 4269 - NAD83
- 3824 - TWD97
- 3889 - IGRS
- 4019 - Unknown datum based on the GRS 80 ellipsoid
- 4023 - MOLDREF99
<table>
<thead>
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4670 - IGM95
4674 - SIRGAS 2000
4686 - MAGNA-SIRGAS
4687 - RGPF
4693 - Nakhl-e Ghanem
4694 - POSGAR 94
4702 - Mauritania 1999
4737 - Korea 2000
4742 - GDM2000
4747 - GR96
4749 - RGNC91-93
4755 - DGN95
4756 - VN-2000
4757 - SVY21
4758 - JAD2001
4759 - NAD83(NSRS2007)
4761 - HTRS96
4762 - BDA2000
4763 - Pitcairn 2006
4764 - RSRGD2000
4765 - Slovenia 1996
102100 - WGS 84 Web Mercator (Auxiliary Sphere)

See also:
Use Mapbox Maps on the next page
Save a Map Source on page 741
Import a Map Source on page 742
Select Background Maps on page 742
Customize How Your Map Looks on page 708

Use Mapbox Maps

If you have access to Mapbox maps, you can add them to your workbooks or use them to create map views in Tableau Desktop.

When you publish a view that uses Mapbox maps to Tableau Server, Tableau Online, or Tableau Public, your audience can view your data and your Mapbox map without having a Mapbox account.

Add a Mapbox map to your workbook

You can add a Mapbox map to your workbook and use it as a background map.

After you add a Mapbox map to your workbook, the map is saved with the workbook and available to anyone with whom you share the workbook. You can also save a Mapbox map as a Tableau Map Source (.tms) file that you can share with others so they can quickly connect to it and use it in their own workbooks. For more information, see Save a Map Source on page 741.

1. Select Map > Background Maps > Map Services.
2. In the Map Services dialog box, select Add > Mapbox Map.
3. In the Add Mapbox Map dialog box, you can add a Mapbox GL map or a classic Mapbox map. To do so, you need the following from your Mapbox account:
   - API access token
   - Username
   - One or more map IDs
   - Style URL (Mapbox GL maps Only)

For more information about any of the above items, see the Access Tokens, Maps, and Styles sections of the Mapbox API Help.

Add a Mapbox GL map

To add a Mapbox GL map, click Mapbox GL in the Add Mapbox Map dialog box, and then do the following:

Note: Mapbox GL is selected by default.
• For **Style name**, enter a name for the Mapbox map. This name can be anything you want, and will appear in the Background maps menu after you add the map.

• For **Url**, enter a style URL for the Mapbox map you want to add. This URL contains the style ID for your Mapbox map, your access token, and your username. It might look similar to the following:

```
https://api.mapbox.com/styles/v1/<username>/<styleid>/?access_token=<access_token>
```

When you add the correct style URL to this field, the **API access token**, **Username**, and **Layer ID** fields automatically populate.

If you don't have a style URL for the Mapbox map, you must enter a Mapbox access token, username, and layer (map) ID to add your Mapbox map.

---

**Add a classic Mapbox map**

To add a classic Mapbox map, click **Classic** in the Add Mapbox Map dialog box, and then do the following:

• For **Style name**, enter a name for the Mapbox map. This name can be anything you want, and will appear in the Background maps menu after you add the map.
For **API access token**, enter the API access token for the Mapbox map you want to add.

Choose a Mapbox preset style, or add one or more custom map layers:

**To use a Mapbox preset style:**
Click **Mapbox preset style**, and then select a style from the drop-down menu.

**To add one or more map layers:**
Click **Custom**, and then enter one or more map IDs in the space indicated.
4. When finished, click OK to exit the Add Mapbox Map dialog box, and then click Close to return to the view.

Create a map view using a Mapbox map

To create a map view using a Mapbox map, select Map > Background Maps, and then select the Mapbox map you want to use. Next, build the map view. For information, see Build a Map View on page 703.

Add or subtract map layers from the view

If you chose to add one or more custom layers by map ID when you connected to your Mapbox map in Tableau, you can add or subtract those layers from the view using the Map Layers pane. For more information, see Add or Remove Map Layers on page 710 in the Customize How Your Map Looks topic.

By default, all map layers appear in the view when you first add a Mapbox map to a workbook.

**Note:** When you use a Mapbox preset style, you can’t toggle the layers within the map.

For example, if you use the Mapbox Streets map, you can’t toggle streets, labels, building footprints, or administrative boundaries like you can with the Tableau map service. This is because Tableau only receives the image tiles that make up the Mapbox map.
Map layers are different from data layers in Tableau. Data Layers are pre-built tiles that include demographic information by various levels, like State, County, and Block Group. Data layers and Mapbox are independent of one another in Tableau. For more information about how data layers work, see Customize How Your Map Looks on page 708.

See also:
Use Web Map Service (WMS) Servers on page 724
Save a Map Source on page 741
Import a Map Source on page 742
Select Background Maps on page 742
Customize How Your Map Looks on page 708

Explore Data in Maps
Tableau maps can help you quickly find locations and analyze data worldwide. There are many ways you can explore and interact with map views. You can zoom in and out, pan, and select marks with the view toolbar, and even search for locations worldwide with map search.

If you don’t see the view toolbar or the map search icon, or if you can’t pan or zoom, it’s probably because the workbook author has chosen to customize how others can interact with the view.
The workbook author can choose to hide the view toolbar and the map search icon so they do not appear in the view. Similarly, the workbook author can choose to turn off pan and zoom to control how you interact with the view.

For more information, see Customize How People Interact with your Map.

**Select marks, pan, and zoom**

You can use the view toolbar in the upper left corner of the view to select marks, pan, and zoom in and out of a map view. For more information, see Select Marks and Pan and Zoom.

**Search for locations**

You can use the map search icon to search for locations in your map view. For more information, see Set Map Search Options.

**Return to the initial view**

After exploring you can return to the initial view of your map. To do so, click the reset axes button on the view toolbar.

**Search for Locations in Your Map**

Map search helps you find locations in a map view so you can quickly explore and inspect data.

The map search icon appears in the top left corner of the view. When you click the search icon, a search box appears.
When you begin to type in the search box, map search suggests possible locations that are in your map view. The suggestions are based on location names and text in your data source.

You can search for the following location types:

- Continent
- Country
- State or province
- County
- City
- Postcode

Select a location from the list of suggestions to pan and zoom to that location on the map.

**Hide Map Search**

By default, the map search icon appears in the top left corner of the view. When you publish a view to Tableau Server or Tableau Online, or share the view through Tableau Reader, the map
search icon remains in the view. If you do not want viewers to search for locations in your map view, you can hide the map search icon.

For more information about showing and hiding map search, see Customize How People Interact with your Map on page 722.

Measure Distances Between Data Points and Locations in a Map

While exploring data in a map view, you might have questions about how that data relates to its surrounding geography, locations, or landmarks. To answer these types of questions, you can use the Radial tool to measure approximate distances in your map view.

The following view shows the number of earthquakes of magnitude 6.0 and higher that have occurred around the world between January, 1994 and February, 2014.

At a global scale, this view is very powerful, but you or your audience might want to zoom in and explore certain areas more closely. For example, maybe you want to see how many earthquakes have occurred in Taiwan in the past 10 years, specifically within 100 miles of its capital, Taipei.

To do so, you can use the Radial tool to find all the earthquakes within approximately 100 miles of the capital city.

Follow the steps below to learn how to measure distance with the Radial tool.
Step 1: Zoom in to an area or location

The first step to measuring distance in maps with the Radial tool is to zoom in to an area or location in the map view. For more information about how to zoom in and out of the view, see Pan and Zoom on page 525.

You can also use map search to quickly navigate to a location in your map.

For more information about how to use map search, see Search for Locations in Your Map on page 735.

Note: Due to the map projection, you can only measure distance at higher zoom levels. This means that you must zoom in several times before you can measure distance with the Radial tool. For more information, see the Measurement accuracy on page 740 section.

Step 2: Select the Radial tool

After you have zoomed in to a particular area or location in your view, select the Radial tool on
the view toolbar, and then click and drag across the view. The measured distance appears to the right of the circle that appears when you drag across the view.

For more information about how to use the Radial tool, see Select Marks on page 522.

Note: If you do not see a measured distance, you must zoom in further to a location or area in the view.

Note: If the view toolbar is hidden, press S on your keyboard to use the Radial tool.

As you drag, the Radial tool selects marks that are located within the radius of the circle. In this example, the radius is 100 miles, and it is centered over Taipei. This means that, according to this data, all of the selected earthquakes (25) have occurred within approximately 100 miles of Taipei in the past 10 years.
Measurement accuracy

By default, Radial tool measurements have a small margin of error because, in the map projection, distances become exaggerated and stretch as you move away from the equator. This means that the Radial tool can only measure approximate distances.

The Radial tool can measure distance more accurately the closer you are to the equator, and the further you zoom in to the view.

Note: By design, the Radial tool does not display a measured distance when you are zoomed too far out of the view, because the measurement might be inaccurate.

Change the units of measurement

By default, your workbook locale determines which units the Radial tool uses to measure distance. If your workbook locale is set to a country that uses the Imperial system, the Radial
tool measures distance in feet and miles. If your workbook locale is set to a country that uses the Metric system, the Radial tool measures distance in meters and kilometers.

You can change the units the Radial tool uses to measure distance for any map view in your workbook.

To do so, select Map > Map Options. Next, under Units, click the drop-down menu and choose from the following:

- If you want to measure distances in meters and kilometers, select Metric.
- If you want to measure distances in feet and miles, select U.S.
- If you want the units of measurement to be determined by your workbook locale, select Automatic.

The units you choose will be saved with the workbook and will remain if you publish the map view to Tableau Server, Tableau Online, or Tableau Public.

**Save a Map Source**

After you add a Mapbox map or WMS server to your workbook, you can save it as a Tableau map source (.tms).

Saving a Mapbox map or WMS server as a Tableau Map Source allows you to share your map with others so they can quickly import it into their own workbooks and use it to create new map views. For more information about importing a Tableau Map Source into a workbook, see Import a Map Source on the next page.

1. Select Map > Background Maps > Map Services. This opens the Map Services dialog box.
2. Select the map that you want to save as a Tableau map source, and then click Export. This opens the Export Connection dialog box.
3. Type a name for the file, choose a location, and then click Save.

The Tableau map source includes any default map layer settings you have specified in the workbook. For example, the map source will include any custom set of map layers you have specified to show by default. For more information, see Set Default Map Layer Options on page 714 in the Set Map Layers topic.

**Note:** If you change the default settings for the map layer options, you should export the map again to include the new settings in the Tableau map source file.

**See also:**

Select Background Maps on the next page
**Import a Map Source**

You can import a Tableau Map Source (.tms) that someone has shared with you into a workbook, and then use it to create custom map views.

1. Select **Map > Background Maps > Map Services**. This opens the Map Services dialog box.
2. Click **Import**. This opens the Import Connection dialog box.
3. Navigate to the saved Tableau map source file (.tms) that you want to import, select it, and then click **Open**. This closes the Import Connection dialog box and adds the Tableau map source to the list of maps in the Map Services dialog box.

   If you want to edit the newly added Tableau map source, select it from the list, and then click **Edit**. Otherwise, click **Close** to return to the view.

You can import as many Tableau map sources as you want into a workbook. Each Tableau map source you add appears as a background map in the **Background Maps** menu and is automatically selected as the default background map until another Tableau map source is imported, until you connect to a WMS server or Mapbox map, or until you select to use a different background map.

**Note:** When you create a new map view, the background map that is selected in the **Background Maps** menu is used to create the map for that view.

**See also:**

- **Save a Map Source** on the previous page
- **Select Background Maps** below

**Select Background Maps**

Tableau comes with a set of online and offline maps that you can access to create map views.

In addition, Tableau supports connecting to a Web Map Server (WMS) or to a Mapbox map so you can create custom maps that are specific to your industry.

You can specify the map background, import new Tableau map sources, or export a Tableau map source to share with others. For more information, see **Save a Map Source** on the previous page and **Import a Map Source** above.

**To select a new background map:**

- Select **Map > Background Maps** and then select the map you want to use as a background map in the view.
By default, Tableau Desktop connects to an online map provider. You can also select to connect to an offline map that ships with the product, or you can add a WMS server or Mapbox map.

The three background maps that come with Tableau are described below.

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Displays data between latitude and longitude axes.</td>
</tr>
<tr>
<td>Offline</td>
<td>Stores the images that make up the map in a cache with your Internet Explorer Temporary Internet Files for improved performance and offline access. For more information, see Use the Offline Background Map on the next page below.</td>
</tr>
<tr>
<td>Tableau</td>
<td>Connects to the Tableau background map. By default, all map views connect to this background map, unless you specify otherwise.</td>
</tr>
</tbody>
</table>

**About the Tableau background map**

The Tableau background map includes updated map and demographic data, as well as stylistic improvements. It has taken the place of the Tableau classic background map. Any map view created with an earlier version of Tableau Desktop, and with a connection to the Tableau classic background map, will automatically connect to the Tableau background map when opened in Tableau Desktop version 9.0 or later.

**Note:** If you create a map view with data layers in Tableau Desktop version 8.3 or earlier using the Tableau classic background map, and then open that view in Tableau Desktop 9.0 or later, the color of the data layers may appear differently due to data layering and color ramp (color palette) improvements made to the Tableau background map.

**Set a Default Background Map**

By default, all map views connect to the Tableau background map. If you do not want your map view to connect to the Tableau background map, you can specify a different background map as the default.

**To specify a default background map:**

1. Select **Map > Background Maps**, and then select the background map that you want to make the default.
2. Select **Map > Background Maps > Set as Default** to set the selected background map to the default.
The background map is automatically saved as a Tableau Map Source (.tms) and placed in the MapSources folder of your My Tableau Repository. It is now the default background map for all new workbooks.

**Use the Offline Background Map**

You can create and inspect data in a map view offline using the offline background map that comes with Tableau.

**To use the offline background map:**

- Select Map > Background Maps > Offline

The offline background map uses map images stored in the cache. There are several actions, however, that require Tableau to retrieve a map image that may not be in the cache. If the new map image is not stored in the cache, you won’t be able to load the map until you reconnect to the online map that comes with Tableau. For more information, see Map Storing below.

You may need to reconnect to the online map if you would like to do one or more of the following:

- **Turn layers on or off** - if you decide to turn on a layer that isn’t stored in the cache, Tableau will need to connect to retrieve the necessary information.

- **Zoom in or out** - zooming in or out on a map requires different map images. If the images at the specified zoom level don’t exist in the cache, Tableau will need to retrieve the updated maps.

- **Pan** - panning sometimes requires new map images. If you are working offline and don’t have the necessary map images and legends stored in the cache, the new images and legends will not load.

**To reconnect to the Tableau online map:**

- Select Map > Background Maps > Tableau

**Map Storing**

When you create map views using the online map provider, Tableau stores the images that make up the map in a cache. That way, as you continue your analysis you don’t have to wait for the maps to be retrieved. In addition, by storing the maps, you can do a certain amount of work when you are offline. For more information, see Select Background Maps on page 742.

The cache for the maps are stored with your temporary internet files and can be cleared at any time by deleting the temporary files from your browser.

Stored map images and legends remain valid for about thirty days. After that time, Tableau will not use the stored image; instead, it will require you to reconnect and fetch an updated map. This is to prevent the map images from becoming outdated.
Advanced Analysis

Now that you understand the basics of building views in Tableau, become an advanced user by learning how to create custom calculations, use the built in statistics tools, leverage dynamic parameters, and more.

Calculated Fields

If your underlying data doesn't include all of the fields you need to answer your questions, you can create new fields in Tableau and then save them as part of the data source. For example, you could create a new calculated field called Profit that calculates the difference between the Sales and the Cost fields, or you could create a formula that sorts values for the Sales Budget field depending on whether they are under budget or over budget.

You created calculated fields in Tableau by defining a formula that is based on existing fields and other calculated fields, using standard functions and operators. You can create calculated fields using the calculation editor, or by double-clicking a field on a shelf and building an ad-hoc calculation.

You can create calculated field with Tableau Desktop or in Tableau web editing environments in products like Tableau Server and Tableau Online.

Note: You can use all types of calculations if you are using a relational data source, however multidimensional data sources do not support aggregations and binned data.

Create or Edit a Calculated Field

Use the calculation editor to create or modify a calculated field.

To display all collapsed content, click the (Expand all) button at the top of the page.

Create a Calculated Field

To open the calculation editor, click the drop down to the right of Dimensions on the Data pane and choose Create Calculated Field.

You can also choose Analysis > Create Calculated Field, or right-click (control-click on Mac) in the Data pane and choose Create Calculated Field.

Click the triangle at the right edge of the editor to open a pane where you can select functions by category or see help for the selected function.
See Create Formulas in Tableau on page 751 for information on how to bring the different element that make up a formula into the calculation editor.

When the workbook is connected to multiple data sources, the current data source is listed next to the calculation name box in the upper left—in the image above, the current data source is Sample - Superstore. As you work in the editor, any fields that you that are not from the current data source are shown with the data source prepended to the field name. For example: [DS1].[Sales].

Click Apply in the calculation editor to save the field as currently defined and add it to the Data pane without closing the editor; click OK to save the calculation and close the editor.

Calculations that return a string or date are saved as dimensions, and calculations that return a number are saved as measures.

Tableau will allow you to save an invalid calculation; however, a red exclamation point appears next to it in the Data pane:

Until you correct an invalid calculated field, you will not be able to drag it into the view.

**Edit a Calculated Field**

To edit a calculated field, right-click (control-click on Mac) it in the Data pane and select Edit. You can only edit calculated fields—that is, named fields created in Tableau (as opposed to named fields that were part of the original data source).

**Drag and Drop Options with the Calculation Editor**

You can work on a calculation in the editor and do other things in Tableau at the same time.
Here is an example of the kind of workflow that is possible with the calculation editor:

1. Start by creating or editing a view.
2. Open the calculation editor and begin working on a calculated field.
3. Drag all or part of your formula to a shelf, dropping it on an existing field, to see how it changes the view.
4. Double-click the field you just dropped on the shelf to open it as an ad-hoc calculation (see Ad-Hoc Calculations on page 755 for details). Then tweak the calculation.
5. Drag the ad-hoc calculation back to the calculation editor and drop it on the original formula in the calculation editor, thereby replacing the original formula.

You can also drag all or part of a formula to the Data pane to create a new field.

As you drag formula content to a shelf, card, or pane, Tableau provides visual feedback:

- A red X indicates that you cannot drop the expression at the current location:

- If you drop an expression that you have dragged from the calculation editor onto a field in the view, the expression replaces that field. If the resulting expression is not valid, the resulting field will be red. You can then edit the expression to make it a valid field.

- If you drag in a field from a secondary data source, it comes with fully qualified name and default aggregation. For example, with a secondary data source named DS1, here is how fields might appear when dragged into the calculation editor:

```
[DS1].[Sales]
SUM([DS1].[Sales])
ATTR([DS1].[Customer Name])
```

For purposes of calculations, the primary data source is whichever data source is currently displayed in the Data pane.

It is not possible to drag numeric bins, generated latitude and longitude fields, Measure Names, or Measure Values into the calculation editor.

**Copy and Paste Calculated Fields**

Calculated fields are available to all sheets that use the same data source in a single workbook. To copy and paste calculated fields between workbooks, right-click the field in the Data window of the source workbook and choose Copy. Then right-click in the Data window in the
destination workbook and choose Paste. You can copy and paste all custom defined fields, including calculated fields, ad hoc groups, user filters, and sets.

**Working in the Calculation Editor**

When you use the calculation editor, the result must always be a calculated field—that is, a user-created named field (as opposed to a named field that was part of the original data source). If you are editing an existing calculated field, then that field is updated when you click OK or Apply. If you are creating a new calculated field, or wish to save your modifications as a new field, type a new field name in the box at the top of the calculation editor before clicking OK or Apply. Ad-hoc calculations, by contrast, do not need to be named. See Ad-Hoc Calculations on page 755.

**Customizing the Calculation Editor**

You can customize the calculation editor in the following ways:

- **Expand or collapse the function list and help area**
  
  You can expand (open) or collapse (close) the function list and the help area on the right side of the calculation editor by clicking the angle control that is between the working area and the function list:

  ![Example of expand/collapse function list and help area](image)

  Click the same control (which now faces left) to reopen the function list and help area.

- **Resize or move the calculation editor**
  
  You can resize the calculation editor by dragging from any of its corners.

  You can move the editor by clicking in the upper-left section (anywhere in the box shown in red, below) until you see the four-way arrow cursor (outlined in blue), and then dragging:
The editor is initially displayed within the view, but you can move it outside the view—for example, to a second monitor. Moving the calculation editor does not move Tableau Desktop, and moving Tableau Desktop does not move the editor.

- **Resize text**

  To increase text size in the calculation editor, hold down the Ctrl key and scroll the mouse button upward. To decrease text size, hold down Ctrl and scroll the mouse button downward. All text in the editor is resized—you cannot resize only selected text. Text size persists until you close the editor. The next time you open the editor, text is at the default size.

**Visual Feedback in the Calculation Editor**

The calculation editor has built-in coloring and validation to help you avoid syntax errors. As you create a formula, syntax errors are underlined with a red line. Hover over the error to see a suggestion for resolving it:

```
[Profit]SUM([Profit])

Syntax error (maybe you are missing an operator).
```

Feedback on formula validity is also displayed at the bottom of the calculation editor. A green check mark indicates that the formula is valid; a red X indicates that it is not. You can click the drop down box to see details:

```
The calculation is incorrect.
Syntax error (maybe you are missing an operator).
```

When you are writing formulas, any part that displays in bold indicates that it will be computed locally within Tableau on the aggregated results. Any normal weight text will be computed at the database level.
Note: If you are connected to a Microsoft Analysis Services data source, the calculation editor contains a "Run before SSAS" check box. Choose this option to execute the Tableau calculation before any Microsoft Analysis Services calculations. For information on connecting to Microsoft Analysis Services data sources, see Microsoft Analysis Services on page 1272.

Sheets Affected
As you edit a calculated field, you can click Sheets Affected in the editor’s status bar to see which other sheets are using the field, which will be updated when you commit your changes:

The Sheets Affected drop-down is only shown if the field you are editing is also being used in other sheets.

Create Formulas in Tableau
You create formulas from the following elements:

- **Functions**
  Tableau functions are listed on the right in the calculation editor. Use the drop-down list above the function list to filter functions by category. You can also type in the Enter Text to Search area to find functions that match the characters that you type. By default all functions are displayed. Certain functions are only available with specific data sources. See Additional Functions on page 1409 for details. For complete help on Tableau functions and other keywords, see Functions, Operators, & Data Types on page 1358. The function help provides examples that demonstrate the correct syntax for functions. For more practical, real-world examples, the Tableau Community and internet blogs may be useful.

  Click a function in the function list to view a brief description and an example on the right.

  Double-click a function in the list to include it at the cursor location in the current formula.

  Functions are colored light blue in formulas.

  Note: Autocomplete is available in the calculation editor. For details, see Autocomplete for Formulas on page 753.

- **Fields**
You can incorporate a field in a formula by dragging it from the Data pane and dropping it in the calculation editor.

You can also drag a field from a shelf in the view to the calculation editor. The result will not necessarily be the same as when you drag a field from the Data pane. For example, if you drag the Sales field from the Data pane to the calculation editor, this is what you will see:

[Sales]

But if you drag Sales to the Rows shelf and then drag it from there to the calculation editor, the field will have changed as a result of being aggregated in the view:

SUM([Sales])

You may also choose to modify a field on a shelf before dragging it to the calculation editor. For example, if you have dragged Sales to the Rows shelf and then added a quick table calculation to the field, you can drag the modified field to the calculation editor to see how the field is expressed in the Tableau calculation language, and to make further modifications. This is what you might see:

```
RUNNING_SUM(SUM([Sales]))
```

You can also drag part or all of an ad-hoc calculation from a shelf to the calculation editor. In addition to the various drag-and-drop options, you can also just type a field name in the calculation editor. Field names that include special characters or spaces must be delimited with square brackets—for example, SUM([Store Profit]). For field names that actually include bracket characters, just type two additional brackets. For example, to specify a field named “Store Profit” you would type [Store Profit]]; two of the brackets say "include the bracket character in the field name," and the third bracket delimits the field name. For information on ad-hoc calculations, see Ad-Hoc Calculations on page 755.

Fields are colored orange in formulas.

- **Operators**
Type any necessary operators into your formula. All standard operators such as addition (+), subtraction (−), multiplication (×), and division (÷) are supported.

Operators are colored black in the formula.

- **Parameters**

Parameters are placeholder variables that can be inserted into calculations to replace constant values. When you use a parameter in a calculation, you can then expose a parameter control in a view or dashboard to allow users to dynamically change the value.

For details, see *Parameters* on page 917.

Parameters are colored purple in formulas.

- **Comments**

To add a comment to a calculation, type two forward slash characters into the formula pane.

For example:

Sales * Profit //John’s calculation

In this example //John’s calculation is a comment.

A comment starts at the two forward slashes (//) and goes to the end of the line. A multiline comment can be written by starting each line with two forward slashes (/!).

Comments are colored green in the formula.

**Auto-Completion for Formulas**

As you type a formula, either in the calculation editor or in an ad-hoc calculation, Tableau displays a list of options for completing the formula.

As you scroll the list, using mouse or keyboard, Tableau shows a short description when the current item is a function:
When the current item is a field, set, or bin, and that keyword has a comment attached, that comment will appear as the description.

For information on adding field comments, see \textbf{Comments on page 310}.

Click a keyword in the list or press Enter to select it. If the keyword is a function, Tableau displays syntax information when you select it:

As you type, the list of suggested keywords is organized into the following categories, in the following order:

- Functions, dimensions, measures, parameters, sets, and bins that \textit{begin} with the string you have typed so far, from the current data source, sorted alphabetically.
- Functions, dimensions, measures, parameters, sets, and bins that \textit{contain} the string you have typed so far, from the current data source, sorted alphabetically.
- If the workbook connects to multiple data sources, dimensions, measures, sets, and bins from the secondary data sources that \textit{begin} with or \textit{contain} the string you have typed so far are displayed, sorted by data source and sorted alphabetically within each data source.

Typing certain characters will either turn off auto-completion or cause it to behave differently:

- Auto-completion will not offer suggestions as you type a quoted string.
- Auto-completion will not offer suggestions if you begin by typing a number.
- If you begin by typing an open square bracket, [, auto-completion shows fields, parameters, sets, and bins, but not functions.

\textbf{Auto-Completion with Multiple Data Sources}

If the workbook is using multiple data sources, auto-completion behaves as follows:

- If the selected field is from a secondary source, auto-completion adds the field with its aggregation and fully qualified name. For example:

  \texttt{ATTR([secondaryDataSource].[sate])}

- Matches from secondary sources are only shown if there is an explicit blend relationship set with the currently active sheet.

- Fields that are being used to blend the two data sources are only shown once in the search results (the field shown is from the primary data source).
Ad-Hoc Calculations

Ad-hoc calculations are calculations that you can create and update as you work with a field on a shelf in the view. Ad-hoc calculations are also known as type-in or in-line calculations.

Double-click on an existing field to start editing.

| iii Columns | ☐ YEAR(Order Date) |
| Rows | SUM([Profit]) |

You can also double-click on an empty shelf or on an empty part of a shelf to create a new calculation.

| iii Columns | ☐ YEAR(Order Date) |
| Rows | |

Type to update the expression, or drag new fields into the expression from the Data pane or elsewhere in the view.

| iii Columns | ☐ MONTH(Order Date) |
| Rows | SUM([Profit])/SUM([Sales]) |

Press Enter, Tab, or click outside the expression to commit the expression, close the calculation, and update the view.

Press Ctrl+Enter (or Command+Enter on a Mac) to commit the expression and update the view without closing the calculation.

| iii Columns | ☐ YEAR(Order Date) |
| Rows | AGG(SUM([Profit])/Sales) |

Ad-hoc calculations are supported on the Rows, Columns, Marks, and Measure Values shelves; they are not supported on the Filters or Pages shelves.

Errors in ad-hoc calculations are underlined in red. Hover over the error to see a suggestion for resolving it.
Note: Ad-hoc calculations are not named, but are saved when you close the workbook. If you want to save an ad-hoc calculation for use in other workbook sheets, copy it to the Data pane. You will be prompted to name the calculation. {On server it just deposits it w/o rename prompt.} Once you name an ad-hoc calculation, it is the same as a calculation you created with the calculation editor, and is available on other sheets in the workbook. See Create or Edit a Calculated Field on page 746

Multi-Line Ad-Hoc Calculations

As you're typing an ad-hoc calculation, you can press Shift+Enter to start a new line. However, only the current line is ever visible in an ad-hoc calculation, so this can be confusing for anyone viewing or editing the calculation who has no way of knowing that it contains multiple lines.

The first line of a multi-line ad-hoc calculation can be a comment that serves as a title for the calculation. This is the only line that is visible on the shelf after the calculation is committed:

```
//City and State

[City] + ', ' + [State]
```

Ad-Hoc Calculations and Aggregation

If Tableau determines that the expression you enter is a measure (that is, returns a number), it automatically adds an aggregation to the expression when you commit the expression. For example, if you type `DATEDIFF('day',[Ship Date],[Order Date])` in an ad-hoc calculation and then press Enter, what you will see is the following:

```
SUM(DATEDIFF('day',[Ship Date],[Order Date]))
```

If you use a field that is already an aggregated field (for example, `SUM([Profit])`) in an ad-hoc calculation, the result is an aggregate calculation. For example, when you commit an ad-hoc calculation `SUM([Profit])/SUM([Sales])`, the result is:

```
AGG(SUM([Profit])/SUM([Sales]))
```

For more information on aggregate calculations, see Aggregate Calculations on page 762.

Ad-Hoc Calculations for Insight and Experimentation

Typically you create ad-hoc calculations on-the-fly to do things like

- Test a hunch
- Try a what-if scenario
- Debug a complex calculation

Managing Ad-Hoc Calculations

Use the following keystrokes to manage ad-hoc calculations.
• Double-click in an existing field on the **Rows, Columns, Marks**, or **Measure Values** shelf to open it as an ad-hoc calculation.

• Double-click elsewhere on any of these shelves to create a new ad-hoc calculation from scratch.

• Press Esc to cancel an ad-hoc calculation.

• Press Enter to commit an ad-hoc calculation, which updates the view and closes the ad-hoc calculation. Press Ctrl+Enter to commit the change and update the view without closing the ad-hoc calculation.

• If there is a field to the right of the current ad-hoc calculation on the same shelf, pressing Tab opens that field as an ad-hoc calculation. If there is no field to the right of the current ad-hoc calculation on the shelf, pressing Tab opens a new ad-hoc calculation. Shift+Tab has the same functionality, except it moves to the left.

• When you double-click a named field on a shelf to edit it, you are not changing the original named field.

In addition, the following rules govern the use of ad-hoc calculations.

• Only one ad-hoc calculation can be open at a time.

• If a field that has a geographic role or a fiscal year setting associated with it is added to an ad-hoc calculation, the ad-hoc calculation inherits that role or setting.

• The right-click context menu for an ad-hoc calculation supports the same options that would be available for any other field in the view of the same type, including the ability to change aggregation, show a filter, or format.

• Ad-hoc calculations are not available when you create groups, sets, hierarchies, or parameters.

• Ad-hoc calculations are valid for creating trend lines, forecasts, and reference lines, bands, and distributions.

**How to Create a Calculated Member**

If you are using a multidimensional data source, you can create calculated members using MDX formulas instead of Tableau formulas. A calculated member can be either a calculated measure, which is a new field in the data source just like a calculated field, or a calculated dimension member, which is a new member within an existing hierarchy. For example, if a dimension Product has three members (Soda, Coffee, and Crackers) you can define a new calculated member Beverages that sums the Soda and Coffee members. When you then place the Products dimension on the **Rows** shelf it displays four rows: Soda, Coffee, Crackers, and Beverages.

**Note:** In Tableau, multidimensional data sources are supported only in Windows.
Defining Calculated Members

You can define a calculated dimension member by selecting **Calculated Members** from the Data pane menu. In the Calculated Members dialog box that opens, you can create, delete, and edit calculated members.

To create a new calculated member do the following:

1. Click New to add a new row to the list of calculated members at the top of the dialog box.

2. Type a Name for the new calculated member in the Member Definition area of the dialog box.
3. Specify the **Parent** member for the new calculated member. **All Member** is selected by default, however, you can choose **Selected Member** to browse the hierarchy and select a specific parent member.

4. Give the new member a solve order.

   Sometimes a single cell in your data source can be defined by two different formulas. The solve order defines the precedence given to each formula. Formulas with a lower solve order are solved first. The default solve order is zero.

5. If you are connected to a Microsoft Analysis Services data source, the calculation editor contains a **Run before SSAS** check box. Choose this option to execute the Tableau calculation before any Microsoft Analysis Services calculations. For information on connecting to Microsoft Analysis Services data sources, see *Microsoft Analysis Services* on page 1272

6. Type or paste an MDX expression into the large white text box.

7. Click **Check Formula** to verify that the formula is valid.

8. When finished, click **OK**.

The new member displays in the **Data** pane either in the Measures area, if you chose [Measures] as the parent member, or in the Dimensions area under the specified parent member. You can use the new member just like any other field in the view.

**Example – Creating a Calculated Field**

This example shows how to create a calculated field using Tableau formulas and then use the new field in a data view.

1. Connect to the **Sample - Superstore** data source, which is included with Tableau Desktop.

2. Click the drop down to the right of Dimensions on the **Data** pane and select **Create**
Calculated Field to open the calculation editor.

See Create Formulas in Tableau on page 751 for information on how to bring the different element that make up a formula into the calculation editor.

3. Name the new field Discount Ratio and create the following formula:
   \[ \text{IIF}([\text{Sales}] \neq 0, \text{[Discount]} / \text{[Sales]}, 0) \]

   Build the formula by first double clicking the IIF statement from the function list and then either dragging the fields from the Data pane or typing them in the editor. You must type the operators (\(!=\) and \(/\)) manually. The IIF statement is used to avoid dividing by zero. For information on the IIF statement, see Logical Functions on page 1380.

4. Click OK to add the new field to the Measures area in the Data pane. The new field is listed under Measures instead of Dimensions because the calculation returns a number.

5. Use the calculation in a new view.

   Place Region on the Columns shelf, Ship Mode on the Rows shelf, and Category on Color in the Marks card. Then place the new calculated field, Discount Ratio, on the Rows shelf.

6. Change the aggregation for Discount Ratio for the field in the view from Sum to Average. To do this, right-click (Control-click on a Mac) the Discount Ratio field on the Rows shelf and choose Measure > Average. Here is what the view should now look like:
7. But now you learn that there has been a change in company policy. You must edit the calculation to compute discount ratio only for sales over $2000.

Right-click **Discount Ratio** in the **Data** pane and select **Edit**.

In the calculation editor, change the formula to compute discount ratio only for sales over $2000:

\[
\text{IIF}([\text{Sales}] > 2000, [\text{Discount}] / [\text{Sales}], 0)
\]

The view automatically updates after you click **OK** to dismiss the calculation editor.
Aggregate Calculations

Aggregate functions allow you to summarize data. As described in Aggregations on page 322, Tableau includes a variety of predefined aggregations such as summation and variance. An aggregate calculation allows you to define aggregations other than these predefined choices.

About Aggregate Calculations

Suppose you want to analyze the overall gross margin for every product in your data source. One way to do this is to create a new calculated field called Margin that is equal to the profit divided by the sales. Then you could place this measure on a shelf and use the predefined summation aggregation. In this scenario, Margin is defined as follows:

\[
\text{Margin} = \text{SUM}([\text{Profit}]/[\text{Sales}])
\]

This formula calculates the ratio of profit and sales for every row in the data source, and then sums the numbers. That is, the division is performed before the aggregation. However, this is almost certainly not what you would have intended because summing ratios is generally not useful.

Instead, you probably want to know the sum of all profits divided by the sum of all sales. That formula is shown below.
Margin = \frac{\text{SUM}([\text{Profit}])}{\text{SUM}([\text{Sales}])}

In this case, the division is performed after each measure is aggregated. An aggregate calculation allows you to create formulas like this.

**How to Create an Aggregate Calculation**

When a calculation uses an aggregate function, it's called an aggregate calculation. You create an aggregate calculation by defining a new calculated field as described in [Create or Edit a Calculated Field](#) on page 746. The formula will contain one or more aggregate functions. You can easily pick an aggregate function in the calculation editor by selecting the **Aggregate** category from the Functions menu as shown below.

These functions are identical to the predefined aggregate functions listed in [Aggregations](#) on page 322.

![Aggregate Calculation Editor](image)

The aggregate calculation appears with the letters **AGG** in front of it when it is placed on a shelf.

<table>
<thead>
<tr>
<th>Columns</th>
<th>Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rows</td>
<td>Region</td>
</tr>
<tr>
<td></td>
<td>AGG(AvgDiscountRati...</td>
</tr>
</tbody>
</table>

When you create an aggregate calculation, no further aggregation of the calculation is possible. Therefore, the field’s context menu does not offer any aggregation choices. However, you can disaggregate the field.

The rules that apply to aggregate calculations are:

- For any aggregate calculation, you cannot combine an aggregated value and a disaggregated value. For example, \(\text{SUM}(\text{Price})*[\text{Items}]\) is not a valid expression because \(\text{SUM}(\text{Price})\) is aggregated and \(\text{Items}\) is not. However, \(\text{SUM}(\text{Price}*\text{Items})\) and \(\text{SUM}(\text{Price})*\text{SUM}(\text{Items})\) are both valid.

- Constant terms in an expression act as aggregated or disaggregated values as appropriate. For example: \(\text{SUM}(\text{Price}*7)\) and \(\text{SUM}(\text{Price})*7\) are both valid expressions.
- All of the functions can be evaluated on aggregated values. However, the arguments to any given function must either all be aggregated or all disaggregated. For example: \( \text{MAX}(\text{SUM}(\text{Sales}), \text{Profit}) \) is not a valid expression because \( \text{Sales} \) is aggregated and \( \text{Profit} \) is not. However, \( \text{MAX}(\text{SUM}(\text{Sales}), \text{SUM}(\text{Profit})) \) is a valid expression.

- The result of an aggregate calculation is always a measure.

- Like predefined aggregations, aggregate calculations are computed correctly for grand totals. Refer to Grand Totals on page 905 for more information.

**Aggregate Calculations in a Disaggregated State**

If an aggregate calculation is disaggregated, the calculation is modified in a way that depends on the functions used. Every function has a disaggregated substitute, as shown below.

<table>
<thead>
<tr>
<th>Aggregation Function</th>
<th>Disaggregated Substitute</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG(data)</td>
<td>data</td>
</tr>
<tr>
<td>COUNT(data)</td>
<td>IIF(ISNULL(data), 0, 1)</td>
</tr>
<tr>
<td>COUNTD(data)</td>
<td>IIF(ISNULL(data), 0, 1)</td>
</tr>
<tr>
<td>MAX(data)</td>
<td>data</td>
</tr>
<tr>
<td>MIN(data)</td>
<td>data</td>
</tr>
<tr>
<td>STDEV(data)</td>
<td>Null</td>
</tr>
<tr>
<td>STDEVP(data)</td>
<td>IIF(ISNULL(data), Null, 0)</td>
</tr>
<tr>
<td>SUM(data)</td>
<td>data</td>
</tr>
<tr>
<td>VAR(data)</td>
<td>Null</td>
</tr>
<tr>
<td>VARP(data)</td>
<td>IIF(ISNULL(data), Null, 0)</td>
</tr>
</tbody>
</table>

Note that \( \text{STDEV} \) and \( \text{VAR} \) are Null because those functions return Null if there are fewer than two elements in a group that are not Null, and each group has size 1 when it is disaggregated. See Aggregations on page 322 for descriptions of the aggregation functions.

Therefore, if you define an aggregate calculation called Margin that is equal to \( \text{SUM(Profit)}/\text{SUM(Sales)} \) and then disaggregate the data, it is interpreted as \( \text{Profit}/\text{Sales} \).

**Example – Aggregate Calculation**

This example shows how to create an aggregate calculation called Margin, and use the new field in a data view.
1. Connect to the **Sample - Superstore** data source, which is included with Tableau Desktop.

2. Click the drop down to the right of Dimensions on the **Data** pane and choose **Create Calculated Field** to open the calculation editor.

   See Create Formulas in Tableau on page 751 for information on how to bring the different element that make up a formula into the calculation editor.

3. Name the new field **Margin** and create the following formula:

   \[
   \text{IIF}(\text{SUM}([\text{Sales}]) \neq 0, \frac{\text{SUM}([\text{Profit}])}{\text{SUM}([\text{Sales}])}, 0)
   \]

4. Build the formula by first double clicking the **IIF** statement from the function list and then either dragging the fields from the **Data** pane or typing them in the editor. You must type the operators (**!=** and **) manually. The **IIF** statement is used to avoid dividing by zero. For information on the **IIF** statement, see Logical Functions on page 1380.

   ![IIF calculation editor](image)

   The new calculated field displays in the **Measures** area of the **Data** pane where you can use it like any other measure.

   ![Measures area](image)

   When **Margin** is placed on a shelf, its name is automatically changed to **AGG(Margin)**, which indicates that it is an aggregate calculation. As a result, the field's context menu does not
include any aggregation choices because it is not possible to aggregate a field that is already aggregated.

Example - Spotlighting Using Calculations

Spotlighting is a technique for showing discrete thresholds based on the values of a measure. For instance, you might want to color-code sales so that those over 10,000 appear green and those below 10,000 appear red. A spotlighting calculation is just a special case of a calculation that results in a discrete measure. A discrete measure is a calculation that is a dependent variable (and therefore a measure), but which results in a discrete result (as opposed to a continuous result). Thus the name discrete measure. Here is an example:
The formula in this example defines a discrete measure named Sales Spotlight. Discrete measures always appear with a blue abc icon in the Data pane. Sales Spotlight is classified as a measure in Tableau because it is a function of another measure; it is discrete because it produces discrete values (“Good” and “Bad”). Here is an example of this categorical measure in use:

Here, Sales Spotlight is on Color in the Marks card. It appears with the AGG prefix because it is an aggregate calculation. Values above 10,000 and below 10,000 are assigned different colors.

**Transform Values with Table Calculations**

A table calculation is a transformation you apply to the values for a measure in the view.

You can use table calculations for a variety of purposes, including:

- Transforming values to rankings
- Transforming values to show running totals
- Transforming values to show percent of total
Table calculations are available as you work with views in Tableau Desktop and also as you edit views in Tableau Server or Tableau Online.

Table calculations are a special type of calculated field that computes on the local data in Tableau. They are calculated based on what is currently in the view and do not consider any measures or dimensions that are filtered out of the view.

**Note:** The “table” is determined by the dimensions in the view—not the tables in your data source. Also, a “table calculation” is an entirely different thing than a calculated field. For information on calculated fields, see Calculated Fields.

**Table Calculation Enhancements in Tableau 10**

Tableau 10 provides some key enhancements to the experience of creating table calculations:

- As you work in the Table Calculation dialog box to configure a calculation, the view updates in real time to show the results of your choices.
- **Highlighting** shows you the scope of your calculation by setting off part of the view with a colored background as you change the **Compute Using** option in the Table Calculation dialog box:

![Table Calculation Example]

If you select a different mark in the view while the Table Calculations dialog box is still open, highlighting will switch to the partition containing that mark.

**What is a Table Calculation?**

A table calculation is a transformation you apply to the values of a single measure in your view, based on the dimensions in the level of detail.

For any Tableau view, there is a virtual table that is determined by the dimensions in the view. This table is not to be confused with the tables in your data source. Specifically, the virtual table is determined by the dimensions within the “level of detail,” which means the dimensions on any of the following shelves or cards in a Tableau worksheet:
Consider this simple view:

In this view, the dimensions are **Order Date** (with values aggregated up to **YEAR**) on **Columns**, and **Segment** on **Rows**. The individual cells in the table show the value of the **Profit** measure for each combination of **Order Date** and **Segment**. There are four years' worth of
Order Date data, and three Segments; multiply these numbers to get 12 individual cells, each showing a Profit value.

Suppose you want to see not absolute dollar values, but the percentage of the total profit that each of these 12 individual profit values contributes to the total profit, so that when all the cell values are added, they total 100%. To do this, you can add a table calculation. Here’s how you could add a table calculation to show this.

1. You always add a table calculation to a measure in the view. In this case there is only one measure in the view—SUM(Profit)—so when you right-click that measure on the Marks card (or Control-click on a Mac) you see two options that mention table calculations:
   - Add Table Calculation
   - Quick Table Calculation

If you choose Quick Table Calculation, you will see a range of options:
2. **Percent of Total** looks right. Choose that, and the view updates to show percentages, instead of absolute dollar values:
Notice the triangle icon that now appears next to \textbf{SUM(Profit)} on the Marks card:

This indicates that a table calculation is currently being applied to this measure.

3. But what about when the view is not a text table? Are table calculations still an option? They are.

   Back up one step (click the Undo button on the toolbar) to remove the quick table calculation.

4. Now use Show Me to change the chart type to horizontal bars:
You might not be as likely to refer to this view as a “table,” but the dimensions in the level of detail are the same, so the view’s virtual table is the same.

5. You can now apply the exact same table calculation as before—right-click \texttt{SUM(Profit)}, choose \textbf{Quick Table Calculation}, and then \textbf{Percent of Total}. The view changes to show percentages along the horizontal axis, instead of dollar values:

\begin{center}
\includegraphics[width=\textwidth]{chart1.png}
\end{center}

\textbf{Note}: When you are learning about table calculations, or experimenting with different options, a text table is usually going to provide more intuitive insight than other chart types.

\section*{Quick Table Calculations}

A quick table calculation is a one-step process where you choose a common table calculation type from a list. Tableau automatically applies the most typical settings for that calculation type.

To apply a quick table calculation, do the following:

1. Click a measure in the view and choose \textbf{Quick Table Calculation} from the context menu.
2. Choose a Calculation type from the sub-menu.

If the results are satisfactory, you’re done. If not, you can continue working with the calculation by clicking the measure again and choosing \textbf{Edit table calculation}.

The list of available quick calculation types does not exactly match the list of default calculation types you see in the Table Calculation dialog box. For example, a \textbf{Compound growth rate}
quick table calculation is a **Percent Difference From** table calculation, but with the **Compute compounded rate** option selected. If you want to know how any given quick table calculation is defined, add the calculation and then go back and edit it to see how it is configured in the Table Calculation dialog box.

**Choose Your Approach to Table Calculations**

The easiest way to add a table calculation is to use a quick table calculation. See **Quick Table Calculations** on the previous page. But if you need more flexibility than a quick table calculation affords, you can base your calculation on the visual structure of your view, or you can reference the specific dimensions in the view.

**Table Calculations: Use the Visual Structure of Your View**

When you configure a table calculation using the **Compute Using** options in the Table Calculation dialog box, you define a table calculation using the visual structure of your view.
As you add or edit a table calculation in the Table Calculation dialog box, Tableau highlights the effects of the **Compute Using** options you choose in the view.

For example, a **Table (Across)** calculation moves from left to right across the entire width of the view:
A Pane (Down then Across) calculation moves down the first column in a pane, then down the second column in a pane, and so on:
The **Compute Using** approach should be convenient and intuitive for most users because the calculation aligns with what you see in your view.

The list of options under **Compute Using** changes according to the content of your view. For example, if you have only two dimensions in your view (one on Rows and one on Columns), there will be no Pane options because your view is not complex enough for there to be multiple panes—in this case, your entire view is single pane.
**Table Calculations: Reference Specific Dimensions in Your View**

With this approach, you define a table calculation by referencing the dimensions in the view. Choose **Specific Dimensions** in the Table Calculation dialog box and then select or clear fields in the box below.

To configure a table calculation using specific dimensions, click **Specific Dimensions** and then select dimensions in the box below. You can also drag dimensions up or down in the list to set the sequence for the calculation:
You can still see the effect of your choices in the view, but because the visual structure and the table calculation are not necessarily aligned (as they always are with the Compute Using options), the results can sometimes look a bit exotic. For example:

If you are configuring table calculations using specific dimensions, then you should become familiar with the concepts of addressing and partitioning. See Table Calculations: Addressing and Partitioning on the next page.
Table Calculations: Addressing and Partitioning

If you are configuring table calculations using specific dimensions, then you should become familiar with the concepts of addressing and partitioning.

Background: How Level of Detail Affects the Direction and Scope of Your Calculations

Your view contains marks; these marks are typically aggregated. This means that an individual mark collects data not from a single row in your data source, but from all rows that have the same values for the dimensions in your view.

See Aggregating Data on page 328 for more on aggregation in Tableau.

The number of marks in your view is determined by the view’s level of detail. Dimensions located on any of the shelves or cards highlighted in the following image contribute to the level of detail:

So if your view has State and Segment on Columns, and Region on Rows, then a single mark represents all rows in your data source that share the same value for these three dimensions. For example, one mark would aggregate individual values for rows where the value of State is Indiana, the value of Segment is Consumer, and the value of Region is Central. The measure that Tableau is aggregating—it might be Profit, Sales, or any other measure in the data source—is for you to decide, as is the aggregation itself—it might be Sum, Average or another aggregation.

When you add a table calculation, you must use all dimensions in the level of detail either for partitioning (scoping) or for addressing (direction):
- The dimensions that define how to group the calculation, that is, define the scope of data it is performed on, are called partitioning fields. The table calculation is performed separately within each partition.

- The remaining dimensions, upon which the table calculation is performed, are called addressing fields, and determine the direction of the calculation.

Partitioning fields break the view up into multiple sub-views (or sub-tables), and then the table calculation is applied to the marks within each such partition. The direction in which the calculation moves (for example, in calculating a running sum, or computing the difference between values) is determined by the addressing fields. So when you order the fields in the Specific Dimensions section of the Table Calculation dialog box from top to bottom, you are specifying the direction in which the calculation moves through the various marks in the partition.

When you add a table calculation using the **Compute Using** options, Tableau identifies some dimensions as addressing and others as partitioning automatically, as a result of your selections. But when you use Specific Dimensions, then it's up to you to determine which dimensions are for addressing and which for partitioning.

The following example demonstrates how experimenting with the options in the Table Calculations dialog box can help you understand how your calculation is working.

**Example - Addressing and Partitioning**

In this example, using the Sample – Superstore data source provided with Tableau Desktop, create the following simple view:

1. Drag Order Date and Segment to Columns.
2. Drag State to Rows.
3. Drag Sales to Text.

This gives you a basic view:

![Tableau view](image)

4. Click **SUM(Sales)** on the Marks card and then select **Add table calculation** from the
context menu.

This opens the Table Calculation dialog box.

Note the yellow highlighting running across the top row of the view. Highlighting shows you exactly how the current **Compute Using** option partitions the view.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>$1,770</td>
<td>$3,965</td>
<td>$2,418</td>
<td>$645</td>
<td>-$1,474</td>
<td>$1,668</td>
<td>$2,310</td>
<td>-$4,973</td>
</tr>
<tr>
<td>Arizona</td>
<td>$1,470</td>
<td>$2,730</td>
<td>$3,184</td>
<td>$7,025</td>
<td>-$2,321</td>
<td>$2,205</td>
<td>$2,951</td>
<td>$372</td>
</tr>
<tr>
<td>Arkansas</td>
<td>$4,000</td>
<td>$1,106</td>
<td>$437</td>
<td>$437</td>
<td>6</td>
<td>$1,983</td>
<td>-$1,980</td>
<td>$238</td>
</tr>
<tr>
<td>California</td>
<td>$10,750</td>
<td>$7,272</td>
<td>$10,400</td>
<td>$13,330</td>
<td>-$1,332</td>
<td>$10,221</td>
<td>$19,394</td>
<td>$23,600</td>
</tr>
<tr>
<td>Colorado</td>
<td>$4,357</td>
<td>$1,061</td>
<td>$3,107</td>
<td>$1,643</td>
<td>-$1,419</td>
<td>$2,438</td>
<td>$2,615</td>
<td>-$2,025</td>
</tr>
<tr>
<td>Connecticut</td>
<td>$551</td>
<td>$1,679</td>
<td>$537</td>
<td>$236</td>
<td>-$713</td>
<td>$1,880</td>
<td>-$74</td>
<td>-$3,650</td>
</tr>
<tr>
<td>Delaware</td>
<td>$4,210</td>
<td>$4,201</td>
<td>$2,717</td>
<td>$4,448</td>
<td>-$1,660</td>
<td>$1,594</td>
<td>-$2,024</td>
<td>-$3,940</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>40</td>
<td>40</td>
<td>$2,670</td>
<td>$2,670</td>
<td>50</td>
<td>1,93</td>
<td>1,93</td>
<td>1,93</td>
</tr>
<tr>
<td>Florida</td>
<td>$2,927</td>
<td>$22,478</td>
<td>$19,521</td>
<td>$1,917</td>
<td>-$6,570</td>
<td>$6,781</td>
<td>$1,474</td>
<td>-$3,912</td>
</tr>
<tr>
<td>Georgia</td>
<td>$1,224</td>
<td>$1,266</td>
<td>$9,118</td>
<td>$7,676</td>
<td>-$1,441</td>
<td>$5,244</td>
<td>$2,422</td>
<td>$2,394</td>
</tr>
<tr>
<td>Idaho</td>
<td>$446</td>
<td>$446</td>
<td>$406</td>
<td>$509</td>
<td>-$1,005</td>
<td>$85</td>
<td>$1,114</td>
<td>$1,140</td>
</tr>
<tr>
<td>Illinois</td>
<td>-$3,752</td>
<td>$672</td>
<td>$7,296</td>
<td>$6,286</td>
<td>-$360</td>
<td>$5,957</td>
<td>$3,217</td>
<td>$1,424</td>
</tr>
</tbody>
</table>

5. **Set Calculation Type** to **Running Total**.

6. **Click Specific Dimensions**, the last item in the **Compute Using** list.

The list box below the **Compute Using** list, which lists all the dimensions in the view’s level of detail, is now available for edit.
Any field with a check mark is an addressing field. **Year of Order Date** and **Segment** are checked, so this leaves **State** as the only partitioning field. This configuration matches **Table (Across)**, which was the **Compute Using** value that was selected when you clicked **Specific Dimensions**.

**Note:** You can select any of the **Compute Using** options and then click **Specific Dimensions** to see how your selected option translates in terms of specific dimensions.

**Year of Order Date** and **Segment** are both on Columns in the view, so these dimensions define the columns in the view. Notice that the values running from left to
right in the view are ascending—the running total increases across the entire width of the view.

But when you get to the second row (Arizona) you enter a new partition, so the calculation restarts.

To gain insight, try changing things up in the list of specific dimensions.

7. Clear the check mark from Year of Order Date.

Year of Order Date is now a partition field, leaving only Segment for addressing. Year of Order Date and State are both now partitioning fields, which means the partitions are more plentiful—and smaller, because you are using two fields to partition (think “divide up”) the view. There are only three marks per partition now, so as you continue moving left-to-right across the view, you enter a new partition with the fourth value, and the calculation restarts.

By default, marks are highlighted in the first partition in the view. The first headers for these fields are also highlighted—in the current case, 2011 and Alabama.

8. Reselect Year of Order Date and then drag Segment to the top of the list—above Year of Order Date. Highlighting shows that the partition is the same as in the default view, stretching left to right across the entire width of the view. This makes sense because the same two fields—Segment and Year of Order Date—are used for addressing.

But notice that the values are not the same as in the previous view:

Because you reversed the order in which the fields are listed for Specific Dimensions, Tableau computes the running total using values for Segment first and then Year of Order Date. The arrows in the image show the order in which Tableau is computing the running sum. The logic of the calculation is now somewhat at odds with the visual
alignment of the view, but that is what can happen when you configure a table calculation using Specific Dimensions.

Customize How Tableau Sorts the Results of Table Calculations

When you add a table calculation using specific dimensions from your view, you can also customize the way Tableau sorts the values. This option is available for all table calculation types except Rank and Percentile.

With custom sorting, you can sort the results of a table calculation using values from a field in the data source. With Specific Dimensions selected in the Table Calculations dialog box, do the following:

1. Click Custom Sort to display drop-down options.

2. Select Custom Sort.

3. From the drop-down list on the left, choose the field with the values you want to sort on.

4. From the drop-down list on the right, choose the aggregation you want to use with the field.

5. Specify whether to sort by Descending or Ascending values.

Create a Table Calculation

You can add a table calculation to a measure in the view. To add a table calculation:

1. Click a measure in the view and choose Add table calculation from the field menu.
   
   Tableau opens the Table Calculation dialog box and also adds highlighting to the view. As you work in the Table Calculation dialog box, highlighting shows the scope and direction of the calculation.

2. Choose a Calculation Type.
   
   For details on available calculation types, see Table Calculation Types on page 789.

   For each calculation type there is a specific set of options for you to consider. For example, for a Difference From calculation, there are two associated fields:
For information on these fields, go to **Table Calculation Types on page 789**, and then click the link for **Difference From Calculation**.

3. To define the table calculation using the visual structure of your view, choose one of the **Compute Using** options.
Alternatively, to define the table calculation by referencing specific dimensions in the view, choose **Specific Dimensions** and then select and order dimensions in the box further down in the Table Calculation dialog box.
For information on these two alternative approaches, see *Choose Your Approach to Table Calculations* on page 774. *Compute Using* is the recommended option for most users.

4. When you are satisfied with your table calculation, click the X in the upper-right corner of the Table Calculations dialog box to close it. Highlighting disappears. To indicate that the field now includes a table calculation, Tableau displays a small triangle next to the field name. Hover the cursor over this triangle to see a description of the table calculation:
Table Calculation Types
As you add or modify a table calculation, you must choose a calculation type. Each type has a specific set of options.

Table Calculation Type: Difference From
For each mark in the view, a Difference From table calculation computes the difference between the current value and another value in the table.
Suppose you are starting with the following text view, which shows sales totals broken out by year (from left to right) and by quarter and month (from top to bottom):

<table>
<thead>
<tr>
<th>Quarter of Order</th>
<th>Month of Order</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td>$13,946</td>
<td>$18,174</td>
<td>$18,542</td>
<td>$44,703</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>$4,811</td>
<td>$12,211</td>
<td>$22,868</td>
<td>$20,284</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>$55,691</td>
<td>$38,467</td>
<td>$51,186</td>
<td>$53,909</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>$28,295</td>
<td>$34,195</td>
<td>$39,249</td>
<td>$40,112</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>$23,648</td>
<td>$30,132</td>
<td>$56,691</td>
<td>$45,651</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>$34,595</td>
<td>$24,797</td>
<td>$39,430</td>
<td>$48,260</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>$33,946</td>
<td>$28,765</td>
<td>$38,441</td>
<td>$48,428</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>$27,909</td>
<td>$36,898</td>
<td>$33,266</td>
<td>$61,516</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>$81,777</td>
<td>$64,596</td>
<td>$72,908</td>
<td>$90,489</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>$31,453</td>
<td>$31,405</td>
<td>$56,463</td>
<td>$77,794</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>$78,629</td>
<td>$75,973</td>
<td>$82,192</td>
<td>$112,326</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>$69,546</td>
<td>$74,920</td>
<td>$97,237</td>
<td>$90,475</td>
</tr>
</tbody>
</table>

Instead of absolute sales values, you want to see by how much values go up or down from month-to-month during the course of each year.

Click for Information on How to Create the Basic View
1. Connect to the Sample - Superstore data source.

2. Click and drag the Order Date field in the Data pane and drag it to the Columns shelf. The default date level is YEAR(Order Date).

3. Click and drag Order Date again and drop it this time on the Rows shelf.

4. Click on the right side of the field to open the context menu. Then choose Quarter.

You will see two options named Quarter. Be sure to choose the first one.

The field should now read QUARTER(Order Date).

Note: If you are creating the view on the web, the menu looks a bit different.

5. Click and drag Order Date a third time and drop it on the Rows shelf to the right of QUARTER(Order Date).

6. Click on the right side of the field to open the context menu and this time choose Month (again, choose the first of two options named Month). The field should now read
MONTH(Order Date).

7. Drag Sales from the Data pane and drop it on Text on the Marks card.

You now have the basic view, showing Sales by Order Date over a four-year period, by month, quarter, and year.

Modify the basic view to show how by how much values go up or down from month-to-month during the course of each year.

1. Click the SUM(Sales) field on the Marks card and then select Add table calculation.

2. In the Table Calculation dialog box, verify that Difference From is the Calculation Type.

   This is the default Calculation Type, so you really shouldn't have to change this field value.

3. Choose Table (Down) from the Compute Using list.

   The highlighting shows how this Compute Using value sets the scope of the calculation in the view:

   Comparing the values in the original text view with the values in this view, you can verify that this is the result that you want.

4. Click the X in the upper-right corner of the Table Calculations dialog box to close it.

   Difference from what?

With a Difference From, Percent Difference From, or Percent From calculation, there are always two values to consider: the current value, and the value from which the difference
should be calculated. In most cases, you want to calculate the difference between the current value and the previous value, as in the procedure above. But in some cases you may want something different:

<table>
<thead>
<tr>
<th>Previous</th>
<th>Calculates the difference between the current value and the previous value in the partition. This is the default value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Next</td>
<td>Calculates the difference between the current value and the next value in the partition.</td>
</tr>
<tr>
<td>First</td>
<td>Calculates the difference between the current value and the first value in the partition.</td>
</tr>
<tr>
<td>Last</td>
<td>Calculates the difference between the current value and the last value in the partition.</td>
</tr>
</tbody>
</table>

**At the level**

Use this setting to set a break (that is, restart of the calculation) in the view, based on a particular dimension. How is this different from just using that dimension for partitioning? In fact, it is partitioning, but it’s partitioning by position rather than by value, which is how partitioning is defined with the Compute Using options.

The **At the level** option is only available when you select Specific Dimensions in the Table Calculations dialog box, and when more than one dimension is selected in the field immediately below the Compute Using options — that is, when more than one dimension is defined as an addressing field.

This option is not available when you’re defining a table calculation with Compute Using, because those values establish partitions by position. But with Specific Dimensions, because the visual structure and the table calculation are not necessarily aligned, the **At the level** option is available to let you fine-tune your calculation.

For example, if you take the result of the Difference From calculation you added above, you can see the effect of **At the level** by doing the following:

1. Click the **SUM(Sales)** field on the Marks card and then select Edit table calculation.
2. In the Table Calculation dialog box, choose Specific Dimensions.

Notice that two dimensions are now checked in the list box of dimensions: **Quarter of Order Date** and **Month of Order Date**. These are the addressing fields, and because more than one field is being used for addressing, At the level is now available.

The choices available from the **At the level** drop-down list are:

<p>| Deepest | Specifies that the calculation should be performed at the level of finest granularity. This is the default option. |</p>
<table>
<thead>
<tr>
<th>Quarter of Order Date</th>
<th>Specifies that the calculation should be performed at the quarter level.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month of Order Date</td>
<td>Specifies that the calculation should be performed at the month level.</td>
</tr>
</tbody>
</table>

3. With this particular view, **Deepest** and **Month of Order Date** are equivalent options, and they are both equivalent to just choosing the **Table (Down)** option from **Compute Using**. The only option that yields a different result is **Quarter of Order Date**:

<table>
<thead>
<tr>
<th>Quarter of Order Date</th>
<th>Month of Order Date</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>February</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>March</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>$14,349</td>
<td>$16,021</td>
<td>$20,706</td>
<td>-$4,591</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>$18,838</td>
<td>$17,921</td>
<td>$33,823</td>
<td>$25,368</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>-$21,096</td>
<td>-$13,670</td>
<td>-$11,756</td>
<td>-$5,649</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>$5,651</td>
<td>-$5,430</td>
<td>-$808</td>
<td>$6,316</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>$4,261</td>
<td>$6,767</td>
<td>-$23,426</td>
<td>$15,865</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>$47,182</td>
<td>$39,799</td>
<td>$33,478</td>
<td>$42,229</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>-$2,493</td>
<td>$2,640</td>
<td>$18,022</td>
<td>$29,365</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>$50,719</td>
<td>$39,074</td>
<td>$48,927</td>
<td>$50,810</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>-$12,232</td>
<td>$10,324</td>
<td>$24,329</td>
<td>-$14</td>
</tr>
</tbody>
</table>

The difference is now calculated between the first month in a given quarter and the first month in the previous quarter.

**Table Calculation Type: Percent Difference From**

For each mark in the view, a **Percent Difference From** table calculation computes the difference between the current value and another value in the table, as a percentage.

Suppose you are starting with the following text view, which shows sales totals broken out by year (from left to right) and by quarter and month (from top to bottom):
Instead of absolute sales values, you want to see how values change, in terms of percentage, from month to month during the course of each year.

**Click for Information on How to Create the Basic View**

1. Connect to the **Sample - Superstore** data source.

2. Click and drag the **Order Date** field in the Data pane and drag it to the Columns shelf.
   
   The default date level is YEAR(Order Date).

3. Click and drag **Order Date** again and drop it this time on the Rows shelf.

4. Click on the right side of the field to open the context menu. Then choose **Quarter**.
You will see two options named **Quarter**. Be sure to choose the first one.

The field should now read **QUARTER(Order Date)**.

**Note:** If you are creating the view on the web, the menu looks a bit different.

5. Click and drag **Order Date** a third time and drop it on the Rows shelf to the right of **QUARTER(Order Date)**.

6. Click on the right side of the field to open the context menu and this time choose **Month** (again, choose the first of two options named **Month**). The field should now read **MONTH(Order Date)**.

7. Drag **Sales** from the Data pane and drop it on **Text** on the Marks card.

You now have the basic view, showing Sales by Order Date over a four-year period, by month, quarter, and year.

Follow these steps to add a **Percent Difference From** table calculation to the basic view.

1. Click the **SUM(Sales)** field on the Marks card and then select **Add table calculation**.

2. In the Table Calculation dialog box, choose **Percent Difference From** as the
Calculation Type.

3. Choose Table (Down) from the Compute Using list.

The highlighting in the view shows how this Compute Using value sets the scope of the calculation in the view:

<table>
<thead>
<tr>
<th>Quarter of O..</th>
<th>Month of Or..</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>-66%</td>
<td>-33%</td>
<td>23%</td>
<td>-55%</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>1,058%</td>
<td>215%</td>
<td>124%</td>
<td>166%</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>-49%</td>
<td>-11%</td>
<td>-23%</td>
<td>-26%</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>-16%</td>
<td>-12%</td>
<td>44%</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>46%</td>
<td>-18%</td>
<td>-30%</td>
<td>6%</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>-2%</td>
<td>16%</td>
<td>-3%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>-18%</td>
<td>28%</td>
<td>-13%</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>193%</td>
<td>75%</td>
<td>119%</td>
<td>47%</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>-62%</td>
<td>-51%</td>
<td>-23%</td>
<td>-14%</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>150%</td>
<td>142%</td>
<td>46%</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>-12%</td>
<td>-1%</td>
<td>18%</td>
<td>-19%</td>
</tr>
</tbody>
</table>

Comparing the values in the original text view with the values in this view, you can see that the result is correct. For example, in the original view we see that the January 2010 value is 530,288 and the February 2010 value is 318,309. In the updated view, the value for February 2010 is -39.9%, which is 39.9% less than 530,288.

4. Click the X in the upper-right corner of the Table Calculations dialog box to close it.

You also have the option to click Compute compounded rate if you want the calculation to be compounded.

Difference from what?

With a Difference From, Percent Difference From, or Percent From calculation, there are always two values to consider: the current value, and the value from which the difference should be calculated. In most cases, you want to calculate the difference between the current value and the previous value, as in the procedure above. But in some cases you may want something different:

<table>
<thead>
<tr>
<th>Previous</th>
<th>Next</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculates the difference between the current value and the previous value in the partition. This is the default value.</td>
<td>Calculates the difference between the current value and the next value in the partition.</td>
</tr>
</tbody>
</table>
At the level

Use this setting to set a break (that is, restart of the calculation) in the view, based on a particular dimension. How is this different from just using that dimension for partitioning? In fact, it is partitioning, but it’s partitioning by position rather than by value, which is how partitioning is defined with the **Compute Using** options.

The **At the level** option is only available when you select **Specific Dimensions** in the Table Calculations dialog box, and when more than one dimension is selected in the field immediately below the **Compute Using** options —that is, when more than one dimension is defined as an addressing field.

This option is not available when you’re defining a table calculation with **Compute Using**, because those values establish partitions by position. But with **Specific Dimensions**, because the visual structure and the table calculation are not necessarily aligned, the **At the level** option is available to let you fine-tune your calculation.

For an example of how the **At the level** option can affect a table calculation, see **Table Calculation Type: Difference From** on page 789.

**Table Calculation Type: Percent From**

For each mark in the view, a **Percent From** table calculation computes a value as a percentage of some other value—typically, as a percentage of the previous value in the table.

Suppose you are starting with the following text view, which shows sales totals broken out by year (from left to right) and by quarter and month (from top to bottom):
Instead of absolute sales values, you want to see how each Year/Quarter/Month value differs from the previous month’s value, as a percentage.

**Click for Information on How to Create the Basic View**

1. Connect to the **Sample - Superstore** data source.
2. Click and drag the **Order Date** field in the Data pane and drag it to the Columns shelf.
   The default date level is YEAR(Order Date).
3. Click and drag **Order Date** again and drop it this time on the Rows shelf.
4. Click on the right side of the field to open the context menu. Then choose **Quarter**.
You will see two options named **Quarter**. Be sure to choose the first one.

The field should now read **QUARTER(Order Date)**.

**Note:** If you are creating the view on the web, the menu looks a bit different.

5. Click and drag **Order Date** a third time and drop it on the Rows shelf to the right of **QUARTER(Order Date)**.

6. Click on the right side of the field to open the context menu and this time choose **Month** (again, choose the first of two options named **Month**). The field should now read **MONTH(Order Date)**.

7. Drag **Sales** from the Data pane and drop it on Text on the Marks card.

You now have the basic view, showing Sales by Order Date over a four-year period, by month, quarter, and year.

Follow these steps to add a **Percent From** table calculation to the basic view.

1. Click the **SUM(Sales)** field on the Marks card and then select **Add table calculation**.
2. In the Table Calculation dialog box, choose **Percent From** as the **Calculation Type**.
3. Choose **Table (Down)** from the **Compute Using** list.

   The highlighting in the view shows how this **Compute Using** value sets the scope of the calculation in the view:

<table>
<thead>
<tr>
<th>Quarter of Q..</th>
<th>Month of Or..</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>34%</td>
<td>67%</td>
<td>123%</td>
<td>45%</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>1,158%</td>
<td>315%</td>
<td>224%</td>
<td>266%</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>51%</td>
<td>89%</td>
<td>77%</td>
<td>74%</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>84%</td>
<td>88%</td>
<td>144%</td>
<td>114%</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>146%</td>
<td>82%</td>
<td>70%</td>
<td>106%</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>98%</td>
<td>116%</td>
<td>97%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>82%</td>
<td>128%</td>
<td>87%</td>
<td>127%</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>293%</td>
<td>175%</td>
<td>219%</td>
<td>147%</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>39%</td>
<td>49%</td>
<td>77%</td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>250%</td>
<td>242%</td>
<td>146%</td>
<td>144%</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>88%</td>
<td>99%</td>
<td>118%</td>
<td>81%</td>
</tr>
</tbody>
</table>

Comparing the values in the original text view with the values in this view, you can verify that the result is correct. For example, in the original view we see that the January 2011 value is 13,946 and the February 2011 value is 4,811. In the updated view, the value for February 2010 is 34%; you can verify that 4,811 is about 34% of 13,946.

4. Click the X in the upper-right corner of the Table Calculations dialog box to close it.

**Difference from what?**

With a **Difference From**, **Percent Difference From**, or **Percent From** calculation, there are always two values to consider: the current value, and the value from which the difference should be calculated. In most cases, you want to calculate the difference between the current value and the previous value, as in the procedure above. But in some cases you may want something different:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous</td>
<td>Calculates the difference between the current value and the previous value in the partition. This is the default value.</td>
</tr>
<tr>
<td>Next</td>
<td>Calculates the difference between the current value and the next value in the partition.</td>
</tr>
<tr>
<td>First</td>
<td>Calculates the difference between the current value and the first value in the partition.</td>
</tr>
<tr>
<td>Last</td>
<td>Calculates the difference between the current value and the last value in the partition.</td>
</tr>
</tbody>
</table>

At the level

Use this setting to set a break (that is, restart of the calculation) in the view, based on a particular dimension. How is this different from just using that dimension for partitioning? In fact, it is partitioning, but it’s partitioning by position rather than by value, which is how partitioning is defined with the Compute Using options.

The At the level option is only available when you select Specific Dimensions in the Table Calculations dialog box, and when more than one dimension is selected in the field immediately below the Compute Using options—that is, when more than one dimension is defined as an addressing field.

This option is not available when you’re defining a table calculation with Compute Using, because those values establish partitions by position. But with Specific Dimensions, because the visual structure and the table calculation are not necessarily aligned, the At the level option is available to let you fine-tune your calculation.

For an example of how the At the level option can affect a table calculation, see Table Calculation Type: Difference From on page 789.

**Table Calculation Type: Percent of Total**

For each mark in the view, a Percent of Total table calculation computes a value as a percentage of all values in the current partition.

Suppose you are starting with the following text view, which shows sales totals broken out by year (from left to right) and by quarter and month (from top to bottom):
Instead of absolute sales values, you want to see the percentage that each month contributes to each year’s total sales. So, for example, you want to see what percent of 2010 sales were realized in January of 2010, what percent in February, and so on.

**Click for Information on How to Create the Basic View**

1. Connect to the **Sample - Superstore** data source.

2. Click and drag the **Order Date** field in the Data pane and drag it to the Columns shelf.
   
   The default date level is **YEAR(Order Date)**.

3. Click and drag **Order Date** again and drop it this time on the Rows shelf.

4. Click on the right side of the field to open the context menu. Then choose **Quarter**.
You will see two options named **Quarter**. Be sure to choose the first one.

The field should now read **QUARTER(Order Date)**.

**Note:** If you are creating the view on the web, the menu looks a bit different.

5. Click and drag **Order Date** a third time and drop it on the Rows shelf to the right of **QUARTER(Order Date)**.

6. Click on the right side of the field to open the context menu and this time choose **Month** (again, choose the first of two options named **Month**). The field should now read **MONTH(Order Date)**.

7. Drag **Sales** from the Data pane and drop it on Text on the Marks card.

You now have the basic view, showing Sales by Order Date over a four-year period, by month, quarter, and year.

Follow these steps to add a **Percent of Total** table calculation to the basic view.

1. Click the **SUM(Sales)** field on the Marks card and then select **Add table calculation**.

2. In the Table Calculation dialog box, choose **Percent of Total** as the **Calculation Type**.
3. Choose **Table (Down)** from the **Compute Using** list. The highlighting in the view shows how this **Compute Using** value sets the scope of the calculation in the view:

<table>
<thead>
<tr>
<th>Quarter of D..</th>
<th>Month of Or..</th>
<th>Order Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2014</td>
</tr>
<tr>
<td>Q1</td>
<td>January</td>
<td>2.88%</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>0.99%</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>11.50%</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>5.84%</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>4.88%</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>7.14%</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>7.01%</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>5.76%</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>16.89%</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>6.50%</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>16.24%</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>14.36%</td>
</tr>
</tbody>
</table>

Comparing the values in the original text view with the values in this view verifies that the result is correct. For example, the 12 values in the view for 2011 add up to 100%.

4. Click the X in the upper-right corner of the Table Calculations dialog box to close it.

Choose **Compute across all pages** if you want the calculation to take account of any dimension on the Pages shelf.

**At the level**

Use this setting to set a break (that is, restart the calculation) in the view, based on a particular dimension. How is this different from just using that dimension for partitioning? In fact, it is partitioning, but it’s partitioning by position rather than by value, which is how partitioning is defined with the **Compute Using** options.

The **At the level** option is only available when you select **Specific Dimensions** in the Table Calculations dialog box, and when more than one dimension is selected in the field immediately below the **Compute Using** options —that is, when more than one dimension is defined as an addressing field.

This option is not available when you’re defining a table calculation with **Compute Using**, because those values establish partitions by position. But with **Specific Dimensions**, because the visual structure and the table calculation are not necessarily aligned, the **At the level** option is available to let you fine-tune your calculation.
Table Calculation Type: Rank

For each mark in the view, a Rank table calculation computes a ranking for each value in a partition.

Suppose you are starting with the following text view, which shows sales totals broken out by year (from left to right) and by quarter and month (from top to bottom):

<table>
<thead>
<tr>
<th>Quarter of O..</th>
<th>Month of O..</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td>$13,946</td>
<td>$18,174</td>
<td>$18,542</td>
<td>$44,703</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>$4,811</td>
<td>$12,211</td>
<td>$22,868</td>
<td>$20,284</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>$55,691</td>
<td>$38,467</td>
<td>$51,186</td>
<td>$53,909</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>$28,295</td>
<td>$34,195</td>
<td>$39,249</td>
<td>$40,112</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>$23,648</td>
<td>$30,132</td>
<td>$56,691</td>
<td>$45,651</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>$34,595</td>
<td>$24,797</td>
<td>$39,430</td>
<td>$48,260</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>$33,946</td>
<td>$28,765</td>
<td>$38,441</td>
<td>$48,428</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>$27,909</td>
<td>$36,896</td>
<td>$33,266</td>
<td>$61,516</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>$81,777</td>
<td>$64,596</td>
<td>$72,908</td>
<td>$90,489</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>$31,453</td>
<td>$31,405</td>
<td>$56,463</td>
<td>$77,794</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>$78,629</td>
<td>$75,973</td>
<td>$82,192</td>
<td>$112,326</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>$69,546</td>
<td>$74,920</td>
<td>$97,237</td>
<td>$90,475</td>
</tr>
</tbody>
</table>

Instead of absolute sales values, you want to see how each month within a given year ranks in total sales, from most sales (ranked 1) to least sales (ranked 12).

**Click for Information on How to Create the Basic View**

1. Connect to the **Sample - Superstore** data source.
2. Click and drag the **Order Date** field in the Data pane and drag it to the Columns shelf.
   The default date level is YEAR(Order Date).
3. Click and drag **Order Date** again and drop it this time on the Rows shelf.
4. Click on the right side of the field to open the context menu. Then choose **Quarter**.
You will see two options named **Quarter**. Be sure to choose the first one.

The field should now read **QUARTER(Order Date)**.

**Note:** If you are creating the view on the web, the menu looks a bit different.

5. Click and drag **Order Date** a third time and drop it on the Rows shelf to the right of **QUARTER(Order Date)**.

6. Click on the right side of the field to open the context menu and this time choose **Month** (again, choose the first of two options named **Month**). The field should now read **MONTH(Order Date)**.

7. Drag **Sales** from the Data pane and drop it on Text on the Marks card.

You now have the basic view, showing Sales by Order Date over a four-year period, by month, quarter, and year.

Follow these steps to add a **Rank** table calculation to the basic view.

1. Click the **SUM(Sales)** field on the Marks card and then select **Add table calculation**.
2. In the Table Calculation dialog box, choose **Rank** as the **Calculation Type**.
3. Choose Table (Down) from the Compute Using list.

The highlighting in the view shows how this Compute Using value sets the scope of the calculation in the view:

![Table with calculation results]

Comparing the values in the original text view with the values in this view shows that the result is correct. The values run from 1 to 12, and the highest sales total in 2011, for September (81,777), is ranked 1 in the updated view, while the second highest value, for November (78,629) is ranked 2 in the updated view.

4. Click the X in the upper-right corner of the Table Calculations dialog box to close it.

**Descending vs. Ascending**

**Ascending** order ranks values from least to most. **Descending** order ranks values from most to least. For Rank table calculation, the default value is **Descending**.

**Rank Type**

One issue with **Rank** calculations is that there may be more than one mark with the same value. What would happen, for example, if Tables in the Central region and Appliances in the South region both had sales of exactly $36,729? Tableau lets you specify how to handle such cases by including an additional field in the Table Calculation dialog box when you set **Calculation Type** to **Rank**.

The choices are listed below. The number sequence at the beginning of each option show how each option would rank a hypothetical set of four values where two of the values are identical:

<table>
<thead>
<tr>
<th>Option</th>
<th>Result</th>
</tr>
</thead>
</table>
Competition \((1, 2, 2, 4)\) | Identical values are assigned an identical rank. The highest value is ranked 1 and then the next two, identical values, are both ranked 2. The next value is then ranked 4.

Modified Competition \((1, 3, 3, 4)\) | Identical values are assigned an identical rank. The highest value is ranked 1 and then the next two, identical values, are both ranked 3. The next value is then ranked 4.

Dense \((1, 2, 2, 3)\) | Duplicate values are all given the same rank, which is the next number in the ranking sequence. The next value after the duplicate values is computed as though the duplicate values were a single value.

Unique \((1, 2, 3, 4)\) | Duplicate values are given unique rankings, according to the direction in which the ranking is being computed.

**Table Calculation Type: Percentile**

For each mark in the view, a **Percentile** table calculation computes a percentile rank for each value in a partition.

Suppose you are starting with the following text view, which shows sales totals broken out by year (from left to right) and by quarter and month (from top to bottom):

<table>
<thead>
<tr>
<th>Quarter of Order</th>
<th>Month of Order</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td>$13,946</td>
<td>$18,174</td>
<td>$18,542</td>
<td>$44,703</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>$4,811</td>
<td>$12,211</td>
<td>$22,868</td>
<td>$20,284</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>$55,691</td>
<td>$38,467</td>
<td>$51,186</td>
<td>$53,909</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>$28,295</td>
<td>$54,195</td>
<td>$39,249</td>
<td>$40,112</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>$23,648</td>
<td>$30,132</td>
<td>$56,691</td>
<td>$45,651</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>$34,595</td>
<td>$24,797</td>
<td>$39,430</td>
<td>$48,260</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>$33,946</td>
<td>$28,765</td>
<td>$30,441</td>
<td>$48,428</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>$27,909</td>
<td>$36,898</td>
<td>$33,266</td>
<td>$61,516</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>$81,777</td>
<td>$64,596</td>
<td>$72,908</td>
<td>$90,489</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>$31,453</td>
<td>$31,405</td>
<td>$56,463</td>
<td>$77,794</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>$78,629</td>
<td>$75,973</td>
<td>$82,192</td>
<td>$112,326</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>$69,546</td>
<td>$74,920</td>
<td>$97,237</td>
<td>$90,475</td>
</tr>
</tbody>
</table>

Instead of absolute sales values, you want to see the values for each month in a given year expressed as a percentile. With this kind of table calculation, the lowest ranked value is
assigned the 0 percentile and the highest ranked value is assigned the 100 percentile (assuming the calculation is working in ascending order, which is the default). All other values are assigned a percentile based on their ranking. So for a set of four values, 1, 3, 22, 67, the percentiles would be 0%, 33%, 67%, and 100%, respectively.

Click for Information on How to Create the Basic View

1. Connect to the **Sample - Superstore** data source.
2. Click and drag the **Order Date** field in the Data pane and drag it to the Columns shelf. The default date level is **YEAR(Order Date)**.
3. Click and drag **Order Date** again and drop it this time on the Rows shelf.
4. Click on the right side of the field to open the context menu. Then choose **Quarter**.

![Image showing how to create the Basic View](image)

You will see two options named **Quarter**. Be sure to choose the first one.

The field should now read **QUARTER(Order Date)**.

Note: If you are creating the view on the web, the menu looks a bit different.
5. Click and drag Order Date a third time and drop it on the Rows shelf to the right of QUARTER(Order Date).

6. Click on the right side of the field to open the context menu and this time choose Month (again, choose the first of two options named Month). The field should now read MONTH(Order Date).

7. Drag Sales from the Data pane and drop it on Text on the Marks card.

You now have the basic view, showing Sales by Order Date over a four-year period, by month, quarter, and year.

Follow these steps to add a Percentile table calculation to the basic view.

1. Click the SUM(Sales) field on the Marks card and then select Add table calculation.
2. In the Table Calculation dialog box, choose Percentile as the Calculation Type.
3. Choose Table (Down) from the Compute Using list.

The highlighting in the view shows how this Compute Using value sets the scope of the calculation in the view:

<table>
<thead>
<tr>
<th>Quarter of Q..</th>
<th>Month of Or..</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td>9.1%</td>
<td>9.1%</td>
<td>0.0%</td>
<td>18.2%</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>0.0%</td>
<td>0.0%</td>
<td>9.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>72.7%</td>
<td>72.7%</td>
<td>54.5%</td>
<td>54.5%</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>36.4%</td>
<td>54.5%</td>
<td>36.4%</td>
<td>9.1%</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>18.2%</td>
<td>36.4%</td>
<td>72.7%</td>
<td>27.3%</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>63.6%</td>
<td>18.2%</td>
<td>45.5%</td>
<td>36.4%</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>54.5%</td>
<td>27.3%</td>
<td>27.3%</td>
<td>45.5%</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>27.3%</td>
<td>63.6%</td>
<td>18.2%</td>
<td>63.6%</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>100.0%</td>
<td>81.8%</td>
<td>81.8%</td>
<td>90.9%</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>45.5%</td>
<td>45.5%</td>
<td>63.6%</td>
<td>72.7%</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>90.9%</td>
<td>100.0%</td>
<td>90.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>81.8%</td>
<td>90.9%</td>
<td>100.0%</td>
<td>81.8%</td>
</tr>
</tbody>
</table>

Comparing the values in the original text view with the values in this view verifies that the result is correct. The lowest value in the original text table was February (4,711); in the new text view, February is 0.0%; the next lowest value in the original table was January (13,946); in the new view, January is 9.1%.
Descending vs. Ascending

Ascending order ranks values from least to most. Descending order ranks values from most to least. For a Percentile table calculation, the default value is Ascending.

Table Calculation Type: Running Total

For each mark in the view, a Running Total table calculation aggregates values cumulatively in a partition. It can do this by summing values, averaging values, or replacing all values with either the lowest or highest actual value.

Suppose you are starting with the following text view, which shows sales totals broken out by year (from left to right) and by quarter and month (from top to bottom):

Instead of absolute sales values, you want to see a running total of sales for each year, such that each month’s sales are added to all previous months’ sales.

Click for Information on How to Create the Basic View

1. Connect to the Sample - Superstore data source.
2. Click and drag the Order Date field in the Data pane and drag it to the Columns shelf. The default date level is YEAR(Order Date).
3. Click and drag Order Date again and drop it this time on the Rows shelf.
4. Click on the right side of the field to open the context menu. Then choose Quarter.
You will see two options named **Quarter**. Be sure to choose the first one.

The field should now read **QUARTER(Order Date)**.

**Note:** If you are creating the view on the web, the menu looks a bit different.

5. Click and drag **Order Date** a third time and drop it on the Rows shelf to the right of **QUARTER(Order Date)**.

6. Click on the right side of the field to open the context menu and this time choose **Month** (again, choose the first of two options named **Month**). The field should now read **MONTH(Order Date)**.

7. Drag **Sales** from the Data pane and drop it on **Text** on the Marks card.

You now have the basic view, showing Sales by Order Date over a four-year period, by month, quarter, and year.

Follow these steps to add a **Running Total** table calculation to the basic view.

1. Click the **SUM(Sales)** field on the Marks card and choose **Add table calculation**.

2. In the Table Calculation dialog box, choose **Running Total** as the **Calculation Type**.
3. Choose **Table (Down)** from the **Compute Using** list.

   The highlighting in the view shows how this **Compute Using** value sets the scope of the calculation in the view:

   ![Table](image)

   Comparing the values in the original text view with the values in this view shows that the result is correct. The monthly values ascend steadily and the December value (484,247) is the same value you see if you show column grand totals (from the Analysis menu, select **Totals > Show column grand totals**).

4. Click the X in the upper-right corner of the Table Calculations dialog box to close it.

   **The Running Total Doesn’t Have to Be a Sum**

   For a **Running Total** table calculation, Tableau can update values cumulatively in other ways than summing. Choose one of the options from the drop-down list just below the **Calculation Type** field:

<table>
<thead>
<tr>
<th>Option</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum</td>
<td>Each value is added to the previous value.</td>
</tr>
<tr>
<td>Average</td>
<td>The running total averages the current and all previous values.</td>
</tr>
<tr>
<td>Minimum</td>
<td>All values are replaced with the lowest value in the original partition.</td>
</tr>
<tr>
<td>Maximum</td>
<td>All values are replaced with the highest value in the original partition.</td>
</tr>
</tbody>
</table>
Restarting Every

Use this setting to set a break (that is, restart of the calculation) in the view, based on a particular dimension.

**Restarting every** can be useful in the following situations:

- With dates or other hierarchies, if you restart every month, as you bring in Year or Quarter, Tableau knows to partition automatically.
- With non-hierarchies, **Restarting every** affects the sorting. If you want to address on **Products** and partition by **State**, but you want the products sorted by **SUM(Sales)** within each state, you need to include **States** as an addressing field under **Specific Dimensions**, but then restart every state. Otherwise, the sort by **SUM(Sales)** would be based on each product's sum of sales across all states.

The **Restarting every** option is only available when you select **Specific Dimensions** in the Table Calculations dialog box and when more than one dimension is selected in the field immediately below the **Compute Using** options—that is, when more than one dimension is defined as an addressing field.

This option is not available when you’re defining a table calculation with **Compute Using**.

For example, if you take the result of the **Running Total** calculation you added above, you can see the effect of **Restarting every** by doing the following:

1. Click the **SUM(Sales)** field on the Marks card and choose **Edit table calculation**.
2. In the Table Calculation dialog box, choose **Specific Dimensions**.
   
   Notice that two dimensions are now checked in the list box of dimensions: **Quarter of Order Date** and **Month of Order Date**. These are the addressing fields, and because more than one field is being used for addressing, **Restarting every** is now available.

   The choices available from the **At the level** drop-down list are:

<table>
<thead>
<tr>
<th>None</th>
<th>Specifies that the calculation should be performed at the level of greatest granularity. This is the default option. This option does not change the view.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarter of Order Date</td>
<td>Specifies that the calculation should be performed at the quarter level.</td>
</tr>
</tbody>
</table>

3. If you choose **Quarter of Order Date**, the view updates to show the effect of this change:
The calculation now restarts after every quarter. If you click out of the Table Calculations dialog box (to dismiss the highlighting) you can see this more clearly.

4. Click the X in the upper-right corner of the Table Calculations dialog box to close it.

Add Secondary Calculation

With **Running Total** and **Moving Calculation** table calculations, you have the option to transform values twice to obtain the result you want—that is, to add a secondary table calculation on top of the primary table calculation. For example, you could add an initial table calculation to calculate the running total for sales per month within each individual year, and then a secondary calculation to calculate the year-over-year percent difference for each month from one year to the next.

To do this, first add the primary table calculation, as shown above. Then continue as follows:

1. Click the **SUM(Sales)** field on the Marks card and select **Edit table calculation**.

2. In the Table Calculation dialog box, click **Add Secondary Calculation**.

   The Table Calculation dialog box expands to show a second panel:
3. In the second panel, choose **Percent Difference From** as the **Secondary Calculation Type**.

4. You do not need to change the **Compute Using** selection: **Table (Across)** is the right option.

5. Click the X in the upper-right corner to dismiss the Table Calculation dialog box.

   Now your view shows what you needed: a year-over-year percent difference of a running total:
Table Calculation Type: Moving Calculation

For each mark in the view, a Moving Calculation table calculation determines the value for a mark in the view by performing an aggregation (sum, average, minimum, or maximum) across a specified number of values before and/or after the current value.

A moving calculation is typically used to smooth short-term fluctuations in your data so that you can see long-term trends. For example, with securities data there are so many fluctuations every day that it is hard to see the big picture through all the ups and downs. You can use a moving calculation to define a range of values to summarize using an aggregation of your choice.

Suppose you are starting with the following text view, which shows sales totals broken out by year (from left to right) and by quarter and month (from top to bottom):
Instead of absolute sales values, you want to find out how sales totals are trending over time. To do this, you transform each monthly total so that it averages the monthly total for the two previous months and the current month. So instead of seeing just raw sales totals for October, 2010 (for example), you want to replace that number with a number that averages sales for August, September, and October.

Click for Information on How to Create the Basic View

1. Connect to the Sample - Superstore data source.
2. Click and drag the Order Date field in the Data pane and drag it to the Columns shelf. The default date level is YEAR(Order Date).
3. Click and drag Order Date again and drop it this time on the Rows shelf.
4. Click on the right side of the field to open the context menu. Then choose Quarter.
You will see two options named **Quarter**. Be sure to choose the first one.

The field should now read **QUARTER(Order Date)**.

**Note:** If you are creating the view on the web, the menu looks a bit different.

5. Click and drag **Order Date** a third time and drop it on the Rows shelf to the right of **QUARTER(Order Date)**.

6. Click on the right side of the field to open the context menu and this time choose **Month** (again, choose the first of two options named **Month**). The field should now read **MONTH(Order Date)**.

7. Drag **Sales** from the Data pane and drop it on Text on the Marks card.

You now have the basic view, showing Sales by Order Date over a four-year period, by month, quarter, and year.

Follow these steps to add a **Moving Calculation** table calculation to the basic view.

1. Click the **SUM(Sales)** field on the Marks card and then click **Add table calculation**.

2. In the Table Calculation dialog box, choose **Moving Calculation** as the **Calculation**
Type.

3. Click in the drop-down list below the Calculation Type option to display the options that you use to configure the calculation:

4. Choose from the drop-down list of available aggregations: Sum, Average, Minimum, or Maximum. In this case, you want Average.

5. Using the Previous values option, specify how many marks preceding the current mark should be included in calculating the average. In this case, you want 2.

6. Using the Next values option, specify how many marks following the current mark should be included in calculating the average. In this case, you want 0.

7. Click Current value to indicate that you want the current value to be included in the calculation.

8. Do not click Null if there are not enough values. You can select this option if you want the current value to be null if there are not enough previous or next values to perform the calculation as specified. When you do not click this option, Tableau will use as many of the values within the specified range as are available.

When you close the drop-down list, Tableau shows a summary of the options you have chosen:
Choose **Table (Down then Across)** from the **Compute Using** list.

This will cause the calculation to run through the entire time range—from January 2010 to December 2013.

Your view is now "smoothed" to show how sales numbers are trending over time:

<table>
<thead>
<tr>
<th>Quarter of</th>
<th>Month of Order</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td>$13,946</td>
<td>$166,348</td>
<td>$169,435</td>
<td>$224,133</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>$18,757</td>
<td>$99,931</td>
<td>$116,330</td>
<td>$162,224</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>$74,448</td>
<td>$88,852</td>
<td>$92,596</td>
<td>$118,896</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>$88,797</td>
<td>$84,873</td>
<td>$113,805</td>
<td>$114,305</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>$107,635</td>
<td>$102,794</td>
<td>$147,126</td>
<td>$139,673</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>$86,539</td>
<td>$89,124</td>
<td>$135,370</td>
<td>$134,023</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>$92,190</td>
<td>$33,694</td>
<td>$134,562</td>
<td>$142,339</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>$96,451</td>
<td>$90,461</td>
<td>$111,137</td>
<td>$158,204</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>$143,633</td>
<td>$130,260</td>
<td>$144,614</td>
<td>$200,433</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>$141,140</td>
<td>$132,899</td>
<td>$162,637</td>
<td>$229,799</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>$191,659</td>
<td>$171,973</td>
<td>$211,564</td>
<td>$280,609</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>$179,628</td>
<td>$132,297</td>
<td>$235,893</td>
<td>$280,595</td>
</tr>
</tbody>
</table>

10. Click the X in the upper-right corner of the Table Calculations dialog box to close it.

**Add Secondary Calculation**

With **Running Total** and **Moving Calculation** table calculations, you have the option to transform values twice to obtain the result you want—that is, to add a secondary table calculation on top of the primary table calculation. For example, you could add an initial table calculation to calculate the running total for sales per month within each individual year, and then a secondary calculation to calculate the year-over-year percent difference for each month from one year to the next.

For an example showing how to create a secondary calculation, see **Table Calculation Type: Running Total** on page 811.
Customize Table Calculations

You can always customize a table calculation by editing it in the Table Calculations dialog box, but there are other, more specialized ways to customize a table calculation.

Customizing a Table Calculation Using Its Context Menu

Click any field in the view to see a context menu listing ways to customize the field. For a field in the view that has a table calculation, you can change the Compute Using option—that is, the option that determines the direction and scope of the calculation relative to the visual structure of the view. Do this by clicking the field and then choosing an option from the Compute Using list.

For Difference From, Percent Difference From, and Percent From table calculations, you can also specify a different field from which the difference should be computed. Do this by clicking the field and then choosing an option from the Relative to list. The options are Previous, Next, First, and Last.

Customizing a Table Calculation Using the Calculation Editor

You can customize a table calculation by dragging it into the calculation editor:

When you edit a table calculation in the calculation editor, you can click Default Table Calculation in the lower-right corner of the editor to open the calculation in the Table Calculation dialog box. This will allow you to create a new named calculated field that uses the same table calculation as the one you are basing the calculation on.
Nested Table Calculations

A nested table calculation can be one of two types of calculated fields:

- A calculated field that includes more than one calculated field with a table calculation (as in the example below), or
- A calculated field that itself has a table calculation and includes at least one calculated field with a table calculation.

With nested table calculations, you can set **Compute Using** configurations for individual calculations independently.

Here is a scenario you can try, using the Sample - Superstore data source that is included with Tableau Desktop, which results in a nested table calculation.

1. Drag **Sub-Category** to Columns and **Region** to Rows.
2. Create a calculated field, **1-nest**, with the definition `TOTAL(SUM([Sales]))`.
   TOTAL is a table calculation function, so this calculated field automatically has a table calculation—when you use it in the view, the field will have the tell-tale table triangle, indicating a table calculation:

   ![1-nest](image)

   For information on table calculation functions, see Table Calculation Functions on page 1393.

3. Create a second calculated field, **2-nest**, with the definition `TOTAL(SUM([Profit]))`.
4. Create a third calculated field, **3-nest**, with the definition `[1-nest] + [2-nest]`.
5. Drag **3-nest** and drop it to the right of **Sub-Category** on Columns.
6. Click **3-nest** on Columns and choose **Edit Table Calculation**.
   In the Table Calculations dialog box, you can now separately configure the underlying
Level of Detail Expressions

Level of detail expressions support aggregation at dimensionalities other than the view level. With level of detail expressions, you can attach one or more dimensions to any aggregate expression.

Unlike table calculations, totals, or reference lines, level of detail expressions are computed in the data source. On the plus side, this lets you avoid the overhead of bringing all the data from the database to your computer over the network. With large data sources, this can be a huge performance gain. On the minus side, this can cause Tableau to run more complicated queries (for example, containing many joins), and if the underlying data source is slow, performance can suffer.

Overview: Level of Detail Expressions

Level of detail expressions (which are sometimes also referred to as "LOD Expressions" or "LOD Calculations") are useful for a variety of use cases, including:

- Cohort analysis – comparing data for different subgroups
- Totals or averages across segments
- Aggregates of aggregates
- Binning aggregates

**Background: Row Level Expressions and View Level Expressions**

In Tableau, expressions referencing **unaggregated** datasource columns are computed for each row in the underlying table. In this case, the dimensionality of the expression is *row level*. An example of a row-level expression is:

\[
\frac{\text{[Sales]}}{\text{[Profit]}}
\]

This calculation will be evaluated in each row of the database. For each row, the Sales value in that row will be divided by the Profit value in that row, producing a new column with the result of the multiplication (a profit ratio).

If you create a calculation with this definition, save it with the name **[ProfitRatio]**, and then drag it from the Data pane to a shelf, Tableau typically aggregates the calculated field for the view:

\[
\text{SUM}[\text{ProfitRatio}]
\]

By contrast, expressions referencing **aggregated** data source columns are computed at the dimensionality defined by the dimensions in the view. In this case, the dimensionality of the expression is *view level*. An example of a view-level expression is:

\[
\frac{\text{SUM}(\text{Sales})}{\text{SUM}(\text{Profit})}
\]

If you drag this calculation to a shelf (or type it directly on a shelf as an ad-hoc calculation), Tableau encloses it in an AGG function:

**AGG(SUM(Sales) / SUM(Profit))**

This is what is known as an aggregate calculation. For details, see **Aggregate Calculations on page 762**.

Dimension and set fields placed on any of the locations highlighted in the following image contribute to the view level of detail:
Before level of detail expressions were supported in Tableau, it was not possible to create calculations at a level of detail other than the view level. For example, if you attempt to save the following expression, Tableau displays the error message: “Cannot mix aggregate and non-aggregate arguments with this function”:

\[ \text{[Sales]} - \text{AVG([Sales])} \]

The user’s intent in this case was to compare store sales for each individual store to the average of sales for all stores. This can now be accomplished with a level of detail expression:

\[ \text{[Sales]} - \{\text{AVG([Sales])}\} \]

This is what is known as a table-scoped level of detail expression. See Table-Scoped Level of Detail Expressions on page 830

**Level of Detail Expression Syntax**

A level of detail expression has the following structure:

\{[\text{FIXED} \mid \text{INCLUDE} \mid \text{EXCLUDE}] \text{ <dimension declaration > : <aggregate expression>}\}

The elements in a level of detail expression are described in the following table.

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>{}</td>
<td>The entire level of detail expression is enclosed in curly braces.</td>
</tr>
<tr>
<td>[FIXED \mid \text{INCLUDE} \mid \text{EXCLUDE}]</td>
<td>The first element after the opening curly brace is one of the following scoping</td>
</tr>
</tbody>
</table>
keywords:

- **FIXED**
  
  FIXED level of detail expressions compute values using the specified dimensions without reference to the view level of detail—that is, without reference to any other dimensions in the view.

  FIXED level of detail expressions also ignore all the filters in the view other than context filters, data source filters, and extract filters.

  **Example:** \{ FIXED [Region] : SUM([Sales]) \}

  See **FIXED Level of Detail Expressions** on page 831.

- **INCLUDE**
  
  INCLUDE level of detail expressions compute values using the specified dimensions in addition to whatever dimensions are in the view.

  INCLUDE level of detail expressions are most useful when including a dimension that isn’t in the view.

  **Example:** \{ INCLUDE [Customer Name] : SUM([Sales]) \}

  See **INCLUDE Level of Detail Expressions** on page 833.

- **EXCLUDE**
  
  EXCLUDE level of detail expressions explicitly remove dimensions from the expression—that is, they subtract dimensions from the view level of detail.

  EXCLUDE level of detail expressions are most useful for eliminating a dimension in the view.
| **<dimension declaration>** | Specifies one or more dimensions to which the aggregate expression is to be joined. Use commas to separate dimensions. For example:

```
[Segment], [Category], [Region]
```

For level of detail expressions, you can use any expression that evaluates as dimension in a dimensionality declaration, including Date expressions.

This example will aggregate the sum of Sales at the Year level:

```
{FIXED YEAR([Order Date]) : SUM(Sales)}
```

This example will aggregate the sum of Sales for the [Order Date] dimension, truncated to the day date part. Because it is an INCLUDE expression, it will also use the dimensions in the view to aggregate the value: |
Note: It is strongly recommended that you drag fields into the calculation editor when creating dimension declarations, instead of typing them. For example, if you see `YEAR ([Order Date])` on a shelf and then type that as the dimension declaration, it will not match the field on the shelf. But if you drag the field from the shelf into the expression, it will become `DATEPART('year', [Order Date])`, and that will match the field on the shelf.

With named calculations (that is, calculations that you save to the Data pane, as opposed to ad-hoc calculations, which you do not name), Tableau cannot match the name of a calculation to its definition. So if you create a named calculation, `MyCalculation`, defined as follows:

\[ MyCalculation = \text{YEAR}([\text{Order Date}]) \]

And then you created the following EXCLUDE level of detail expression and used it in the view:

\{EXCLUDE \text{YEAR}([\text{Order Date}]) : \text{SUM}(\text{Sales})\}

Then `MyCalculation` would not be excluded. Similarly, if the EXCLUDE expression specified `MyCalculation`:

\{EXCLUDE MyCalculation : \text{SUM}(\text{Sales})\}

Then `\text{YEAR}([\text{Order Date}])` would not be excluded.

A colon separates the dimension declaration
<table>
<thead>
<tr>
<th>&lt;aggregate expression&gt;</th>
<th>from the aggregate expression.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The aggregate expression is the calculation performed to define the target dimensionality.</td>
<td></td>
</tr>
</tbody>
</table>

**Limitations for Level of Detail Expressions**

The following limitations and constraints apply for level of detail expressions. Also see [Data Source Constraints for Level of Detail Expressions](#) on page 843.

- Level of detail expressions that reference floating-point measures can behave unreliably when used in a view that requires comparison of the values in the expression. For details, see [Data Types](#) on page 1358.
- Level of detail expressions are not shown on the Data Source page. See [Data Source Page](#) on page 126.
- When referencing a parameter in a dimensionality declaration, always use the parameter name, and not the parameter value.
- With data blending, the linking field from the primary data source must be in the view before you can use a level of detail expression from the secondary data source. See the Knowledge Base article [Data Blending Limitations with COUNTD, MEDIAN, and RAWSQLAGG](#).

In addition, some data sources have complexity limits. Tableau will not disable calculations for these databases, but query errors are a possibility if calculations become too complex.

**Level of Detail Expressions Can Be Dimensions or Measures**

When you save a level of detail expression, Tableau adds it to either Dimensions or Measures.

FIXED level of detail expressions can result in measures or dimensions, depending on the underlying field in the aggregate expression. So MIN([Date]) will be a dimension because [Date] is a dimension, and {fixed Store : SUM([Sales])} will be a measure because [Sales] is a measure. When a FIXED level of detail expression is saved as a measure you have the option of moving it to dimensions.

INCLUDE and EXCLUDE level of detail expressions are always measures.

**Table-Scoped Level of Detail Expressions**

It is possible to define a level of detail expression at the table level without using any of the scoping keywords. For example, the following expression returns the minimum (earliest) order date for the entire table:

{MIN([Order Date])}

This is equivalent to a FIXED level of detail expression with no dimension declaration:
FIXED Level of Detail Expressions

FIXED level of detail expressions compute a value using the specified dimensions, without reference to the dimensions in the view.

The following examples can be recreated using the Sample - Superstore data source.

Example 1

The following FIXED level of detail expression computes the first purchase date for each customer in the data source:

{FIXED [Customer Name] : MIN([Order Date])}

The resulting field, saved as [First Purchase Date], is then used in a second calculated field to compute the interval between a customer's first purchase date and any subsequent purchase:

DATETRUNC('month', [Order Date]) - DATETRUNC('month', [First Purchase Date])

By placing this calculated field, saved as [Days Since First Purchase], on the Columns shelf, and a running total of sales on the Rows shelf, you can show customer buying behavior over time, as measured by days since first purchase:
Example 2

The following FIXED level of detail expression computes the sum of sales per region:

{FIXED [Region] : SUM([Sales])}

This level of detail expression, named [Sales by Region], is then placed on Text to show total sales per region:

The view level of detail is [Region] plus [State], but because FIXED level of detail expressions do not consider the view level of detail, the calculation only uses the [Region] dimension, and so the values for the individual states in each region are identical. See Level of Detail Expressions and Aggregation on page 839 for an explanation of why this is so.

If the INCLUDE keyword had been used in the level of detail expression instead of FIXED, the values would be different for each state, because Tableau would add the dimension in the expression ([Region]) with any additional dimensions in the view ([State]) in determining values for the expression. The result would be:
**INCLUDE Level of Detail Expressions**

INCLUDE level of detail expressions compute values using the specified dimensions in addition to whatever dimensions are in the view.

INCLUDE level of detail expressions can be useful when you want to calculate at a fine level of detail in the database and then re-aggregate and show at a coarser level of detail in your view. Fields based on INCLUDE level of detail expressions will change as you add or remove dimensions from the view.

**Example 1**

The following INCLUDE level of detail expression computes total sales per customer:

```
{ INCLUDE [Customer Name] : SUM([Sales]) }
```

When that calculation is placed on the **Rows** shelf, aggregated as AVG, and the **[Region]** dimension is placed on the **Columns** shelf, the view shows the average customer sales amount per region:
If the [Sales] measure is then dragged to the Rows shelf, the result illustrates the difference between the average sale (somewhere between $200 and $250 per region) and the average sale per customer (between $750 and $1100 per region):
Example 2

The following INCLUDE level of detail expression calculates sum of sales on a per-state basis:

{ INCLUDE [State] : SUM(Sales) }

Type the calculation directly on the Rows shelf, and then change the aggregation to AVG using the field's context menu. The resulting view averages the sum of sales by state across categories.
The view can be further enhanced by adding [Segment] to Columns and then copying the ad-hoc calculation from Rows to Label (using Ctrl+drag). In the image below we also dragged Segment to Color and then edited the colors for aesthetic effect. Now we can see how the average sum of sales per state varies across categories and segments.
EXCLUDE Level of Detail Expressions

EXCLUDE level of detail expressions declare dimensions to omit from the view level of detail. EXCLUDE level of detail expressions are useful for ‘percent of total’ or ‘difference from overall average’ scenarios. They are comparable to such features as Totals and Reference Lines.

EXCLUDE level of detail expression cannot be used in row-level expressions (where there are no dimensions to omit), but can be used to modify either a view level calculation or anything in between (that is, you can use an EXCLUDE calculation to remove dimension from some other level of detail expression).

Example 1

The following EXCLUDE level of detail expression computes the average sales total per month and then excludes the month component:

\[
\{\text{EXCLUDE } [\text{Order Date (Month / Year)}] : \text{AVG}\{\{\text{FIXED } [\text{Order Date (Month / Year)}] : \text{SUM}\{[\text{Sales}]}\}\}\}\]

Notice that this is a nested level of detail expression—that is, a level of detail expression within another level of detail expression.

Saved as [average of sales by month], the calculation can then be subtracted from the sum of sales per month by means of an ad-hoc calculation on the **Rows** shelf:
With **Month**([Order Date]) on the **Columns** shelf, this creates a view that shows the difference between actual sales per month over a four-year period and the average monthly sales for the entire four-year period:

![Chart showing difference between actual sales and average sales per month over a four-year period.](image)

**Example 2**

The following level of detail expression excludes **Region** from a calculation of the sum of **Sales**:

\{EXCLUDE [Region]: SUM([Sales])\}

The expression is saved as **ExcludeRegion**.

To illustrate how this expression might be useful, first consider the following view, which breaks out the sum of sales by region and by month:
Dropping [ExcludeRegion] on Color shades the view to show total sales by month but without the regional component:

Level of Detail Expressions and Aggregation

The level of detail of the view determines the number of marks in your view. When you add a level of detail expression to the view, Tableau must reconcile two levels of detail—the one in the view, and the one in your expression.

The behavior of a level of detail expression in the view varies depending on whether the expression's level of detail is coarser, finer, or the same as the level of detail in the view. What do we mean by “coarser” or “finer” in this case?

**Level of Detail Expression is Coarser Than View Level of Detail**

An expression has a coarser level of detail than the view when it references a subset of the dimensions in the view. For example, for a view that contained the dimensions [Category] and
**Level of Detail Expression**

You could create a level of detail expression that uses only one of these dimensions:

\[
\{\text{FIXED } [\text{Segment}] : \text{SUM}([\text{Sales}])\}
\]

In this case, the expression has a coarser level of detail than the view. It bases its values on one dimension ([**Segment**]), whereas the view is basing its view on two dimensions ([**Segment**] and [**Category**]).

The result is that using the level of detail expression in the view causes certain values to be replicated—that is, to appear multiple times.

Replicated values are useful for comparing specific values against average values within a category. For example, the following calculation subtracts average sales for a customer from the average sales overall:

\[
[\text{Sales}] - \{\text{FIXED } [\text{Customer Name}] : \text{AVG}([\text{Sales}])\}
\]

When values are being replicated, changing the aggregation for the relevant field in the view (for example, from AVG to SUM) will not change the result of the aggregation.

**Level of Detail Expression is Finer Than View Level of Detail**

An expression has a finer level of detail than the view when it references a superset of the dimensions in the view. When you use such an expression in the view, Tableau will aggregate results up to the view level. For example, the following level of detail expression references two dimensions:

\[
\{\text{FIXED } [\text{Segment}], [\text{Category}] : \text{SUM}([\text{Sales}])\}
\]
When this expression is used in a view that has only [Segment] as its level of detail, the values must be aggregated. Here's what you would see if you dragged that expression to a shelf:

\[
\text{AVG}([\text{FIXED} \ [\text{Segment}]], \ [\text{Category}] : \text{SUM}([\text{Sales}]))]
\]

An aggregation—in this case, average—is automatically assigned by Tableau. You can change the aggregation as needed.

**Adding a Level of Detail Expression to the View**

Whether a level of detail expression is aggregated or replicated in the view is determined by the expression type (FIXED, INCLUDE, or EXCLUDE) and whether the expression’s granularity is coarser or finer than the view’s.

- **INCLUDE** level of detail expressions will have either the same level of detail as the view or a finer level of detail than the view. Therefore, values will never be replicated.

- **FIXED** level of detail expressions can have a finer level of detail than the view, a coarser level of detail, or the same level of detail. The need to aggregate the results of a FIXED level of detail depends on what dimensions are in the view.

- **EXCLUDE** level of detail expressions always cause replicated values to appear in the view. When calculations including EXCLUDE level of detail expressions are placed on a shelf, Tableau defaults to the ATTR aggregation (as opposed to SUM or AVG) to indicate that the expression is not actually being aggregated and that changing the aggregation will have no effect on the view.

Level of detail expressions are always automatically wrapped in an aggregate when they are added to a shelf in the view unless they’re used as dimensions. So if you double-click on a shelf and type

\[
[\text{FIXED} \ [\text{Segment}], \ [\text{Category}] : \text{SUM}([\text{Sales}])]
\]

and then press Enter to commit the expression, what you now see on the shelf is

\[
\text{SUM}([\text{FIXED} \ [\text{Segment}], \ [\text{Category}] : \text{SUM}([\text{Sales}])])
\]

But if you double-click into the shelf to edit the expression, what you see in edit mode is the original expression.

If you wrap a level of detail expression in an aggregation when you create it, Tableau will use the aggregation you specified rather than assigning one when any calculation including that expression is placed on a shelf. When no aggregation is needed (because the expression’s level of detail is coarser than the view’s), the aggregation you specified is still shown when the expression is on a shelf, but it is ignored.
Filters and Level of Detail Expressions

There are several different kinds of filters in Tableau and they get executed in the following order from top to bottom.

The text on the right shows where level of detail expressions are evaluated in this sequence.

Extract Filters (in orange) are only relevant if you’re creating a Tableau Extract from a data source. Table calculations filters (dark blue) are applied after calculations are executed and therefore hide marks without filtering out the underlying data used in the calculations.

If you’re familiar with SQL, you can think of measure filters as equivalent to the HAVING clause in a query, and dimension filters as equivalent to the WHERE clause.

FIXED calculations are applied before dimension filters, so unless you promote the fields on your Filter shelf to Improve View Performance with Context Filters on page 652, they will be ignored. For example, consider if you have the following calculation on one shelf in a view, along with [State] on a different shelf:

\[ \text{SUM([Sales])} / \text{ATTR({FIXED : SUM([Sales])})} \]

This calculation will give you the ratio of a state’s sales to total sales.

If you then put [State] on the Filters shelf to hide some of the states, the filter will affect only the numerator in the calculation. Since the denominator is a FIXED level of detail expression, it will still divide the sales for the states still in the view against the total sales for all states—including the ones that have been filtered out of the view.

INCLUDE and EXCLUDE level of detail expressions are considered after Dimension filters. So if you want filters to apply to your FIXED level of detail expression but don’t want to use Context Filters, consider rewriting them as INCLUDE or EXCLUDE expressions.
Data Source Constraints for Level of Detail Expressions

For some data sources, only more recent versions support level of detail expressions. Some data sources do not support level of detail expressions at all.

In addition, some data sources have complexity limits. Tableau will not disable calculations for these databases, but query errors are a possibility if calculations become too complex.

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actian Vectorwise</td>
<td>Not supported.</td>
</tr>
<tr>
<td>Amazon EMR</td>
<td>Supported for Hive 0.13 and later.</td>
</tr>
<tr>
<td>Amazon Redshift</td>
<td>Supported.</td>
</tr>
<tr>
<td>Aster Database</td>
<td>Supported for version 4.5 and later.</td>
</tr>
<tr>
<td>Cloudera Hadoop</td>
<td>Supported for Hive 0.13 and later.</td>
</tr>
<tr>
<td>Cloudera Impala</td>
<td>Supported for Impala 1.2.2 and later.</td>
</tr>
<tr>
<td>Cubes (multidimensional data sources)</td>
<td>Not supported.</td>
</tr>
<tr>
<td>DataStax Enterprise</td>
<td>Not supported.</td>
</tr>
<tr>
<td>EXASolution</td>
<td>Supported.</td>
</tr>
<tr>
<td>Firebird</td>
<td>Supported for version 2.0 and later.</td>
</tr>
<tr>
<td>Generic ODBC</td>
<td>Limited. Depends on the specific data source.</td>
</tr>
<tr>
<td>Google Big Query</td>
<td>Not supported.</td>
</tr>
<tr>
<td>Hortonworks Hadoop Hive</td>
<td>Supported for Hive 0.13 and later.</td>
</tr>
<tr>
<td>On version 1.1 of Hive level of detail expressions that produce cross joins are not reliable. Cross join occur when there is no explicit field to join on. For example, for a level of detail expression <code>fixed [Product Type] : sum(sales)</code> when the view only contains one dimension [Ship Mode], Tableau creates a cross-join. A cross join produces rows</td>
<td></td>
</tr>
</tbody>
</table>
which combine each row from the first table with each row from the second table.

<table>
<thead>
<tr>
<th>Database</th>
<th>Compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP Vertica</td>
<td>Supported for version 6.1 and later.</td>
</tr>
<tr>
<td>IBM BigInsights</td>
<td>Supported.</td>
</tr>
<tr>
<td>IBM DB2</td>
<td>Supported for version 8.1 and later.</td>
</tr>
<tr>
<td>MarkLogic</td>
<td>Supported for version 7.0 and later.</td>
</tr>
<tr>
<td>Microsoft Access</td>
<td>Not supported.</td>
</tr>
<tr>
<td>Microsoft Jet-based connections (legacy connectors for Microsoft Excel, Microsoft Access, and text)</td>
<td>Not supported.</td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td>SQL Server 2005 and later.</td>
</tr>
<tr>
<td>MySQL</td>
<td>Supported.</td>
</tr>
<tr>
<td>IBM Netezza</td>
<td>Supported version 7.0 and later.</td>
</tr>
<tr>
<td>Oracle</td>
<td>Supported version 9i and later.</td>
</tr>
<tr>
<td>ParAccel</td>
<td>Supported version 3.1 and later.</td>
</tr>
<tr>
<td>Pivotal Greenplum</td>
<td>Supported for version 3.1 and later.</td>
</tr>
<tr>
<td>PostgreSQL</td>
<td>Supported version 7 and later.</td>
</tr>
<tr>
<td>Progress OpenEdge</td>
<td>Supported.</td>
</tr>
<tr>
<td>SAP HANA</td>
<td>Supported.</td>
</tr>
<tr>
<td>SAP Sybase ASE</td>
<td>Supported.</td>
</tr>
<tr>
<td>SAP Sybase IQ</td>
<td>Supported version 15.1 and later.</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td>Spark SQL</td>
<td>Supported.</td>
</tr>
<tr>
<td>Splunk</td>
<td>Not supported.</td>
</tr>
<tr>
<td>Tableau Data Extract</td>
<td>Supported.</td>
</tr>
<tr>
<td>Teradata</td>
<td>Supported.</td>
</tr>
</tbody>
</table>

**Find Clusters in Data**

Cluster analysis partitions marks in the view into clusters, where the marks within each cluster are more similar to one another than they are to marks in other clusters.

In Tableau Desktop, you create clusters by dragging **Cluster** from the **Analytics** pane and dropping it in the view.
The result is a statistical object that Tableau places on Color. If there is already a field on Color, Tableau moves that field to Detail and replaces it on Color with the clustering results.

Tableau assigns each mark in the view to one of the clusters; in some cases, it also assigns marks that do not fit well into any of clusters to a "Not Clustered" cluster.

When you add a cluster to the view, or edit an existing cluster on Color, Tableau displays a dialog box where you can:

- Add variables to or remove variables from clusters. Variables are the field that Tableau uses to compute clusters.
- Specify the number of clusters you want—or let Tableau determine the number of clusters automatically.
- Change the aggregation for a variable by right-clicking it and opening a context menu.

If you drag a cluster to the Data pane, it becomes a group dimension in which the individual members (Cluster 1, Cluster 2, etc.) contain the marks that the cluster algorithm has determined are more similar to each other than they are to other marks.

After you drag a cluster group to the Data pane, you can use it in other worksheets. See Create a Tableau Group from Cluster Results on page 850.

**Clustering constraints**

Clustering is available in Tableau Desktop, but is not available for authoring on the web (Tableau Server, Tableau Online). Clustering is also not available when any of the following conditions apply:
- When you are using a cube (multidimensional) data source.
- When there is a blended dimension in the view.
- When there are no fields that can be used as variables (inputs) for clustering in the view.
- When there are no dimensions present in an aggregated view.

When any of those conditions apply, you will not be able to drag Clusters from the Analytics pane to the view.

In addition, the following field types cannot be used as variables (inputs) for clustering:

- Table calculations
- Blended calculations
- Ad-hoc calculations
- Generated latitude/longitude values
- Groups
- Sets
- Bins
- Parameters
- Dates
- Measure Names/Measure Values

See Also
Quick Start: Find Clusters in Data on page 1523

Create Clusters
To find clusters in a view in Tableau, follow these steps.

1. Create a view.

2. Drag Cluster from the Analytics pane into the view, and drop it on in the target area in the view:
You can also double-click **Cluster** to find clusters in the view.

Two things happen when you drop or double-click **Cluster**:

- Tableau adds **Clusters** on **Color**, and colors the marks in your view by cluster.
- Tableau displays a Clusters dialog box, where you can customize the cluster.
3. Customize the cluster results by doing either of the following in the Clusters dialog box:

- Drag new fields from the **Data** pane into the Variables area of the Clusters dialog box.
  
  When you add variables, measures are aggregated using the default aggregation for the field; dimensions are aggregated using ATTR, which is the standard way that Tableau aggregates dimensions.

- Specify the number of clusters. If you do not specify a value, Tableau will go as high as 25 clusters in trying to determine the number of clusters. If you specify a value, you can choose any number between 2 and 50.

4. When you finish customizing the cluster results, click the X in the upper-right corner of the Clusters dialog box to close it:

   ![Close Clusters Dialog Box]

   **Note:** You can move the cluster field from Color to another shelf in the view. However, you cannot move the cluster field from the **Filters** shelf to the **Data** pane.
To edit Clusters you have previously created, right-click (Control-click on a Mac) the Clusters field on Color and choose Edit clusters.

For an example showing the process of creating clusters with sample data (world economic indicators), see Example - Create Clusters from World Economic Indicators Data on page 857.

Create a Tableau Group from Cluster Results

Drag Clusters from the Marks card (or from any other shelf you had already dragged it to) to the Data pane to create a Tableau group:

After you create a group from clusters, the group and the original clusters are separate and distinct. Editing the clusters does not affect the group, and editing the group does not affect the cluster results. The group has the same characteristics as any other Tableau group. It is part of the data source. Unlike the original clusters, you can use the group in other worksheets in the
workbook. So if you rename the saved cluster group, that renaming is not applied to the original clustering in the view. See Groups on page 458.

**Constraints on Saving Clusters**

You will not be able to save Clusters to the Data pane under any of the following circumstances:

- When the measures in the view are disaggregated and the measures you are using as clustering variables are not the same as the measures in the view. See Disaggregating Data on page 332.
- When the Clusters you want to save are on the Filters shelf.
- When Measure Names or Measure Values is in the view.
- When there is a blended dimension in the view.

**Statistics for Clustering**

The Describe Clusters dialog box provides information about the models that Tableau computed for clustering. You can use these statistics to assess the quality of the clustering.

When the view includes clustering, you can open the Describe Clusters dialog box by right-clicking Clusters on the Marks card (Control-clicking on a Mac) and choosing Describe Clusters. The information in the Describe Clusters dialog box is read-only, though you can click Copy to Clipboard and then paste the screen contents into a writeable document.

The Describe Clusters dialog box has two tabs: a Summary tab and a Models tab.

**Describe Clusters – Summary Tab**

The Summary tab identifies the inputs that were used to generate the clusters and provides some statistics that characterize the clusters.

**Inputs for Clustering**

**Variables**

Identifies the fields Tableau uses to compute clusters. These are the fields listed in the Variables box in the Clusters dialog box.

**Level of Detail**

Identifies the fields that are contributing to the view’s level of detail—that is, the fields that determine the level of aggregation. For details, see Dimensions and the Level of Detail on page 270.

**Scaling**

Identifies the scaling method used for pre-processing. Normalized is currently the only scaling method Tableau uses. The formula for this method, also known as min-max normalization, is 

\[(x - \min(x)) / (\max(x) - \min(x)).\]
Summary Diagnostics

Number of Clusters
The number of individual clusters in the clustering.

Number of Points
The number of marks in the view.

Between-group sum of squares
A metric quantifying the separation between clusters as a sum of squared distances between each cluster’s center (average value), weighted by the number of data points assigned to the cluster, and the center of the data set. The larger the value, the better the separation between clusters.

Within-group sum of squares
A metric quantifying the cohesion of clusters as a sum of squared distances between the center of each cluster and the individual marks in the cluster. The smaller the value, the more cohesive the clusters.

Total sum of squares
Totals the between-group sum of squares and the within-group sum of squares. The ratio (between-group sum of squares)/(total sum of squares) gives the proportion of variance explained by the model.

Cluster Statistics
For each cluster in the clustering, the following information is provided.

# Items
The number of marks within the cluster.

Centers
The average value within each cluster (shown for numeric items).

Most Common
The most common value within each cluster (only shown for categorical items).

Describe Clusters – Models Tab
Analysis of variance (ANOVA) is a collection of statistical models and associated procedures useful for analyzing variation within and between observations that have been partitioned into groups or clusters. In this case, analysis of variance is computed per variable, and the resulting analysis of variance table can be used to determine which variables are most effective for distinguishing clusters.

Relevant Analysis of variance statistics for Tableau Clustering include:
F-statistic

The F-statistic for one-way, or single-factor, ANOVA is the fraction of variance explained by a variable. It is the ratio of the between-group variance to the total variance.

The larger the F-statistic, the better the corresponding variable is distinguishing between clusters.

p-value

The p-value is the probability that the F-distribution of all possible values of the F-statistic takes on a value greater than the actual F-statistic for a variable. If the p-value falls below a specified significance level, then the null hypothesis (that the individual elements of the variable are random samples from a single population) can be rejected. The degrees of freedom for this F-distribution are \((k - 1, N - k)\), where \(k\) is the number of clusters and \(N\) is the number of items (rows) clustered.

The lower the p-value, the more the expected values of the elements of the corresponding variable differ among clusters.

Model Sum of Squares and Degrees of Freedom

The Model Sum of Squares is the ratio of the between-group sum of squares to the model degrees of freedom. The between group sum of squares is a measure of the variation between cluster means. If the cluster means are close to each other (and therefore close to the overall mean), this value will be small. The model has \(k - 1\) degrees of freedom, where \(k\) is the number of clusters.

Error Sum of Squares and Degrees of Freedom

The Error Sum of Squares is the ratio of within-group sum of squares to the error degrees of freedom. The within-group sum-of-squares measures the variation between observations within each cluster. The error has \(N - k\) degrees of freedom, where \(N\) is the total number of observations (rows) clustered and \(k\) is the number of clusters.

The Error Sum of Squares can be thought of as the overall Mean Square Error, assuming that each cluster center represents the "truth" for each cluster.

How Clustering Works in Tableau

Cluster analysis partitions the marks in the view into clusters, where the marks within each cluster are more similar to one another than they are to marks in other clusters. Tableau distinguishes clusters using color.

**Note:** For additional insight into how clustering works in Tableau, see the blog post Understanding Clustering in Tableau 10.
The clustering algorithm

Tableau uses the k-means algorithm for clustering. For a given number of clusters k, the algorithm partitions the data into k clusters. Each cluster has a center (centroid) that is the mean value of all the points in that cluster. K-means locates centers through an iterative procedure that minimizes distances between individual points in a cluster and the cluster center. In Tableau, you can specify a desired number of clusters, or have Tableau test different values of k and suggest an optimal number of clusters (see Determining the optimal number of clusters on page 856).

K-means requires an initial specification of cluster centers. Starting with one cluster, the method chooses a variable whose mean is used as a threshold for splitting the data in two. The centroids of these two parts are then used to initialize k-means to optimize the membership of the two clusters. Next, one of the two clusters is chosen for splitting and a variable within that cluster is chosen whose mean is used as a threshold for splitting that cluster in two. K-means is then used to partition the data into three clusters, initialized with the centroids of the two parts of the split cluster and the centroid of the remaining cluster. This process is repeated until a set number of clusters is reached.

Tableau uses Lloyd’s algorithm with squared Euclidean distances to compute the k-means clustering for each k. Combined with the splitting procedure to determine the initial centers for each $k > 1$, the resulting clustering is deterministic, with the result dependent only on the number of clusters.

The algorithm starts by picking initial cluster centers:
It then partitions the marks by assigning each to its nearest center:
Then it refines the results by computing new centers for each partition by averaging all the points assigned to the same cluster:

It then reviews the assignment of marks to clusters and reassigns any marks that are now closer to a different center than before.

The clusters are redefined and marks are reassigned iteratively until no more changes are occurring.

**Determining the optimal number of clusters**

Tableau uses the Calinski-Harabasz criterion to assess cluster quality. The Calinski-Harabasz criterion is defined as

\[
\frac{SS_B}{SS_W} \times \frac{(N - k)}{(k - 1)}
\]

where $SS_B$ is the overall between-cluster variance, $SS_W$ the overall within-cluster variance, $k$ the number of clusters, and $N$ the number of observations.
The greater the value of this ratio, the more cohesive the clusters (low within-cluster variance) and the more distinct/separate the individual clusters (high between-cluster variance).

Since the Calinski-Harabasz index is not defined for k=1, it cannot be used to detect one-cluster cases.

If a user does not specify the number of clusters, Tableau picks the number of clusters corresponding to the first local maximum of the Calinski-Harabasz index. By default, k-means will be run for up to 25 clusters if the first local maximum of the index is not reached for a smaller value of k. You can set a maximum value of 50 clusters.

**Note:** If a categorical variable (that is, a dimension) has more than 25 unique values, then Tableau will disregard that variable when computing clusters.

**What values get assigned to the Not Clustered category?**

When there are null values for a measure, Tableau assigns values for rows with null to a Not Clustered category. Categorical variables (that is, dimensions) that return * for ATTR (meaning that all values are not identical) are also not clustered.

**Scaling**

Tableau scales values automatically so that columns having a larger range of magnitudes don’t dominate the results. For example, an analyst could be using inflation and GDP as input variables for clustering, but because GDP values are in trillions of dollars, this could cause the inflation values to be almost completely disregarded in the computation. Tableau uses a scaling method called min-max normalization, in which the values of each variable is mapped to a value between 0 and 1 by subtracting its minimum and dividing by its range.

**Example - Create Clusters from World Economic Indicators Data**

The Tableau clustering feature partitions marks in the view into clusters, where the marks within each cluster are more similar to one another than they are to marks in other clusters. This example shows how a researcher might use clustering to find an optimal set of marks (in this case, countries) in a data source.

**The objective**

As life expectancy increases around the world, and as older people remain more active, senior tourism can be a lucrative market for companies that know how to find and appeal to potential customers. The World Indicators sample data set that comes with Tableau contains the kind of data that might help companies identify the countries where there are enough of the right kind of customers.
Finding the right countries

Here is an example of how Tableau clustering could help such a company identify the countries where a senior tourism business could succeed. Imagine you are the analyst. Here is how you might proceed.

1. Open the **World Indicators** sample data source in Tableau Desktop.
2. Double-click **Country** in the **Data** pane.
   
   Tableau automatically creates a map view, with a mark in each country.
3. On the **Marks** card, change the mark type to **Filled Map**:

![Filled Map](image)

You should now see a map projection where all countries are filled with a solid color:
4. The next step is to identify the fields that you will use as variables for clustering. Here are the fields you choose:

<table>
<thead>
<tr>
<th>Field</th>
<th>Reason for inclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Life Expectancy Female and Life Expectancy Male</strong></td>
<td>Where people are living longer, there are more likely to be people who are interested in traveling later in life.</td>
</tr>
<tr>
<td><strong>Population Urban</strong></td>
<td>It is easier to market services in areas with greater population density.</td>
</tr>
<tr>
<td><strong>Population 65+</strong></td>
<td>The target population is older residents with the time and funds to travel.</td>
</tr>
<tr>
<td><strong>TourismPerCapita</strong></td>
<td>This is a measure that you must create as a named calculated field. The formula is:</td>
</tr>
<tr>
<td></td>
<td>[ \text{SUM(\text{Tourism Outbound})} / \text{SUM(\text{Population Total})} ]</td>
</tr>
<tr>
<td><strong>Tourism Outbound</strong></td>
<td><em>Tourism Outbound</em> aggregates the money (in US dollars) that residents of a country spend annually on international travel. But this total must be divided by the population of each country</td>
</tr>
</tbody>
</table>
to determine the average amount each resident spends on international travel.

There is no guarantee that these are the ideal fields to choose, or that these fields will produce cluster results that are clear and unambiguous. Clustering is an iterative process—experimentation leads to discovery which leads, in turn, to more experimentation.

5. Drag these five fields from the Data pane to Detail on the Marks card.

6. Click to open the Analytics pane:

7. Drag Cluster from the Analytics pane and drop it in the view:
Tableau displays the Clusters dialog box and adds the measures in the view to the list of variables:

![Clusters dialog box]

It also updates the view by adding clusters to Color. In this case, Tableau finds two distinct clusters, and is unable to assign certain countries (colored reddish-pink) to either cluster:
8. You decide that two clusters isn’t enough—you don’t have the resources to set up shop in half the countries in the world. So you type 4 in the **Number of Clusters** field in the Clusters dialog box.

   The map becomes more interesting:
But how do these clusters relate to the variables you have chosen? Which one correlates best with the factors that support senior tourism? It's time to look at the statistics behind the clusters.

9. Close the Clusters dialog box by clicking the X in its upper-right corner:

10. Click the Clusters field on the Marks card and choose Describe Clusters.

The table at the bottom of the Models tab in the Describe Clusters dialog box shows the average value for each variable in each cluster:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>89</td>
<td>74.216</td>
<td>69.003</td>
<td>0.054043</td>
<td>0.5325</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>52</td>
<td>76.75</td>
<td>74.429</td>
<td>0.033189</td>
<td>0.33127</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>29</td>
<td>73.164</td>
<td>71.706</td>
<td>0.15493</td>
<td>0.62532</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>30</td>
<td>83.287</td>
<td>76.355</td>
<td>0.15906</td>
<td>0.87123</td>
</tr>
<tr>
<td>Not Clustered</td>
<td>28</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cluster 4 has the highest life expectancy (both male and female), the highest concentration of urban population, and the highest expenditure for international tourism: $1360.40 per capita. The only variable for which Cluster 4 does not have the highest value is Population 65+, where Cluster 3 has the advantage: 0.15493 (just under 16%) to 0.11606 (just over 11%) in Cluster 4.
The clustering algorithm does not know whether you are looking for the maximum value for these variables, the minimum value, or something in the middle—it just looks for correlation. But you know that higher values for these variables is the signal you're looking for, and Cluster 4 is the best choice.

11. You could attempt to pick out the Cluster 4 countries from the map, but there is an easier way. Close the Describe Clusters dialog box and then click Cluster 4 on the Color legend and choose Keep Only.

![Keep Only option](image)

12. Choose Text Table from ShowMe.

You now see a list of the countries in Cluster 4:
This list is not the end of the process. You might try clustering again with a somewhat different set of variables and maybe a different number of clusters, or you might add some countries to the list and remove others, based on other factors. For example, if your tours are mostly to tropical locales, you might remove countries like Curacao and the Bahamas from the list, because tropical tours might not appeal to residents of those countries.
Another option is to filter your data before you re-cluster, to only show countries with populations above a certain threshold, or to target countries in a particular geographical area.

**Percentages**

Any analysis in Tableau can be expressed in terms of percentages. For example, rather than viewing sales for every product, you might want to view each product’s sales as a percentage of the total sales for all products.

You calculate percentages by selecting the **Analysis > Percentages Of** menu item. When you do this, all measures on the worksheet are displayed as a percentage based on all the table data.

The percentage options on the Analysis menu correspond to the percentage table calculations. When you select a percentage option, you are actually adding a Percent of Total table calculation. See *Transform Values with Table Calculations* on page 767 for more information.

**About Percentages**

There are two factors that contribute to the percentage calculation:

- The aggregation – Percentages are calculated on the basis of the current aggregation for each measure. Refer to **Percentages and Aggregations** on the next page for more information.

- The data to which you compare all percentage calculations – Percentages are a ratio of numbers. The numerator is the value of a given mark. The denominator depends on the type of percentage you want, and is the number to which you compare all your calculations. The comparison can be based on the entire table, a row, a pane, and so on. By default, Tableau uses the entire table. Other percentage calculations are available via the **Percentage of** menu item. Refer to **Percentage Options** on page 869 for more information.

The figure below is an example of a text table with percentages. The percentages are calculated with the **Sales** measure aggregated as a summation, and are based on the entire table.
Percentages and Aggregations

Percentages are computed on the basis of the aggregation for each measure. Standard aggregations include summation, average, and several others. See Aggregations on page 322 for more information.

For example, if the aggregation applied to the Sales measure is a summation, then the default percentage calculation (percent of table) means that each number displayed is the SUM(Sales) for that mark divided by the SUM(Sales) for the entire table.

In addition to using predefined aggregations, you can use custom aggregations when calculating percentages. You define your own aggregations by creating a calculated field. Once the new field is created, you can use percentages on the field as you would any other field. See Aggregate Calculations on page 762 for more information.

Percent calculations can also be applied to disaggregated data. In this case, all values are expressed as the percentage of a summation. You cannot choose any other aggregation.

Example – Percentages and Aggregations

The view below shows a nested bar chart created using two dimensions and a measure that is aggregated as a maximum. Additionally, the data are color-encoded by a dimension and the default percentage calculation has been applied. Notice that the axis labels are modified to reflect the percent calculation.

The tooltip reveals that the maximum sales for furniture in the east in 2011 is 17.70% of the maximum for the entire table. What is the maximum for the table? If you recreate the view you'll
see that the maximum occurs in the South, in the Technology category, in the year 2011. The tooltip for this bar segment would reveal a maximum sales of 100%.

The next view displays two disaggregated measures as a scatter plot. Again, the default percentage calculation has been applied as reflected by the modified axis labels.

The tooltip shows that the selected data point constitutes -0.475 percent of total profit and a 0.3552 percent of total sales. Percentage calculations are based on the entire data source.
Percentage Options

Computing a percentage involves specifying a total on which the percentage is based. In Tableau, the default percentage calculation is based on the entire table. However, you can change the default by selecting a different percentage option from the Analysis > Percentage of menu.

The option you choose is applied uniformly to all measures that appear on a worksheet. For instance, you cannot choose Percent of Column for one measure and Percent of Row for another.

If you are unsure what the current percentage calculation means, display the grand totals. This provides more information about each row and column. For example, if you select Percent of Row while displaying grand totals, you will see that the total for each row is exactly 100%. See Grand Totals on page 905 for more information on grand totals.

The percent calculation options are described in the following sections. In each case, the grand totals are displayed as well.

Percent of Table

When you select Percentage Of > Table from the Analysis menu, each measure on the worksheet is expressed as a percentage of the total for the entire worksheet (table). For example, Technology in the East region accounts for 3.79% of total sales in 2014. The grand totals for rows show that 2014 accounts for 31.95% of the total sales. Summing the grand totals for rows or for columns yields 100% of the total.
Percent of Column

When you select **Percentage of > Column** from the **Analysis** menu, each measure on the worksheet is expressed as a percentage of the total for the column. The values within the red box add up to 100%.
Percent of Row

When you select **Percentage of Row**, each measure on the worksheet is expressed as a percentage of the total for the row. The values within the red box add up to 100%.

Percent of Pane

When you select **Percentage of Pane** from the Analysis menu, each measure on the worksheet is expressed as a percentage of the total for the panes in the view. This option is equivalent to **Percent of Table** when the table consists of only a single pane.

In the following view, the red box constitutes a single pane; the values within the red box add up to 100%.
Percent of Row in Pane

When you select **Percentage of > Row in Pane** from the **Analysis** menu, each measure on the worksheet is expressed as a percentage of the total for a row within a pane. This option is equivalent to as **Percent of Row** when the table is only a single pane wide.

In the following view, the red box constitutes a row within a pane; the values within the red box add up to 100%.

**Note:** If you place **Measure Names** as the inner dimension on the **Columns** shelf (that is, the dimension farthest to the right), Tableau will return 100% for each mark because you cannot total up the values for multiple measure names. For example, you can’t total up the values for SUM(Sales) and SUM(Profit).
Percent of Column in Pane

When you select **Percentage of > Column in Pane** from the Analysis menu, each measure in the worksheet is expressed as a percentage of the total for a column within a pane. This option is equivalent to as **Percent of Column** when the table is only a single pane high.

In the following view, the red box constitutes a column within a pane; the values within the red box add up to 100%.

If you place **Measure Names** as the inner dimension on the Rows shelf (that is, the dimension farthest to the right on the shelf), Tableau will return 100% for each mark because you cannot total up the values for multiple measure names. For example, you can’t total up the values for SUM(Sales) and SUM(Profit).

Reference Lines, Bands, Distributions, and Boxes

Add a reference line, band, distribution or box plot to identify a specific value, region, or range on an axis. For example, if you are analyzing the monthly sales for several products, you may want to include a reference line at the average sales mark so you can see how each product performed against the average. Alternatively you may want to shade a particular area along the axis, show a distribution, or show the full range of values, using a box plot.

For information about how to use reference lines to create a control chart, see the knowledge base article **Using Control Charts**.
Tableau lets you add an unlimited number of reference lines, bands, distributions, and box plots. Right-click (control-click on a Mac) on an axis and select **Add Reference Line** to open the Add Reference Line, Band, or Box dialog box:

**Note:** Reference lines, bands, distributions, and boxes are not available when the view is a map using online or offline maps.

**Types of Reference Lines, Bands, and Boxes**

Tableau offers four types of reference lines, bands, and boxes:
- Line - adds a line at a constant or computed value on the axis. Computed values can be based on a specified field. You can also add confidence intervals with a reference line. See Adding Reference Lines on page 878.

- Band - shades an area behind the marks in the view between two constants or computed values on the axis. See Adding Reference Bands on page 884.
- Distribution - adds a gradient of shading to indicate the distribution of values along the axis. Distribution can be defined by percentages, percentiles, quantiles (as in the following image), or standard deviation.
Reference distributions can be used to create bullet charts. See Adding Reference Distributions (Bullet Graphs) on page 888.

- **Box Plot** - adds a box plot that describes the distribution of values along the axis. Box plots show quartiles and whiskers. Tableau provides different box plot styles, and allows you to configure the location of the whiskers and other details. See Adding Box Plots on page 895.
Adding Reference Lines

You can add a reference line to any continuous axis.

To add a reference line:
1. Right-click (control-click on Mac) on a quantitative axis and select **Add Reference Line**.

2. In the Add Reference Line, Band, or Box dialog box, select **Line**.
3. Select one of the following scopes:
4. Select a measure from the Value field to use as the basis for your reference line. You can also select an existing parameter, or create a new parameter on the fly. See Creating Parameters on page 917.

You cannot select a measure that isn’t currently in the view as the basis for your reference line. If you want to use such a measure, close the Add Reference Line, Band, or Box dialog box and then drag the measure from the Data pane to the Details target on the Marks card. Change the measure’s aggregation if necessary. This will not change the view, but it will allow you to use that measure as the basis for your reference line. Now re-open the Add Reference Line, Band, or Box dialog box and resume at step 2, above.

5. Select one of the following aggregations:
   - **Total** - places a line at the aggregate of all the values in either the cell, pane, or the entire view. This option is particularly useful when computing a weighted average rather than an average of averages. It is also useful when working with a calculation with a custom aggregation. The total is computed using the underlying data and behaves the same as selecting one of the totals option the Analysis menu.
   - **Sum** - places a line at the SUM of all the values in either the cell, pane, or entire view.
   - **Constant** - places a line at the specified value on the axis.
   - **Minimum** - places a line at the minimum value.
   - **Maximum** - places a line at the maximum value.
- Average - places a line at the average value along the axis.
- Median - places a line at the median value.

6. Select how you want to label the line. You can select from the following options:
   - **None** – select this option to not show a label for the reference line.
   - **Value** – select this option to show a label corresponding to the line’s value on the axis.
   - **Computation** – select this option to display the name of the measure that is the basis for your reference line and any computation that is performed.
   - **Custom** – select this option to build a custom label in the text box. You can use the menu to the right of the text box to insert values such as the computation or the value. You can also type text directly into the box, so you could create a value such as `<Field Name> = <Value>`.

7. Specify whether to display the line with a confidence interval, just the line, or just the confidence interval.

   Confidence interval distribution bands shade the region in which the population average will fall $n$ of the time, where $n$ is the value you select in the drop-down on the right. You can choose one of the listed numeric values, enter a custom numeric value, select an existing parameter, or create a new parameter on the fly:

   The higher the value you select, the wider the bands will be.

8. Specify Formatting options for the line. You can change the style, thickness, and color.
9. Optionally, add a Fill color **Above** and **Below** the line.

When you are displaying a line and a confidence interval, the shading will be darker within the confidence interval, and lighter beyond it:
When you are displaying a confidence interval without a line, the fill colors are disregarded, though they are retained and then applied if you decide later to show a line.

10. Specify whether to Show recalculated line for highlighted or selected data points. For more information, see Marks and Data Analysis on page 518

Adding Reference Bands

Reference bands are shaded areas behind the marks in the view between two constant or computed values on the axis. You can add reference bands to any continuous axis.

To add a reference band:

1. Right-click (Control-click on Mac) on a quantitative axis and select Add Reference Line.
2. In the Add Reference Line, Band, or Box dialog box, select **Band**.
3. Select one of the following scopes:
4. Select measures and an aggregation from the Value field—once in the **Band From** area and once in the **Band To** area—to use as the basis for your reference band. You can also select an existing parameter, or create a new parameter on the fly. Just be sure not to select the same measure and aggregation in both areas.

You cannot select a measure that isn't currently in the view as the basis for your reference band. If you want to use such a measure, close the Add Reference Line, Band, or Box dialog box and then drag the measure from the Data pane to the Details target on the Marks card. Change the measure's aggregation if necessary. This will not change the view, but it will allow you to use that measure as the basis for your reference band. Now re-open the Add Reference Line, Band, or Box dialog box and resume at step 2, above.

The following aggregations are available:

- **Total** - extends the band to a value that is at the aggregate of all the values in either the cell, pane, or the entire view. This option is particularly useful when computing a weighted average rather than an average of averages. It is also useful when working with a calculation with a custom aggregation. The total is computed using the underlying data and behaves the same as selecting one of the totals option the Analysis menu.

- **Sum** - extends the band to a value that is at the SUM of all the values in either the cell, pane, or entire view.

- **Constant** - extends the band to a value that is at the specified value on the axis.

- **Minimum** - extends the band to a value that is at the minimum value.
- Maximum - extends the band to a value that is at the maximum value.
- Average - extends the band to a value that is at the average value along the axis.
- Median - extends the band to a value that is at the median value.

5. Format the reference band. You can mark the two values with a line and/or select a shading color for the band.

6. When finished, click **OK**.

7. Specify whether to Show recalculated band for highlighted or selected data points. For more information, see Marks and Data Analysis on page 518

**Adding Reference Distributions (Bullet Graphs)**

Reference distributions are a special type of reference band. A reference distribution adds a gradient of shading to indicate the distribution of values along the axis. Distributions can be defined by confidence interval, percentages, percentiles, quantiles, or standard deviation. In addition to the shading, you can add a line to mark a constant or computed value along the axis.

**Basic Reference Distributions**

To add a reference distribution:

1. Right-click (Control-click on a Mac) on a quantitative axis and select **Add Reference Line**.
2. In the Add Reference Line, Band, or Box dialog box, select **Distribution**.
3. Select one of the following scopes:
4. Select the computation that will be used to create the distribution. You can select from the following options:

- **Percentages** - shades the interval between which lie specified percentages of values. Use a comma to separate multiple percentage values (for example, 60, 80).

- **Percentiles** - shades intervals at the specified percentiles. When you select this option, you must also specify two or more numerical values (for example, 60, 80 or 25, 50, 75).

- **Quantiles** - breaks the view into the specified number of tiles using shading and lines. When you select this computation, you must also specify the number of tiles (from 3 to 10, inclusive). For example, if you select 3, Tableau calculates the boundaries between the first, second and third terciles by calling the general
quantile function and asking for the 33.33 and the 66.66 quantiles. It then shades the three terciles differently.

Tableau uses estimation type 7 in the R standard to compute quantiles and percentiles. For details, see How Tableau Computes Quantiles in the Tableau Knowledge Base.

- **Standard Deviation** - places lines and shading to indicated the specified number of standard deviations above and below the mean. When you select this option you must specify the factor, which is the number of standard deviations and whether the computation is on a sample or the population.

5. Specify formatting options. You can format the lines at the distribution boundaries (for example, style, thickness, and color) as well as the fill gradient. Select from a list of predefined gradients. Select Symmetric to use a single color instead of a gradient. You can also specify whether to add additional shading above and below the defined distribution.

6. Specify whether to **Show recalculated band for highlighted or selected data points**. For more information, see Marks and Data Analysis on page 518

**Bullet Graphs**

Reference distributions can also be used to create bullet graphs. A bullet graph is a variation of a bar graph developed to replace dashboard gauges and meters. The bullet graph is generally used to compare a primary measure to one or more other measures in the context of qualitative ranges of performance such as poor, satisfactory, and good. You can create a bullet graph by adding two reference lines: a distribution to indicate the qualitative ranges of performance, and a line to indicate the target.

1. Select one or more dimensions, and two measures in the Data pane. The bullet graph will compare measure values. For example, budget vs. actual; actual vs. target; etc. Select multiple fields in the Data pane by holding down the Ctrl key as you click fields.
2. Click the **Show Me** button in the toolbar.
3. Select **Bullet Graph** in the Show Me pane.

Two reference lines are added. By default, Tableau adds a reference distribution that is defined at 60% and 80% of the Average of the measure on Detail. It also adds a reference line that marks the Average of that same measure. The other measure is placed on the Rows shelf.
To quickly swap the two measures, right-click (Control-click on a Mac) on the continuous axis and choose **Swap Reference Line Fields**.

When you use ShowMe to add a bullet graph, Tableau adds a reference line and a reference distribution. You can edit either of these to change its definition. For example, you may want to add 100%, or draw a line at a constant value. Right-click (Control-click on a Mac) on the continuous axis and choose **Edit Reference Line**. You'll then see a sub-menu listing all lines, bands, and distributions currently in the view.

**Adding Box Plots**

Use box plots, also known as box-and-whisker plots, to show the distribution of values along an axis.

Boxes indicate the middle 50 percent of the data (that is, the middle two quartiles of the data's distribution).

You can configure lines, called *whiskers*, to display all points within 1.5 times the interquartile range (in other words, all points within 1.5 times the width of the adjoining box), or all points at the maximum extent of the data, as shown in the following image:
Boxplots are also available from the Show Me pane when you have at least one measure in the view:
To add a box plot:

1. Right-click (Control-click on a Mac) on a quantitative axis and select Add Reference Line.
2. In the Add Reference Line, Band, or Box dialog box, select Box Plot.
3. Under Plot Options, specify placement for the whiskers:
   - **Data within 1.5 times the IQR** - places whiskers at a location that is 1.5 times the interquartile range—that is, 1.5 times further out than the width of the adjoining box. This is also known as a schematic box plot.
   - **Maximum extent of the data** - places whiskers at the farthest data point (mark) in the distribution. This is also known as a skeletal box plot.

4. Specify whether to **Hide underlying marks (except outliers)**—that is, whether to hide all marks except those beyond the whiskers.

5. Configure the appearance of the plot by selecting a **Style**, **Fill**, **Border**, and **Whiskers**.

**Show Me Vs. Add Reference Line, Band, or Box**

The difference between adding a box plot using Show Me and adding a box plot using Add Reference Line is that with Show Me, the box plot is your visualization, whereas with Add Reference Line, Band, or Box, you are adding a box plot to an existing visualization. For
example, you could create the following view by first selecting a circle view in Show Me, and then adding a box plot from Add Reference Line:

![Image of a circle view with a box plot](image)

**Editing Reference Lines, Bands, Distributions, or Boxes**

After you’ve added a reference line, band, or box, you can edit the definition. To do this, right-click (Control-click on a Mac) the continuous axis and select *Edit Reference Line*. If there are multiple reference lines, bands, or boxes in the view, use the additional menu to select the one you want to edit.

![Menu for editing reference lines](menu)
When you have multiple reference lines, bands, or boxes, you may want to change the order they are drawn in the view. To reorder a reference line, right-click (Control-click on a Mac) the line and select **Move to Front** or **Move to Back**.

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**Removing Reference Lines, Bands, Distributions or Boxes**

You can remove an individual reference line, band, or box, or remove them all at once.

To remove an individual reference line, band, or box, right-click (Control-click on a Mac) the reference line, band, or box in the view and select **Remove**. If you are removing a reference band or distribution that doesn’t include a line, right-click at the beginning or end of the shaded area. In distributions, you can also right-click between the different shades in the gradient.

---

To remove all reference lines, bands, or boxes at once, right-click the continuous axis and select **Remove All Reference Lines**.
Totals

You can automatically compute grand totals and subtotals for the data in a view. By default Tableau uses the underlying data to compute totals. However, if you are using a multidimensional data source you can specify whether to compute the total on the server using the underlying data or locally using the data that you see in the table. In Tableau, multidimensional data sources are supported only in Windows.

To add totals to the view:

1. On the left side of the workspace, click the Analytics pane.
2. Drag and drop Totals onto one of the options in the Add Totals dialog box that appears.

You can also add grand totals and subtotals to the view using the Analysis menu. To do so, select Analysis > Totals, and then select to add row or column grand totals, or subtotals.

Local vs. Server Computation

If you are using a multidimensional data source, you can specify whether the computation is performed on the server using the underlying data in the data source, or locally in Tableau using the data that you see in the table.

Note: In Tableau, multidimensional data sources are supported only in Windows.

The default setting is to compute all totals on the server if you are connected to a Microsoft Analysis Services data source, and locally if you are connected to an Essbase data source.
using the aggregation specified in the cube. However, there are cases when it is not possible for the server to compute the expected subtotals due to filtering or perfect pivoting.

For example, let’s say you have a view showing the sales of Amaretto, Columbian, and Decaf Irish Cream coffees. Then you filter the view to only show Amaretto and Columbian coffee sales. When you turn on subtotals for the Product Type field, so you can see the total sales for all Coffees, one of the following will happen:

- If the total can be computed using the filter, the correct total will display. In this case Tableau would compute the total sales for all Coffees.
- If the total cannot be computed using the filter, the totals cells in the view will be empty. In this case you would want to specify a local computation that only includes the values you see in Tableau.

**To specify a local computation:**

1. Select **Total Using** on the context menu for the measure you are using to calculate the subtotals.

   If you are not displaying totals, this menu item does not appear. See [Show Grand Totals on page 905](#).

2. Then select an aggregation.
**Hide** tells Tableau to not show a total for the field.

An additional value, **Server**, may be available. Server computation is not always available and sometimes the totals will be blank for specific members in the view. When using server computation keep in mind the following information.

- Server computation is only available for ASO cubes.
- Server computation is not available for dynamic hierarchies. This means that if the members in the view are part of a dimension or hierarchy that is tagged as dynamic, they cannot be included in the set of values you are using to compute the totals and will show up as blank in the view.
- If you are computing totals for a calculated field whose formula makes assumptions about other calculated members at different levels in the hierarchy, the totals will display as blank in the view.
Grand Totals

Any view in Tableau can include grand totals. For example, in a view showing the total sales for each department and category for four years, you can turn on grand totals to also see the totals across all products and all years.

Show Grand Totals

You can calculate grand totals by selecting one of the Grand Totals options on the Analysis > Totals menu. The grand totals are added as an additional row or column to your table.
You can also drag total in from the Analytics pane. See Analytics Pane on page 131.

The following rules dictate whether you can turn on grand totals:

- The view must have at least one header — Headers are displayed whenever you place a dimension on the Columns shelf or the Rows shelf. If column headers are displayed, you can calculate grand totals for columns. If row headers are displayed, you can calculate grand totals for rows.

- Measures must be aggregated — The aggregation determines the values displayed for the totals. See Grand Totals and Aggregations on page 911 for more information.

- Grand Totals cannot be applied to continuous dimensions.

You can also display totals for graphical views of data. In the figure below, only column totals are calculated because the table contains only column headers.
Note: By default, totals are computed on the server if you are connected to a Microsoft Analysis Services data source, and locally if you are connected to an Essbase data source, using the aggregation specified in the cube. Refer to Local vs. Server Computation on page 902 to learn more.

Options for Calculating Grand Totals

When you first turn on grand totals (see Show Grand Totals on page 905), the totals are computed using disaggregated data in the underlying data source. Consider the following view:
The average that you see at the right of the first row under Grand Total is $339. But if you compute the average for the four values you see in the row ($329, $306, $390, $348), the result comes to $343.25, not $339. The discrepancy is due to the fact that Tableau is averaging the data in the underlying data source. In this case there are more than four numbers to average, perhaps many more. The result is derived by averaging all values that have the properties Ship Mode = First Class, Category = Furniture, without regard to region.

To see totals that correspond to the numbers you see in your view requires two averaging operations in Tableau: first, values for the individual marks (or cells) in the view must be derived—for example, by averaging all values that have the properties Ship Mode = First Class, Category = Furniture, and Region = Central. Then the results for each region must be derived, by averaging the results for the individual marks. Fortunately, you do not need to perform two operations. To display a result of this type, from the Analysis menu choose Totals > Total All Using > Average. Now the average is performed on the values you see, and not on the disaggregated date in the data source:
This kind of total is sometimes referred to as a two-pass total, because the average you see in the grand total column is aggregated twice—once to derive the column or row value, and then again across column or rows to derive the grand total.

**Configuring Grand Totals**

When grand totals are turned on in the view (either row grand totals or column grand totals), you can specify how totals should be computed.

To configure grand totals, from the Analysis menu choose **Totals > Total All Using** to display a submenu:
When you choose **Current Aggregation** from the submenu, totals are computed as they always were in earlier versions of Tableau: with column and row totals based on the configured aggregation for the field. In this case, computations are based on the underlying data, which is disaggregated, and not on the data in the view. See Options for Calculating Grand Totals on page 907. And for details on how Tableau computes totals using the current aggregation, see Grand Totals and Aggregations on the next page.

You can quickly set the aggregation for a grand totals by clicking the column or row header and choosing an aggregation from the drop-down list on the tooltip:
When you choose any of the other values (Sum, Average, Minimum, or Maximum), all totals are computed using the selected aggregation. The computations are performed on the aggregated data you see in the view.

You can also configure an aggregation for a specific field in the view. To do this, right-click (Control-click on a Mac) a field in the view and choose Total Using. With the first value, Automatic, Tableau uses the currently configured aggregation for the field. If you choose any of the other values (which are other types of aggregation), that aggregation is used for totals.

**Grand Totals and Aggregations**

When you turn on grand totals, the initial values are computing using the current aggregation for the fields in the view. In this case, totals are based on the underlying data rather than the data in the view.

For example, if you are totaling the SUM(Profit) for several products, the grand total will be the sum of the sums of profit. For aggregations such as SUM, you can easily verify the grand total because a summation of a group of sums is still a summation. However, be aware that your results may be unexpected when using other aggregations, especially custom aggregations. For details, See Configuring Grand Totals on page 909. You can verify any calculation such as an aggregation or a grand total by viewing the underlying disaggregated data.

The following table summarizes the standard aggregations and the grand totals that are calculated by default when, from the Analysis menu, Totals > Total All Using is set to the default value Automatic.

<table>
<thead>
<tr>
<th>Aggregation</th>
<th>Calculation Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum</td>
<td>Shows the sum of the values shown in the row or column.</td>
</tr>
<tr>
<td>Average</td>
<td>Shows the average of the values shown in the row or column.</td>
</tr>
<tr>
<td>Median</td>
<td>Shows the median for</td>
</tr>
<tr>
<td>Aggregation</td>
<td>Calculation Description</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Count; Count Distinct</td>
<td>the values shown in the row or column.</td>
</tr>
<tr>
<td>Count Distinct</td>
<td>Shows how many values or distinct values are displayed in the rows and columns in the view.</td>
</tr>
<tr>
<td>Minimum</td>
<td>Shows the minimum value shown in the row or column.</td>
</tr>
<tr>
<td>Maximum</td>
<td>Shows the maximum value shown in the row or column.</td>
</tr>
<tr>
<td>Percentile</td>
<td>Shows the average percentile for all values shown in the row or column.</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>The grand total using standard</td>
</tr>
</tbody>
</table>
### Aggregation Calculation Description

- **deviation** is the standard deviation of the values shown in the row or column.

- **Variance**
  The grand total using variance is not the variance of the rows and columns in which they reside but rather of the underlying data behind the row or column.

---

**Subtotals**

Any data view in Tableau can include subtotals. For example, you may have a view containing the total sales for two product types broken down by specific products. In addition to seeing the sales for each product you may want to see the total sales for each product type.

You can add subtotals for all fields or for selected fields. To add subtotals for all fields, choose **Totals > Add All Subtotals** from the **Analysis** menu. You then have the option of turning subtotals off for one or more individual fields. You do this by toggling subtotals off, as per the instructions below for turning subtotals off for individual fields.

To calculate subtotals for an individual field, right-click (Control-click on a Mac) the field in the view and choose **Subtotals** from the context menu.
A check mark then appears next to Subtotals on the context menu.

You can quickly set the aggregation for subtotals by clicking the column or row header and choosing an aggregation from the drop-down list on the tooltip:

When you turn on subtotals for a specific field, the totals will change based on where that field is in the view. Consider the following example. The view below shows the sales for different product types sold across four different markets. Each product type is broken down by specific products. In addition, subtotals are turned on so that the view shows the total sales for each product type.
Now let’s move the Product Type field from the Rows shelf to the Columns shelf. The view still shows the sales for four different product types; but now, the product types are broken down by market. Because subtotals were turned on for the Product Type, the subtotals are the sum of the sales completed in each market.

Note: By default subtotals are computed on the server if you are connected to an SSAS data source and locally if you are connected to an Essbase data source using the aggregation specified in the cube. That means if you are analyzing the average sales for each product, calculating the subtotals for each product type would result in the average
sales of all products within that product type. This is not the case if you perform the computation locally instead of remotely.

**Move Totals**

By default, row grand totals and subtotals appear on the right of the view, and column grand totals and subtotals appear at the bottom of the view. You can also select to display totals on the left or top of the view.

**To move row totals to the left of the view:**

- Select **Analysis > Totals**, and then select **Row Totals to Left**.

**To move column totals to the top of the view:**

- Select **Analysis > Totals**, and then select **Column Totals to Top**.
Parameters

Parameters are dynamic values that can replace constant values in calculations, filters, and reference lines. For example, you may create a calculated field that returns true if Sales is greater than $500,000 and otherwise return false. You can replace the constant value of “500000” in the formula with a parameter. Then using the parameter control you can dynamically change the threshold in your calculation. Alternatively, you may have a filter to show the top 10 products by profit. You can replace the fixed value “10” in the filter to by a dynamic parameter so you can quickly look at the top 15, 20, and 30 products.

Creating Parameters

You can create a new parameter based on a selected field in the Data pane, or you can create a new parameter from any location where you can use a parameter (for example, as you add a reference line or create a filter). Follow the instructions below to create a new parameter from the Data pane.

1. In the Data pane, right-click (Control-click on a Mac) a field to base the parameter on and select Create > Parameter.

2. Alternatively, you can use the drop-down arrow in the upper right corner and select Create Parameter.

In the Create Parameter dialog box, give the field a Name and optionally write a Comment to describe the parameter.
Specify the data type for the values it will accept:

3.

Specify a current value. This is the default value for the parameter.

4.

Current value: 10/27/2010

5. Specify the display format to use in the parameter control.
Specify how the parameter will accept values. You can select from the following options:

- **All** - the parameter control is a simple type in field.
- **List** - the parameter control provides a list of possible values for you to select from.
- **Range** - the parameter control lets you select values within a specified range.

The availability of these options is determined by the data type. For example, a string parameter can only accept all values or a list. It does not support a range.

If you select List, you must specify the list of values. Click in the left column to type a value. Each value can also have a display alias. You can copy and paste a list of values by clicking **Paste from Clipboard**. Alternatively you can add the members of a field as the list of values by selecting **Add from Field**.
If you select **Range** you must specify a minimum, maximum and step size. For example, you can define a date range between January 1, 2010 and December 31, 2010, with the step size set to 1 month to create a parameter control that lets you select each month in 2010.

When finished, click **OK**.

The parameter is listed in the Parameters section at the bottom of the **Data** pane.

It is also available everywhere else you can use a parameter—for example, on the Top tab in the Filter dialog box, or in the Reference Line dialog box. Parameters are global across the workbook and can be used in any worksheet.

**Editing Parameters**

You can edit parameters from the Data pane or the parameter control. Follow the instructions below to edit a parameter:
1. Do one of the following:
   - Right-click (Control-click on a Mac) the parameter in the Data pane and select Edit.
   - Select Edit Parameter on the parameter control card menu.
2. In the Edit Parameter dialog box, make the modifications as necessary.
3. When finished, click OK. The parameter is updated along with any calculations that use it.

   To delete a parameter, right-click it in the Data pane and select Delete. Any calculated fields that use the deleted parameter will become invalid.

**Using Parameters in Calculations**

Parameters give you a way to dynamically modify values in a calculation. Rather than manually editing the calculation (and all dependent calculations), you can use a parameter. Then when you want to change the value, you open the parameter control, change the value, and all of the calculations that use that parameter are updated.

To use a parameter in a calculation, drag the parameter from the Data pane and drop it in the calculation editor, either at a new location in the formula or to replace a part of the current formula:

![Diagram showing parameter usage in a calculation]

**Using Parameters in Filters**

Parameters give you a way to dynamically modify values in a TopN filters. Rather than manually setting the number of values you want to show in the filter, you can use a parameter. Then when you want to change the value, you open the parameter control and the filter updates. For example, when creating a filter to show the Top 10 products based on total profit, you may want to use a parameter instead of the fixed “10” value. That way, you can quickly update the filter to show the top 10, 20, or 30 products.
A list of parameters is available in the drop-down lists on the **Top** tab of the Filter dialog box. Select the parameter you want to use in the filter.

![Filter Dialog Box](image)

To show the parameter control, right-click the parameter in the Data pane and select **Show Parameter Control**. Use the parameter control to modify the filter to show the top 10 products, 15 products, 20 products, and so on.

![Data Pane](image)

**Using Parameters in Reference Lines**

Parameters give you a way to dynamically modify a reference line, band, or box. For example instead of showing a reference line at a fixed location on the axis, you can reference a parameter. Then you can use the parameter control to move the reference line.

A list of parameters is available in the Value drop-down list in the Add Reference Line, Band, or Box dialog box. Select the parameter you want to use.
The reference line is drawn at the Current Value specified by the parameter. To open the parameter control, right-click (Control-click on a Mac) the parameter in the Data pane and then select **Show Parameter Control**. Use the parameter control to change where the reference line is drawn.

**Parameter Controls**

The parameter control is a worksheet card that lets you modify the parameter value. Parameter controls are very similar to filter cards in that they contain controls that modify the view. You can open parameter controls on worksheets and dashboards and they are included when you save to the web or publish to Tableau Server.

To open the parameter control, right-click (Control-click) the parameter in the Data pane and select **Show Parameter Control**.
Like other cards, parameter controls have a menu that you can open using the drop-down arrow in the upper right corner of the card. Use this menu to customize the display of the control. For example, you can show a list of values as radio buttons, a compact list, a slider, or a type in field. The options available on this menu depend on the data type of the parameter as well as whether it accepts all, a list, or a range of values.

Example – Add a Parameter to a Map View
This example uses the World Indicators sample data source to demonstrate the following:

- How to build a map view that shows the birth rate for each country in the world.
- How to create a calculated field that distinguishes countries with a low birth rate from those with a high birth rate.
- How to create and display a parameter so that users can set the threshold for low vs. high birth rate.
Build a map view

1. In the Data pane, double-click Latitude and then Longitude.
   Tableau puts Longitude on Columns, Latitude on Rows, and displays a map of the world.

2. Drag the Year dimension to Filters.

3. In the Filter Field [Year] dialog box, choose Years and then click Next:

4. In the Filter [Year of Year] dialog box, select 2012 and then click OK:
5. Drag the **Country** dimension to **Detail**.

6. Set the Marks type to Filled Map:
7. Drag the **Birth Rate** measure to **Label**.

You now have a map that shows birth rates for countries around the world:
You can zoom the map or hover to see a tooltip for any country.

**Create a calculated field to set a threshold**

Next, you'll distinguish a low birth rate from a high birth rate.

1. From the top menu, select **Analysis > Create Calculated Field**.

2. Name the field **High Birth Rate** and type or paste this calculation in the formula field:

   ```sql
   IF ([Birth Rate]) >= 0.014 THEN "High" ELSE "Low" END
   ```

   The value 0.014 is equivalent to 1.4%. The range of actual values that we can see on the map range from below 1% up to nearly 5%.

   When you click **OK** to apply and save this calculation, Tableau categorizes it as a dimension.

3. Drag **High Birth Rate** to **Color**.

   The map now shows low birth rate countries in one color and high birth rate countries in another:
But the definition of high birth rate as anything equal to or greater than 1.4% is arbitrary—that value was chosen because it divided the world’s countries about evenly.

Instead, you can let users define that threshold, or give them a control that they can use to see how changing the threshold changes the map. To do this, you create a parameter.

**Create a parameter**

1. Right-click (control-click on a Mac) in the Data pane and select Create > Parameter.

   **Note:** If you clicked on a field on the Data pane, some fields might be filled. You can just change the fields as needed.

2. In the Create Parameter dialog box, name the new parameter Set Birth Rate and configure it as shown:
For information on the fields in the Create Parameter dialog box, see Creating Parameters on page 917.

Because the Data Type is Float, the parameter control, when you display it in the next procedure, will be in the form of a slider. This is because floating point values are continuous—there are an infinite number of possible values.

The Current value sets the default for the parameter: 0.019 is 1.9%. The Range of values section sets the minimum and the maximum values and the step size—that is, the least amount by which the value can change.

3. Click OK.

Create and display the parameter control

Now you must connect the parameter to the High Birth Rate field.

1. Right-click High Birth Rate in the Data pane and select Edit.

2. Replace the hard-coded 0.014 value in the field definition with the parameter name:

   IF ([Birth Rate]) >= [Set Birth Rate] THEN "High" ELSE "Low" END

   Then click OK.

3. Right-click the Set Birth Rate parameter in the Data pane and select Show Parameter Control.
By default, the parameter control is shown on the right. Now you and users of your view can raise or lower this value incrementally to see how changing the definition of "high birth rate" affects the map.

**Background Images**

Background images are images that you display underneath your data in order to add more context to the marks in the view. A common use of background images is adding custom map images that correspond to a coordinate system in your data. For example, you may have data that corresponds to several floors in a building. You can use background images to overlay that data on the actual floor plan of the building to give more context. Other examples of using background images include showing a model of the sea floor, images of web pages for analyzing web logs, and even levels from video games to visualize player statistics.

While Tableau allows you to load dynamic maps from the online and offline provider, background images allow you to use your own custom images whether they are special maps or any other image that corresponds to your data.

**Adding Background Images**

When you add a background image to the view, you need to specify a coordinate system by mapping both the x and y axes to the values of fields in your database. If you are adding a map, the x and y axes should be longitude and latitude expressed as a decimal. However, you can map the axes to any relevant fields based on your own coordinate system.
To add a background image:

Select **Map > Background Images** and then select a data source.

1. In the Background Images dialog box, click **Add Image**.

2.

3. In the Add Background Image dialog box do the following:
   - Type a name for the image into the **Name** text box.
   - Click **Browse** to navigate to and select the image you want to add to the background. You can also type a URL to link to an image hosted online.
   - Select the field to map to the x-axis of the image and specify the left and right values. When adding a map, the longitude values should be mapped to the x-axis using decimal values (instead of degrees/minutes/seconds or N/S/E/W).
   - Select the field to map to the y-axis of the image and specify the top and bottom values. When adding a map, the latitude values should be mapped to the y-axis using decimal values (instead of degrees/minutes/seconds or N/S/E/W).
You can adjust the intensity of the image using the Washout slider. The farther the slider moves to the right, the more faded the image will appear behind your data.

4. You can specify the following options using the **Options** tab:
   - **Lock Aspect Ratio** - select this option to maintain the original dimensions of the image for any manipulations of the axes. Deselecting this option allows the image’s shape to be distorted.
   - **Always Show Entire Image** - select this option to avoid cropping the image when the data encompasses only a portion of the image. If you lock both the axis in a view, this option may be negated.
Add conditions for when to show the image. Refer to Filter Data from Your Views on page 630 to learn more about defining conditions.

5. Click OK.

When you add the x and y fields to the Rows and Columns shelf in the view, the background image displays behind the data. If the background image does not display, make sure that you are using the disaggregated measures for the x and y fields. To disaggregate all measures, select Analysis > Aggregate Measures. To change each measure individually, right-click the field on the shelf and select Dimension. Finally, if you’ve used the generated Latitude and Longitude fields for the x and y fields, you’ll need to disable the built in maps before your background image will display. Select Map > Background Maps > None to disable the built-in maps.

In order to make the marks in a view more visible when placed on top of a background image, each mark is surrounded by a solid contrasting color called a halo. You can turn mark halos off by selecting Format > Show Mark Halos.

Setting up the View

After you add a background image, you need to build the view in a way that matches the x and y mappings you specified for the image. That is, the fields you specified as x and y must be on the proper shelves. Follow the steps below to set up the view correctly:
1. Place the field mapped to the x-axis on the **Columns** shelf.
   If you are working with maps, the longitude field should be on the columns shelf. It may seem backward at first, however, the fields on the columns shelf determine the values distributed across the x-axis.

2. Place the field mapped to the y-axis on the **Rows** shelf.
   If you are working with maps, the latitude field should be on the rows shelf. It may seem backward at first, however, the fields on the rows shelf determine the values distributed across the y-axis.

**Managing Background Images**

You can add several background images to the workbook and then select the image or images to make active on each sheet. The Background Images dialog box lists all of the images, the required fields, and whether they are visible. The visibility is determined based on whether the required fields are used in the current view.

**Editing an Image**

After adding a background image, you can always go back and edit the x and y field mappings as well as any of the options on the Options tab.

To edit an image:

1. Select **Map > Background Images**.
   In the Background Images dialog box, select the image you want to edit and click **Edit** (you can also just double-click the image name).

2. In the Edit Background Image dialog box, make the changes to the image and click **OK**.
Enabling/Disabling Images

Although you can add multiple images to a workbook, you may want to only use a subset of the images for a particular set of worksheets. For example, you may want to show a map of the entire United States of America on one view, and maps of individual states in other views.

Use the check boxes in the Background Images dialog box to enable and disable the images for the current worksheet. You can show several images by enabling multiple images on a single worksheet. For example, you may have several images that you want to tile in the background to make a larger background image.

To enable or disable a background image:

1. Select Map > Background Images.
   In the Background Images dialog box, select the check boxes next to the images you want enabled.

2. Click OK.

Adding Show/Hide Conditions

When you add a background image and enable it, the image will be shown automatically on any worksheet that has the required fields used in the view. To avoid showing an image on all the worksheets, you can specify show/hide conditions. Show/Hide conditions are conditional statements that you define to specify when to show the image. For example, you may have a floor plan image for a multi-story building. While each image is associated with the same coordinates (the corners of the building), you do not want to show the first floor map when
looking at the third floor information. In this case, you can specify a condition to only show the first floor image when the Floor field is equal to one.

To specify show/hide conditions:

1. Select Map > Background Images and then select a data source.
2. In the Background Images dialog box, select the image you want to add a condition to and click Edit.
3. In the subsequent dialog box, select the Options tab.
   
   Click the Add button at the bottom of the dialog box.

   ![Add Background Image dialog box](image)

4. "Add..." button at the bottom of the dialog box.
Select a field to base the condition on. In the example described above, the field is Floor.

5.
Specify when you want to show the image by selecting a value of the field. For this example, one is selected.

6. 

7. Click **OK**.

   A condition statement is added to the image. In the building floor plan example, the condition statement is Only show the image when Floor is equal to One.

8. Click **OK** twice to close the Background Image dialog boxes and apply the changes.

   When you add multiple conditions, the background image will only show when all conditions are met. For example, if a background image has two conditions on Property Name and Floor, it will only show when Property is Greenwood Estates and Floor is 3.

**Removing an Image**

When you no longer want to use a background image you can either disable it or remove it, making it unavailable to all worksheets.

**To remove an image:**
1. Select **Map > Background Images**.

2. In the Background Images dialog box, select the image you want to remove and click **Remove**.

3. Click **OK**.

**Log Axes**

Sometimes you will have a measure that uses a logarithmic scale as opposed to linear. For example, some well known logarithmic scales include the Richter magnitude scale to measure the strength of earthquakes, pH to measure acidity, and the stellar magnitude scale, which measures the brightness of stars. You can edit the axis scale for any measure to be logarithmic using the Edit Axis dialog box. By default the tick marks are drawn at powers of ten, however, you can specify any base that is greater than 1.

**To change the scale of an axis:**
Right-click (Control-click on a Mac) the axis in the view and select **Edit Axis**.

1. In the Edit Axis dialog box, select **Logarithmic** for the axis scale.

2. Select the **Tick Marks** tab.

3. Select one of the following Major Tick mark options:
   - **Automatic** - the major tick marks are drawn at powers of 10.
   - **Fixed** - the major tick marks are drawn at a specified exponent. Type a number into the Powers of text box.
   - **None** - major tick marks are not shown.

4. When finished, click **OK**.

You can also reverse the axis by selecting **Reverse** in the Scale area on the General tab of the Edit Axis dialog box.

If your data contains negative values Tableau cannot plot them on a logarithmic scale. All values with a negative value will be displayed at 1 on the axis. You can then filter these records to exclude them from the view.
Optimize Workbook Performance

When we talk about *performance*, we mean the speed with which you can work in Tableau. That might mean speed of data analysis, for example, if you work in Tableau Desktop on a large corporate database that takes forever in real-time when you access it remotely. Or it might mean simply the speed of loading views or dashboards that you access on your desktop or from Tableau Server.

If you are working with small data volumes, many of the recommendations in this section are optional for you. Your workbook performance is probably as speedy as you expect.

But if you work with hundreds of millions of records, designing an efficient workbook is critically important to the speed at which you can work. We recommend that you review the topics and tips in this section before you start building your first view.

Tableau provides a number of features designed to help you optimize performance. These features are discussed throughout the help within the descriptions of tasks and workflows where you would most likely encounter them. They are also collected here in case you want make performance your focus.

Making performance improvements almost always means making trade-offs. For example: Do you sacrifice speed to make sure you have the most current data? Is it important to include *all* the data for analysis, or will a speedier subset do?

The bigger and more complicated the data, the longer it takes to interpret and render, but there are things you can do to accelerate the process. Think of fine-tuning your workbook performance as working on a puzzle with multiple pieces. This section provides you with the pieces of information, and you pick and choose which pieces solve your particular puzzle.

This section starts by discussing the big picture and then drills down to specific functionality. We start with databases, data, and extracts, and then proceed through things you can do that affect your data source, your workbooks, your calculations, and visualizations. Next, we talk about how to record and analyze workbook performance. Finally we look at how to reduce upload times to a Tableau server.

**Know Your Data at the Database Level**

Understanding the impact that certain factors in the design of your database have on Tableau performance might give you information you can use to work with your database team to optimize data at the database level.

**Enable support for referential integrity**

Databases that support referential integrity support the Tableau Assume Referential Integrity feature, which improves the performance of inner joins. Joins cost time and resources to process on the database server. When you join multiple tables in a data source, Tableau uses
functionality that is generally invisible to the user, called join culling. Join culling queries only the relevant tables instead of all tables defined in your join. Join culling only occurs where referential integrity is defined between tables. For more information, see Assuming Referential Integrity on page 361.

Make sure database permissions support creating temp tables

Does your database grant users permission to create and drop temporary tables, also known as temp tables, and does the environment have sufficient spool space for the queries being run? Tableau creates temp tables to help improve performance and add functionality. The temp tables temporarily hold information specific to a connection. If the creation of temp tables in the database is restricted, the overall performance of workbooks and views isn’t as fast as it could be. For more information, see Temp Tables in Tableau Desktop and Tableau Server in the Tableau Knowledge Base.

Create indexes for tables

Index the tables in your relational database. To successfully index your data set, identify the fields that you frequently filter on and add them to the index. If you have a field that you use as a context filter often, consider setting it as your primary index. If you are working with Access tables that have more than 200,000 rows of data, consider setting indexes on the tables. You can learn how to do this by searching for “index” in the Access online help. You can officially store 2 GB of data (approximately 1-2 million rows) in an Access database, but it performs poorly well below this limit.

Many database management system (DBMS) environments have management tools that will look at a query and recommend indexes that would help.

Break up your data

You can often improve performance if you partition a large database table into multiple smaller tables. For example, you can create a cluster of Access tables that addresses specific subsets of your data.

Use a database server

If you have a lot of data, you might consider storing it in a database server, such as Oracle, MySQL, or Microsoft SQL Server. The Professional Edition of Tableau can connect to these larger database servers.

Test Your Data and Use Extracts

You probably have no control over the hardware, processing power, and disk space that your database runs on. Or how many people access the database at any given time, how many services are running, or how robust the network is. But you can test the raw performance of the
data before you begin to build a workbook, so that you understand the environment you’re working in. And there are things you can do to affect the performance of the workbooks you create, starting with how you choose to connect to your data: the drivers you use, and whether your connection type is live or extract.

**Test as close to the data as possible**

A good way to test the raw performance of the data is to install Tableau Desktop on the computer where the data resides and to run some queries. This eliminates external factors such as network bandwidth and latency from performance results, and help you to understand the raw performance of the query in the data source.

Additionally, you can use the localhost name for the data instead of the DNS name to help determine if environmental factors such as slow name resolution or proxy servers are slowing performance.

**Connect with native database drivers**

When you connect to data with native database drivers, you will often experience significantly faster performance than when you connect to the same data with ODBC drivers. When you use native database drivers, make sure that you’re using the latest version. Database vendors are always working to improve their drivers. For a list of drivers, see [Drivers and Activation](#) on the Tableau website.

**Work with extracts instead of live data**

Depending on your data, you can choose between a live or extract connection on the data source page. A live connection is a direct connection to your data. A Tableau data extract is a compressed snapshot of data stored locally and loaded into memory as required to render a Tableau visualization. Extracts are designed to use all parts of your computer’s memory optimally.

There are several reasons to use an extract, but the main performance-related reason is if your query execution is slow. The extract data format is designed to provide a fast response to analytic queries. In this case, you can think of the extract as a query acceleration cache.

For more information about Tableau extracts, see [Extract Your Data](#) on page 409. Another reference is a three-part blog post about extracts that starts with the first post, [Understanding Tableau Data Extracts](#).

**Reduce the amount of data**

When you create an extract, use filters to exclude data that you don’t need. Also, ask yourself if you need all of the records in a data source, or if you can limit the extract to a representative sample. For more information, see [Extract Your Data](#) on page 409.
Hide unused fields

Hidden fields are not included when you create an extract. Use the Hide All Unused Fields option to hide unnecessary fields before you create an extract. This makes the extract smaller, which improves performance. For more information, see Hide or Unhide Fields on page 306.

Optimize extracts

Since an extract is a columnar store, the wider the data set, the slower the query time. You can optimize an extract by selecting a data source on the Data menu and then selecting Extract > Optimize. Optimizing an extract creates secondary structure in the extract that speeds up future queries. For more information, see Optimize Extracts on page 418.

Use extracts for file-based data

In general it’s best practice to import file-based data—text files such as CSV, Microsoft Excel spreadsheets, and Microsoft Access files, as well as statistical files like SPSS, SAS, and R—into Tableau. This makes queries perform much faster and also results in a much smaller file to store the data values.

If your data is a large text or Excel file, using an extract not only improves performance but also makes more functionality available to you. Note that if you connect Tableau to a large text file, you will be prompted to extract the data if Tableau discovers that the file is too large to perform well.

Use custom SQL with an extract

In most cases, custom SQL runs slower than queries created by Tableau. Tableau cannot perform query optimizations on custom SQL. In cases where you must use custom SQL, use an extract so that the query runs only once. For more information, see Connect to a Custom SQL Query on page 389.

Create Efficient Joins and Blends

Now that you’ve made the initial connection to your data, consider how you set up your data source—especially joins and blends—to make it efficient.

If your analysis requires data from different databases, including different workbooks or files, you should consider the impact of joining or blending your data. Joins and blends can improve performance, but they also require more processing power, and so take more time to execute.

A key factor in efficiency is reducing the amount of data you analyze. We’ll outline a few ways you can do this.
Should I join or blend my data?

When you consider joining tables or blending tables, think about where the data is coming from, the number of connections, and the number of records you have. If the workbook uses data from more than one database, you must either blend data or add another connection to the existing data source and create a cross-database join. If the workbook uses multiple tables from the same database, joining the tables can improve performance and filtering control.

For more information, see Blend Your Data on page 363.

Use blending and joins carefully

You should restrict joins to the fewest number of tables possible. In cases where you need access to many tables in a workbook, you may want to create separate data connections with joins that are tailored to a particular worksheet.

Blending queries the data from both data sources at the level of the linking fields, and then merges the results of both queries together in memory. For this reason, best practice is to avoid data blending on dimensions with many unique values (for example, Order ID, Customer ID, or exact date/time).

Reduce query time by aggregating, then blending data

If you have multiple connections to large amounts of data that take a long time to query, consider aggregating the tables, and then blending the data on the aggregate. For more information, see Data Blending with Summarized Data in the Tableau Knowledge Base. For information about aggregating data in an extract, see Quick Start: Aggregated Extracts on page 1449.

Create a primary group

If you must blend two data sources because one contains the “fact” records and the other contains dimensional attributes, you may be able to improve performance by creating a primary group or alias. Primary groups are used for one-to-many relationships and primary aliases are used for one-to-one relationships. Note that both primary groups and aliases are not dynamic and must be updated if the data changes. Consequently, they aren’t a great solution for frequently updated data, but if you need a quick mapping, they can potentially eliminate the need for costly blends. For an example, see Bring a Field into the Primary Data Source on page 373.

Design for Performance While You Build a View

You’re connected to your data, and you’ve built your data source. The next step is to begin building a view in Tableau. There are a few things to keep in mind as you build your workbook so that it will perform faster while you’re building it, as well as after it is created.
Use the Describe field to get to know your data

Rather than dragging a dimension out onto the rows shelf so that you can eyeball the data—which requires Tableau to render the data as a crosstab, one of the slowest visualization types—use the Describe field option. Right-click the field in the Data pane to view a description of the data type as reported by the data source, as well as a sample of the dimension member values.

Keep workbooks a reasonable size

The fewer worksheets and data sources in a workbook, the faster it will perform. If you have a big topic to explore and are tempted to put everything into a single monolithic workbook, reconsider. Notice if your workbook starts to slow down with the addition of a new view and additional queries. If the performance starts to suffer as you enlarge the scope of your workbook, think about breaking your workbook into separate files.

Turn off Automatic Updates

When you place a field on a shelf, Tableau generates the view by automatically querying the data. If you are creating a dense data view, the queries might be time-consuming and significantly degrade system performance. In this case, you can turn off queries in Tableau while you build the view. You can then turn queries back on when you are ready to see the result. For more information, see Turn off Automatic Updates to Boost Performance on page 1627.

Look for warnings

Tableau displays a performance warning dialog box when you attempt to place a large dimension (with many members) on any shelf. The dialog box provides four choices, as shown below. If you choose to add all members, then you might experience a significant degradation in performance.
You might also see a warning when you attempt to create too many panes in a table. In this case, Tableau warns you that the requested table "contains more than the recommended maximum number of panes." It is best not to display more than the recommended number of panes, in part because you won’t get a useful view. For more information, see Panes on page 162.

**Filter Your Data Carefully**

Filters are an effective way to restrict the amount of data for analysis. The less data to analyze, the faster the query executes. In Tableau, there are a variety of ways to filter your data. You can create a filter on a data source, you can implement a filter when you create an extract, you can filter dimensions, measures, and dates. You can create a context filter that acts as an independent filter—then any other filters you set are dependent filters because they process only the data that passes through the context filter. You can also show a filter in a view that users can interact with. For information about when filters are executed, see Tableau’s Order of Operations on page 278.

Filters provide enormous flexibility, but you should use them carefully. They can be computationally expensive, so reducing the number of filters can improve workbook performance.

**Filter your data in the data source**

When you create a filter on a data source, you reduce the amount of data in the data source. For systems that rely heavily on partitions or indexing, data source filters may yield tremendous control over the performance of queries issued by Tableau. For more information, see Filter Data from Data Sources on page 408.

**Use Keep Only filters instead of Exclude filters**

Because Exclude filters load all of the data for a dimension, they run more slowly than Keep Only filters. For more information, see Select to keep or exclude data points in your view on page 631.

**Add filters first**

If you are working with a large amount of data and have automatic updates turned off, you can inadvertently create a very slow query when you add filters to the view. Rather than building the view first, and then specifying filters, specify the filters first and then drag fields to the view. That way, when you run the update or turn on automatic updates, the filters are evaluated first.

**Use context filters sparingly**

Think of a context filter as an independent filter; any other filters you set process only the data that passes through the context filter. Only use context filters when they limit the size of the data
set significantly. If you are setting filters that significantly reduce the data set size, and that will be used for more than several data views, you should set those filters as context filters. For more information, see Improve View Performance with Context Filters on page 652. For more information about performance improvement with context filters, see Speed up Context Filters on page 653.

**Use a set to filter data**

If you want to filter a dimension to remove members based on a range of measure values, you should create a set rather than using a quantitative filter. For instance, you can create a set that only returns the Top 50 items in a dimension, rather than all of the items in a dimension.

When you create a group from a selection as described in Creating Groups on page 458, make sure you include only the columns of interest. Each additional column in the set decreases performance.

**Aggregate your data using custom SQL**

As an alternative to filters, another effective way to restrict the amount of data for analysis is to use custom SQL to aggregate measures before you bring the data into Tableau. Suppose your reviews data is stored in a SQL Server table, and for your analysis, you’re only interested in the data from the “rating” and “reviewer ID” fields. To pre-aggregate the data so that you bring into Tableau only the fields you’re interested in, you might use the following custom SQL:

```
SELECT AVG(rental_reviews.Rating) AS Rating, rental_reviews.id AS id
FROM dbo.rental_reviews
GROUP BY id
```

This custom SQL query reduces the amount of data brought into Tableau because it pre-aggregates the reviews and averages the values in the review ratings.

**Filter your cube data**

Here are some specific tips that apply to filtering cube data.

**Filter on a specific dimension**

If your cube has a single large dimension, you should set a filter directly on that dimension rather than setting a filter on another dimension or measure. For example, suppose you want to
reduce the numbers of products being displayed in a view. It is much more efficient to set the filter directly on Products or to create a computed set based on Products (such as Top 10) rather to filter other fields such as Location or Profit.

Also, avoid selecting large numbers of members from a large dimension. When a dimension is large, keep the size of the filter to less than a thousand members.

Create a set

When creating a set from a selection as described in Creating a Set on page 474, make sure you've included only the columns of interest in the Create Set dialog box. Each additional column in the group decreases performance. For example, if you create a set that contains all regions with sales between 8,000 and 15,000, but you include a column that doesn't affect the members of the set, you might notice a performance decrease. To remove extra columns, right-click the column and select Remove This Column from the context menu.

Don’t apply sorts to levels

Avoid applying sorts to levels within a very large hierarchy in a cube.

Use the Exclude command

If you are working with a dimension whose root level is greater than 1000 but less than 100,000, avoid using the Filter dialog box to filter the data. Instead, drag the dimension to a shelf and use the Exclude command in the headers context menus to limit the data that is displayed in the view.

Create Efficient Calculations

When your data doesn’t provide all the information you need to answer your questions, you can create calculated fields to help with your analysis.

Within a calculated field you can define a hardcoded constant (such as a tax rate), do very simple mathematical operations like subtraction or multiplication (for example, revenues minus cost), use more complex mathematical formulas, perform logical tests (IF/THEN, CASE), do type conversions, send expressions to external services such as R, and much more.

There are different calculation types in Tableau:

Basic and aggregate calculations: These types of calculations are generated as part of the query to the underlying data source and are calculated in the database. In general, basic and aggregate calculations scale very well, and there are many database tuning techniques that can improve their performance.

Table calculations: These calculations are calculated by Tableau on the query result set. While this means more work for Tableau, table calculations are generally done over a much smaller set of records than are in the original data source. If table calculation performance is a problem (possibly because the result set returned to Tableau is very large) consider pushing
some aspects of the calculation back to the data source layer. One way to do this is to aggregate the data and then perform the calculation on the aggregated data.

**Level of detail (LOD) expressions:** LOD expressions are generated as part of the query to the underlying data source and are calculated in the database. They are expressed as a *nested select*, so they are dependent on database performance. A table calculation or blending might perform better than a LOD expression, or vice versa.

If you suspect performance is slow due to a LOD expression, you might try replacing it with a table calculation or a data blend to see if performance improves. For an example, see Example 2 in *Tableau’s Order of Operations* on page 278.

LOD expressions can be affected by join culling, so look at *Assuming Referential Integrity* on page 361 if your queries run slowly when you use LOD expressions.

For more information, see the Tableau whitepaper *Understanding Level of Detail (LOD) Expressions*.

**Booleans and integers are faster**

When you create calculated fields, the data type you use has a significant impact on the calculation speed. Integers and Booleans are generally much faster than strings. If your calculation produces a binary result (for example, yes/no, pass/fail, over/under), be sure to return a Boolean result rather than a string.

**Use parameters for conditional calculations**

A common technique in Tableau is to show a parameter control so users can select a value that determines how a calculation is performed. Typically, to give the user easy-to-understand options, it makes sense to create the parameter as a string type. But numerical calculations are much faster than string calculations, so take advantage of the *Display As* feature of parameters: that is, show text labels but use underlying integer values for the calculation logic. For more information, see *Creating Parameters* on page 917.

**Convert date fields**

Users often have date data that is not stored in native date formats—for example, a date might be a string or a numeric timestamp. You can use the DATEPARSE function if your data supports it—this function is available for non-legacy Microsoft Excel and text file connections, MySQL, Oracle, PostgreSQL, and Tableau data extract data sources. Otherwise, parse the field into a date string such as “2012-01-01”. ISO strings are preferred because they are not locale-specific. Then pass the value to the DATE function. If the originating data is a numeric field, converting it first to a string and then to a date is very inefficient. It is much better to keep the data as numeric and use DATEADD and date literal values to perform the calculation. The performance gains can be significant with large data sets. See *Date Functions* on page 1374 for more information about these functions.
Use ELSEIF logic statements

When working with complex logic statements, remember that ELSEIF is faster than ELSE IF, because a nested IF computes a second IF statement rather than being computed as part of the first.

Aggregate measures

If the views you create are slow, make sure you are working with aggregated measures. With disaggregated data, you might be trying to view many rows of data at once. You can reduce the number of rows by aggregating the data. To do this, select Analysis > Aggregate Measures.

Calculation tips

There are lots of little things you can do that can improve calculation performance.

- Distinct counting values is one of the slowest aggregation types in almost all data sources. Use the COUNTD aggregation sparingly.
- Using parameters with a wide scope of impact (for example, in a custom SQL statement) can affect cache performance.
- Filtering on complex calculations can potentially cause indexes to be missed in the underlying data.
- Script functions like RAWSQL and SCRIPT_* for integrating with external services can be slow, particularly if there are lots of values that need to be passed back and forth from the DBMS/R server.
- Use NOW only if you need the time stamp level of detail. Use TODAY for date level calculations.
- Remember that all basic calculations are passed through to the underlying data—even literal calculations like label strings. If you need to create labels (for example, for column headers) and your data is very large, create a simple text/Excel file data source with just one record to hold them so they don’t add overhead on the big data source.

Make Visualizations Faster

You’ve put in a lot of work to make your visualization—view, dashboard, or story—make a point or tell a story. You don’t want to lose your audience while you wait for the visualization to load. By following the guidelines in this topic, you can improve the speed of your visualizations.

Reduce the scope

Whether you’re creating a view, dashboard, or story, it’s tempting to pack a lot of information into your visualization because it’s so easy to add more fields and calculations to the view and
more sheets to the workbook. But the result can be that the visualization becomes slower and slower to render.

Remember that each worksheet runs one or more queries against the data, so the more sheets, the longer it takes to render the visualization.

Take advantage of the fact that Tableau is designed to deliver interactive visualizations to your users, and spread the data out across multiple visualizations, if you can. Be strategic when designing your visualization—the fewer sheets and data sources, the faster your visualization will perform.

**Limit the number of filters you show in the view**

Filters that you show in your view (formerly called quick filters) are a very powerful feature of Tableau that you can use to create rich, interactive visualizations for your users. See the filters highlighted on the right in the following screenshot:

![Screenshot of Tableau visualization](image)

When you add an interactive filter to a view, each filter in the view requires a query in order to populate the options. If you add a lot of interactive filters to your dashboard, it can cause the dashboard to take a long time to render.
Also, when you use “show relevant values” on a filter, it requires a query to update the shown values each time other filters are changed. Use this feature sparingly.

**Reduce the number of marks on the view**

While there is no hard and fast rule on what defines “too many marks,” be aware that more marks means that more processing power and memory is required to render them. You can find the number of marks by looking at the lower left of the Tableau Desktop window in the status bar. Watch out for large crosstabs and for maps with complex custom polygons. Keep in mind that too many data points on a view can also reduce the visual analytics value by causing information overload.

To avoid this problem, compile related views and connect them with action filters so that you can go from an overview to a more granular view as you explore the data. Make sure that you remove any unneeded dimensions from the **Detail** shelf. You can also try displaying your data in different types of views to see what’s most effective.

**Zoom without filtering**

When users zoom in on a visualization with a large number of marks, Tableau doesn’t filter out the marks you can’t see. What changes is the view of the data, not the total number of marks. If you only need a subset of the data, filter out the data you don’t need.

**Record and Analyze Workbook Performance**

Your workbook is done and you’re wondering if its performance is taking a little longer than it should. To find out what’s slowing it down, you can use a performance recording to evaluate your workbook. This is an especially good idea if you plan to share or publish the workbook.

The Performance Recording feature in Tableau records performance information about key events as you interact with a workbook. You can then view performance metrics in a workbook that Tableau creates to analyze and troubleshoot different events that are known to affect performance:

- Query execution
- Geocoding
- Connections to data sources
- Layout computations
- Extract generation
- Blending data
- Server blending (Tableau Server only)

Tableau support may ask that you create a performance workbook as they work with you to diagnose performance issues.
Create a performance recording in Tableau Desktop

To start recording performance, follow this step:

**Help > Settings and Performance > Start Performance Recording**

To stop recording, and then view a temporary workbook containing results from the recording session, follow this step:

**Help > Settings and Performance > Stop Performance Recording**

You can now view the performance workbook and begin your analysis.

If you are sending the recording to Tableau Support, save this workbook as a packaged workbook (.twbx) file, and then send it.

Interpret a performance recording workbook

A performance recording workbook is a Tableau dashboard that contains three views: **Timeline**, **Events**, and **Query**.

**Timeline**

The uppermost view in a performance recording dashboard shows the events that occurred during recording, arranged chronologically from left to right. The bottom axis shows elapsed time since Tableau started, in seconds.

In the Timeline view, the **Workbook**, **Dashboard**, and **Worksheet** columns identify the context for events. The **Event** column identifies the nature of the event, and the final column shows each event’s duration and how it compares chronologically to other recorded events:

**Events**

The middle view in a performance recording workbook shows the events, sorted by duration (greatest to least). Events with longer durations can help you identify where to look first if you want to speed up your workbook.
Different colors indicate different types of events. The range of events that can be recorded is:

- **Computing layouts**
  If layouts are taking too long, consider simplifying your workbook.

- **Connecting to data source**
  Slow connections could be due to network issues or issues with the database server.

- **Executing query**
  - For live connections, if queries are taking too long, it could be because the underlying data structure isn’t optimized for Tableau. Consult your database server’s documentation. As an alternative, consider using an extract to speed performance.
  - For extracts, if queries are taking too long, review your use of filters. If you have a lot of filters, would a context filter make more sense? If you have a dashboard that uses filters, consider using action filters, which can help with performance.

- **Generating extract**
  To speed up extract generation, consider only importing some data from the original data source. For example, you can filter on specific data fields, or create a sample based on a specified number of rows or percentage of the data.

- **Geocoding**
  To speed up geocoding performance, try using less data or filtering out data.

- **Blending data**
  To speed up data blending, try using less data or filtering out data.

- **Server rendering**
  You can speed up server rendering by running additional VizQL Server processes on additional machines.

**Query**

If you click on an **Executing Query** event in either the **Timeline** or **Events** section of a performance recording dashboard, the text for that query is displayed in the Query section. For example:
If it makes sense, you can use the query text to work with your database team on optimizing at the database level. Sometimes the query is truncated and you’ll need to look in the Tableau log to find the full query. Most database servers can give you advice about how to optimize a query by adding indexes or other techniques. See your database server documentation for details.

Sometimes for efficiency, Tableau combines multiple queries into a single query against the data. In this case, you may see an **Executing Query** event for the Null worksheet and zero queries being executed for your named worksheets.

**Reduce Upload Times to Tableau Server**

You’ve created your workbook and analyzed its performance recording to make sure that it’s been optimized for speed. Now you’re ready to publish the workbook to Tableau Server. It isn't always possible to reduce upload times to Tableau Server, but here are some considerations to keep in mind.

**Avoid publishing packaged workbooks**

It is a best practice to publish workbooks (.twb files) and data sources separately, rather than publishing them together as packaged workbook (.twbx files). This may not make your initial uploads of workbooks and data sources any faster than publishing them together, but it makes republishing workbooks faster (if you don’t have to also republish data sources), and it makes data sources available online for new workbooks. For data sources that are extracts, it also allows you to schedule automated refreshes.

**Make extracts smaller**

For Tableau extracts, you can help speed uploads by making your extract smaller. As you create extracts, consider:

- Removing unused fields from extracts.
- Making extracts smaller with sampling and filtering.
- Aggregating data for visible dimensions.

**See also**

Extract Your Data on page 409
Publish a Data Source on page 1122
Present your work

The ideal visualization combines science with art. With formatting, dashboards, and stories you can make your data discoveries clearer, more persuasive, and beautiful.

Formatting

Formatting is an important part of both your analysis and presentation. You can format almost everything you see on a worksheet including the fonts, shading, alignment, borders, and graph lines. For example, in a text table you may want to add banded shading to help you visually separate consecutive groups of rows or columns. In a scatter view with reference lines you may want to change the line thickness and color. All of these settings can be changed using the Format window.

Most often you will want to specify format settings for the entire worksheet, all rows, or all columns. However, Tableau also allows you to format individual parts of the view as well. For example, you can format specific fields, resize the cells and the table, and edit individual axes.

Visual Best Practices

The fonts, colors, shading, alignment, borders, and grid lines in your visualization are important parts of both your analysis and the story you’re telling. Tableau products are designed so that you can create great-looking visualizations that use visual best practices by default, freeing you from the need to think about things like fonts and colors—unless you want to.

If you do want to customize, you can control the look of almost everything you see on a worksheet. This topic outlines visual best practices and tips to keep in mind while you customize, from ideal workflow to how to get the most out of tooltips.

Format from largest to smallest

As you change the look and feel of your work, use a "biggest to smallest" workflow. Start by formatting fonts and titles at the workbook level, then move on to the worksheet level. Save formatting the individual parts of a view for last. A workbook is the largest possible "container" for formatting changes and making changes at that level first will save you time.
See Change Formatting at the Workbook Level on page 977, Change Formatting at the Worksheet Level on page 980, and Format Parts of a View on page 986 for details.

**Change color with purpose**

If you want to change the colors used by your visualization, Tableau makes it easy: just click the Color card, then Edit Colors. For example, maybe you want to emphasize a key finding. You can use neutral colors with a single, bright color to highlight what you want your viewers to pay attention to. If you want to match your company’s brand, you can create a custom palette. See Create Custom Color Palettes on page 1009 for steps.

When you change colors, keep the following best practices in mind.

**Discrete fields and categorical palettes**

Discrete fields are ones where the field's values are unique. One example of this is customer names. Tableau automatically associates discrete fields with *categorical* palettes, which have colors that are designed to be distinct from one another yet also work well together in the visualization as a whole.
Continuous fields and quantitative palettes

With continuous fields, the field's values are part of a whole (such as sales over time). Tableau automatically associates these fields with *quantitative* palettes, where colors are along a continuum or range. If the field's values are positive, a single-color range is best:

If there are both positive and negative values, choose a two-color range:

**Limit colors**
Color used correctly can enhance analysis. Too many colors can create visual overload for your users and impede analysis. In the view below, the stacked bars represent cell phone subscriptions and the trend line is internet usage over time. In the first image, Years is on the **Colors** shelf. Notice how hard it is to pick out the trend line among all the other colors and how easy it is to spot the trend line in the second image, where there are only two colors.

**To many values on colors**

Click the image to replay it.

**Use fonts that optimize online readability**

The fonts in the Tableau typeface were designed to be paired with data visualizations and are optimized for legibility at small sizes. Tableau visualizations use them by default.
If you need to use a different font, choose one that optimizes readability online, such as the following:

- Arial
- Trebuchet MS
- Verdana
- Times New Roman
- Lucida sans

**Reinforce your story with tooltips**

A person looking at your dashboard will intuitively use his or her mouse to explore marks, and this makes tooltips appear. Tooltips appear by default for most views and they are a great way to reinforce your data story. You can customize your tooltips by clicking Worksheet > Tooltip.

For example, here’s a tooltip for a view on pageviews for a web site:
Here’s an example of how the above tooltip could be rewritten and formatted to highlight what’s important to the people looking at this view:

You can also rewrite your tooltips to tell a mini-story. For example, here’s a tooltip about the number of oil rigs in Italy.

Below, the tooltip is rewritten as a phrase and key elements have been put in bold to draw the viewer’s attention.
Consider your axes

By default, an axis range in Tableau will automatically adjust, based on the data in your visualization. Filtering and other actions can change the axis range. If you are trying to create a specific comparison between two views, changing axes ranges can make analysis difficult for your users. If this is the case, you can set your axes to a specific, fixed range. For steps on how to do this, see Try it: Change the Axis Range on page 967.

If you’re working with data that has a very large range, a fixed axis may not be practical. If this is the case, add grid lines to your visualization. Grid lines can help your users stay oriented when the axis automatically adjusts. See Format lines on page 984 for more information.

Edit Axes

When you add a measure to the Columns or Rows shelf, you add an axis to the view. An axis shows data points that lie within a range of values.

For each axis you can specify the range, scale, and tick mark properties. Axis formatting options are available in the Edit Axis dialog box.

When you select an axis, the marks associated with the axis are not selected so that you can edit and format the axis without modifying the marks. To select the marks, right-click the axis and select Select Marks. You can also select each mark individually. For more information, see Select Marks on page 522.

Change an axis range

You can limit the axis range to focus the view to where the data points lie. For example, you may have a view showing sales over four years. The automatic axis may range from 0 to $750,000 but your sales never went below $470,000. You could adjust the Axis Range so that it starts at $470,000 thus focusing on where the data points actually lie.

To change an axis range:
1. Right-click (control-click on Mac) on the axis that you want to edit and select **Edit Axis**.

2. In the **Edit Axis** dialog box, select one of the following options:
   - **Automatic**. Automatically bases the axis range on the data used in the view.
   - **Uniform axis range for all rows or columns**. Sets the axis range uniformly to the maximum data range for all panes in the view.
   - **Independent axis ranges for each row or column**. Makes the axis range independent. The axis range varies for each pane in the view, depending on the range of data in each pane.
   - **Fixed**. Specifies to start and/or end the axis at a specific value. You can fix both ends of the axis or only one end. When you fix both ends of the axis, the axis range is determined by the values you specify. When you fix only one end of the axis, you must set the other end of the axis as automatic, uniform, or independent.

3. You can also specify whether to include zero. When you clear the **Include zero** check box, the axis range adjusts to show only the range of values in the data.

4. Click **OK**.

**Change the appearance of an axis**
Every axis has a title that is automatically generated based on the fields in the view. You can specify a custom axis title and add a subtitle using the Edit Axis dialog box. You can also specify the scale of the axis, such as whether to use a logarithmic scale or whether to reverse the axis.

**To change the appearance of an axis:**

1. Right-click (control-click on Mac) on the axis that you want to edit and select **Edit Axis**.
2. In the Edit Axis dialog box, type a new title in the **Title** text box.

3. To add a custom subtitle, clear the **Automatic** check box.
4. To change the scale of the axis, select one of the following options:
   - **Reversed**: select this option to reverse the order of values on the axis.
   - **Logarithmic**: select this option to use a logarithmic scale on the axis.
5. Click OK.

**Format tick marks**

You can specify how often the tick marks are displayed along the axis. Tableau allows you to modify both the Major and Minor tick marks. Major tick marks are accompanied by unit labels while Minor tick marks simply represent smaller increments between the major marks. You can choose to use automatic or fixed tick marks or have none at all.

**To format tick marks:**

1. Right-click (control-click on Mac) the axis you want to edit and select **Edit Axis**.
2. In the Edit Axis dialog box, select the **Tick Marks** tab.
3. For both **Major** and **Minor tick marks**, select from one of the following options:
   - **Automatic** - select this option to automatically show tick marks based on the data in the view.
   - **Fixed** - select this option to specify how often the tick mark should display and the starting value.
   - **None** - select this option to hide the tick marks completely.
4. Click **OK**.

**Try it: Change the Axis Range**

In this example you will build three views using the same data. However, each view will use a different axis range format. These views use the **Sample-Superstore** data source to display the aggregated total sales for three product categories over the course of four years.

**Build a view with a uniform axis range**

A uniform axis range means that the same range is applied to each row or column in your view. The range is automatically generated based on the underlying data values.

1. Place the **Order Date** dimension on the **Columns** shelf and the **Category** dimension on the **Rows** shelf.
2. Place the **Sales** measure on the **Rows** shelf.

   The measure is automatically aggregated as a summation and an axis is added to the view. By default the view uses a uniform axis range. Notice that the axis range is the
same, from zero to 250,000 for each product category.
Build a view using independent axis ranges

When you use an independent axis range, each row or column will have its own axis range based on the underlying data values.

1. Right-click (control-click on Mac) the SUM(Sales) axis in the view and select **Edit Axis**.

2. In the Edit Axis dialog box, select **Independent axis ranges for each row or column**.

3. Click **OK**.
The axis range for each product category are now independent from each other. The Technology and Office Supplies categories still range from zero to 250,000, but the Furniture category ranges from zero to a little over 200,000.
Build a view using a fixed axis range

You can fix one or both ends of an axis in order to customize how much of the data you can see in the view.
The first example shows how to fix both ends of the axis. The second shows how to fix only one end of the axis, and then define the axis range for all panes in the view.

**To fix both ends of the axis:**

1. Right-click (control-click on Mac) the **SUM(Sales)** axis in the view and select **Edit Axis**.
2. In the Edit Axis dialog box, select **Fixed**, and then define **Start** and **End** values either by typing into the text boxes or by dragging the sliders toward each other. For this example, type **0** for **Start** and **200,000** for **End**.

![Edit Axis dialog box](image)

3. Click **OK**.
The categories now display only up to $200,000 in sales. The axes are marked with a pin symbol ⭐️, which indicates that you have limited the axis range and that some data might not be displayed.
To fix one end of the axis:

1. Right-click (control-click on Mac) the SUM(Sales) axis in the view and select Edit Axis.
2. In the Edit Axis dialog box, select Fixed, click the Fixed End drop-down menu, and then
3. Click **OK**.

Notice that the categories now have slightly different axis ranges. For example, Office Supplies has an axis range from 0 to 250,000 dollars, while Furniture only has a range from 0 to 200,000 dollars.
For more information about the difference between automatic, uniform, and independent axis ranges, see Edit Axes on page 964.
**Change Formatting at the Workbook Level**

You can quickly change how fonts and titles look in every view in a workbook by specifying format settings at the workbook level instead of at the worksheet level. For example, you might want to use a specific font, size, and color for every worksheets' title, but leave your dashboard titles the way they are.

You can also change the theme used by your workbook. Themes control items like the default font, colors, and line thickness. When you create a new workbook, it automatically uses the Default theme, which incorporates visual best practices.

**Change all fonts in your workbook**

You can change all fonts in your workbook or you can change fonts for only certain areas, such as just worksheet titles.

**To change fonts in a workbook:**

1. On the **Format** menu, select **Workbook**.

2. The **Format Workbook** pane replaces the **Data** pane on the left and provides a series of drop-down lists where you can change all font settings in a workbook, as well as the font settings for titles of worksheets, stories, and dashboards.
If you have made font changes at the worksheet level, such as on a filter card or a worksheet title, changing the font at the workbook level will overwrite those changes.

**Upgrade or change your workbook theme**

If your workbook is set to a theme other than Default, it will retain that theme when you upgrade from one version of Tableau to another, but you can easily change the theme to Default. Conversely, you can change your workbook's theme from Default to a different, earlier theme.

If you upgraded from version 9.3 to version 10.0 and your theme was set to Default in version 9.3, it will be set to Previous in version 10.0. After you switch to the Default theme, check your
workbook to confirm that items are sized appropriately. You might need to make some manual adjustments.

**To change your workbook theme:**

1. On the **Format** menu, select **Workbook Theme**.
2. Choose a theme.

Each theme is associated with a different version of Tableau Desktop.

<table>
<thead>
<tr>
<th>This workbook theme...</th>
<th>Is associated with these Tableau versions...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Default</td>
<td>Version 10.x</td>
</tr>
<tr>
<td>Previous</td>
<td>Versions 8.0.x – 9.3.x</td>
</tr>
<tr>
<td>Modern</td>
<td>Versions 3.5 – 7.0.x</td>
</tr>
<tr>
<td>Classic</td>
<td>Versions 1.0 – 3.2</td>
</tr>
</tbody>
</table>

**Reset a workbook to its default settings**

When you make changes to your workbook's font settings, a gray dot appears next to the setting in the **Format Workbook** pane. You can quickly switch back to default settings using the **Reset to Defaults** button.

**To return your workbook to its default settings:**
1. On the **Format** menu, select **Workbook**.

2. In the **Format Workbook** pane, click **Reset to Defaults**.

---

**Change Formatting at the Worksheet Level**

You can format settings for fonts, alignment, shading, borders, lines and tooltips at the worksheet level. When you make formatting changes at this level, they apply only to the view you’re working on.

For example, you might want to remove all the borders in a text table, or add shading to every other column in a view.

To access these settings, select the **Format** menu, then choose the part of the view, such as **Font**, or **Border**, that you want to format.

You can also copy and paste formatting at the worksheet level.

To make large-scale formatting changes to every view in your workbook, the best place to start is at the workbook level. See *Change Formatting at the Workbook Level* on page 977 for details on what you can change.

**Format fonts**

For a view, you can specify the font, style, size, and color for either the pane text or header text,
or both. For example, in the view below, the header text is set to use the Tableau Bold font.

If you have totals or grand totals in the view, you can specify special font settings to make these values stand out from the rest of the data. This is particularly useful when you are working with a text table. The view below shows a text table in which the grand totals are formatted to be dark red.

Format text alignment

Tableau uses visual best practices to determine how text is aligned in a view, but you can also customize text. For example, you can change the direction of header text so that it is horizontal
(normal) instead of vertical (up).

For each text area you can specify the following alignment options:

**Horizontal** - Controls whether text aligns to the left, right, or center.

**Vertical Alignment** - Controls whether text aligns at the top, middle, or bottom.

**Direction** - Rotates text so that it runs horizontally (normal), top-to-bottom (up), or bottom-to-top (down).

**Wrap** - Controls whether long headers and pane text wrap to the next line or are abbreviated.

**Note:** If cells are not large enough to show more than one row of text, turning on wrapping will have no visible effect. If this happens, you can hover the cursor over a cell until a double-sided arrow appears, and then click and drag down to expand the cell size.

**Format shading**

Shading settings control the background color of the pane and headers for totals, grand totals,
as well as for the worksheet areas outside those areas.

You can also use shading to change or add banding. Banding is when the background color alternates from row to row or column to column. Banding is useful for text tables because the alternating shading helps your eye distinguish between consecutive rows or columns.

Table with Banding

<table>
<thead>
<tr>
<th>Location</th>
<th>Row</th>
<th>Column</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinton St &amp; Washington Blvd</td>
<td>1,033</td>
<td>2,873</td>
</tr>
<tr>
<td>Canal St &amp; Jackson Blvd</td>
<td>942</td>
<td>2,355</td>
</tr>
<tr>
<td>Clinton St &amp; Madison St</td>
<td>994</td>
<td>1,946</td>
</tr>
<tr>
<td>Franklin St &amp; Jackson Blvd</td>
<td>1,649</td>
<td>1,829</td>
</tr>
<tr>
<td>Daley Center Plaza</td>
<td>1,147</td>
<td>1,772</td>
</tr>
<tr>
<td>Michigan Ave &amp; Lake St</td>
<td>2,919</td>
<td>1,522</td>
</tr>
<tr>
<td>Dearborn St &amp; Adams St</td>
<td>1,456</td>
<td>1,464</td>
</tr>
<tr>
<td>Clark St &amp; Randolph St</td>
<td>956</td>
<td>1,447</td>
</tr>
<tr>
<td>Clinton St &amp; Lake St</td>
<td>701</td>
<td>1,370</td>
</tr>
<tr>
<td>Dearborn St &amp; Monroe St</td>
<td>838</td>
<td>1,353</td>
</tr>
<tr>
<td>State St &amp; Kinzie St</td>
<td>1,957</td>
<td>1,304</td>
</tr>
<tr>
<td>Kingsbury St &amp; Erie St</td>
<td>877</td>
<td>1,049</td>
</tr>
</tbody>
</table>

For banding on rows or columns, you can use the following options:

**Pane and Header** - The color the bands use.

**Band Size** - The thickness of the bands.

**Level** - If you have nested tables with multiple dimensions on the rows and columns shelves, this option allows you to add banding at a particular level.

**Format borders**
Borders are the lines that surround the table, pane, cells, and headers in a view. You can specify the border style, width, and color for the cell, pane, and header areas. Additionally, you can format the row and column dividers. For example, in this view the **Row Divider** borders are formatted to use an orange color:

Row and column dividers serve to visually break up a view and are most commonly used in nested text tables. You can modify the style, width, color, and level of the borders that divide each row or each column using the row and column divider drop-downs. The level refers to the header level you want to divide by.

**Format lines**

You can control the appearance of the lines that are part of the view, such as grid lines and zero lines, as well as lines that help you inspect data, such as trend lines, reference lines, and drop lines.

For example, you can set trend lines to use a red color and an increased thickness:
Format highlighters

The highlighter on your worksheet can be formatted to use a different font, style, color, background color, font size, and border. Formatting highlighters allows you to better integrate them into your dashboard or worksheet style. You can also edit the title that displays on each highlighter that shows in the view.

For more information about using highlighters, see Highlight Data Points in Context on page 1027.

To format highlighters:

1. Select Format > Highlighters or click the drop-down arrow on the highlighter and select Format Highlighters.
2. In the Format pane, specify settings for the title and body of the highlighters.

Copy and paste worksheet formatting

After you format a worksheet, you can copy its formatting settings and paste them into other worksheets. The settings that you can copy are anything you can set in the Format pane, with the exception of reference lines and annotations. Adjustments like manual sizing and level of zoom are not copied.

To copy and paste formatting between worksheets:

1. Select the worksheet from which you want to copy formatting.
2. Right-click (control-click on Mac) the worksheet tab and select Copy Formatting.
3. Select the worksheet you want to paste the formatting into.
4. Right-click (control-click on Mac) the worksheet tab and select Paste Formatting.
Format Parts of a View

After you apply formatting settings on a large scale such as the entire workbook or worksheet level, you might want to format only certain parts of a view, such as a single title. To specify individual format settings, right-click (control-click on Mac) a specific part of the view and select Format.

Format Fields and Field Labels

You can format a specific field in a view, as well as individual field labels. When formatting is done this way, your formatting changes are scoped to only where the field appears in the view, or only an individual label.

Format a field

In the view below, the **Month(Order Date)** field has been formatted so that the headers use the Tableau Semibold font, in blue. Notice that the header values along the Profit axis are not affected.

To format a specific field:
1. Right-click (control-click on Mac) the field and select **Format**.

The **Format** pane opens to settings for the selected field.

2. Make your changes in the **Format** pane.

   For discrete fields, such as Region or Customer Name, you can specify font and alignment properties for both header and pane areas. For continuous fields, such as Profit or Sales, you can format font properties for the pane and axis as well as number and tick mark colors. For more information about other axis options, see **Edit Axes** on page 964. The view is updated as you make changes so you can quickly see the colors and formats that work with your view.

**Format a field label**

Field labels are row and column headings that indicate the data fields used to create a view. By default, Tableau shows field labels, but you can choose to hide them. When field labels are showing they appear in three different parts of the view: rows, columns, and the corner. The view below shows an example of each of these types of field labels.
You can format the font, shading, alignment, and separators for each of these types of field labels.

**To format a specific field label:**

1. Right-click (control-click on Mac) the field label in the view and select **Format**.
2. In the **Format** pane, specify the settings of the font, shading, and alignment field labels.

**Note:** When you have multiple dimensions on the rows or columns shelves, the field labels appear adjacent to each other in the table. Each field label is separated from the others with a forward slash symbol. Specify a different separator in the **Format** pane.

**Format Numbers and Null Values**

When you format a measure, you can specify the number format for both the axis and the pane text. You can select from a set of standard formats, such as number, currency, scientific, and percentage; or you can define a custom number format using Microsoft Excel style format codes.

When a measure contains null values, the nulls are usually plotted as zero. You can use formatting, however, to handle the null values in a different way, such as hiding them.

**Specify a number format**

1. Right-click (control-click on Mac) a measure or axis in the view and select **Format**.
2. In the **Format** pane, click the **Numbers** drop-down menu.
3. Select a number format.

Some formats require additional settings. For example, if you select **Scientific**, you must also specify the number of decimal places.
Here are the number formats and associated options available in Tableau.

<table>
<thead>
<tr>
<th>Number Format</th>
<th>Format Options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Automatic</strong>: format</td>
<td>None.</td>
</tr>
<tr>
<td>is automatically</td>
<td></td>
</tr>
<tr>
<td>selected based on</td>
<td></td>
</tr>
<tr>
<td>either the format</td>
<td></td>
</tr>
<tr>
<td>specified by the</td>
<td></td>
</tr>
<tr>
<td>data source or the</td>
<td></td>
</tr>
<tr>
<td>data contained in the</td>
<td></td>
</tr>
<tr>
<td>field.</td>
<td></td>
</tr>
<tr>
<td><strong>Number (Standard)</strong></td>
<td>Locale: number</td>
</tr>
<tr>
<td>format is based on</td>
<td>format changes</td>
</tr>
<tr>
<td>locale selected.</td>
<td>based on the</td>
</tr>
<tr>
<td></td>
<td>geographical</td>
</tr>
<tr>
<td></td>
<td>location</td>
</tr>
<tr>
<td></td>
<td>selected.</td>
</tr>
<tr>
<td><strong>Number (Custom)</strong></td>
<td>Decimal</td>
</tr>
<tr>
<td>format is</td>
<td>Places: the</td>
</tr>
<tr>
<td>Number Format</td>
<td>Format Options</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td>customized to your choice.</td>
<td>number of decimal places to display.</td>
</tr>
<tr>
<td></td>
<td>Negative Values: how negative values are displayed.</td>
</tr>
<tr>
<td></td>
<td>Units: the number is displayed using the specified units. For example, if the number is 20,000 and the units are thousands, the number will be displayed as 20K.</td>
</tr>
<tr>
<td></td>
<td>Prefix/Suffix: characters that precede and follow each displayed number.</td>
</tr>
<tr>
<td></td>
<td>Include thousands separators: whether the</td>
</tr>
<tr>
<td>Number Format</td>
<td>Format Options</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>number shows separators every thousand (example: 100,000 vs. 100000).</td>
</tr>
</tbody>
</table>

**Currency (Standard):** format and currency symbol is based on locale selected.

**Locale:** currency format based on the geographical location selected.

**Currency (Custom):** format and currency symbol is customized to your choice.

**Decimal Places:** the number of decimal places to display.

**Negative Values:** how negative values are displayed.

**Units:** the number is displayed using the specified units. For example, if the number is 20,000
<table>
<thead>
<tr>
<th>Number Format</th>
<th>Format Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>and the units are thousands, the number is displayed as 20K.</td>
</tr>
<tr>
<td></td>
<td>Prefix/Suffix: characters that precede and follow each displayed number.</td>
</tr>
<tr>
<td></td>
<td>Include thousands separators: whether the number shows separators every thousand (example: 100,000 vs. 100000).</td>
</tr>
<tr>
<td>Scientific:</td>
<td>Decimal: the number of decimal places to display.</td>
</tr>
<tr>
<td>Percentage:</td>
<td>Decimal: the number of decimal places to display.</td>
</tr>
<tr>
<td>Number Format</td>
<td>Format Options</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------</td>
</tr>
<tr>
<td>symbol. The value of 1 is interpreted as 100% and 0 as 0%</td>
<td></td>
</tr>
<tr>
<td><strong>Custom:</strong> format is based entirely on what is specified in the format options.</td>
<td>Custom: type in the format you want to use. This format can be specified by an Excel style number code. See Number format codes in the Microsoft Knowledge Base for details.</td>
</tr>
</tbody>
</table>

**Set the default number format for a field**

Right-click (control-click on Mac) the field in the Data pane and select Default Properties > Number Format.

In the subsequent dialog box, specify a number format to be used whenever the field is added to the view. The default number format is saved with the workbook. It is also exported when you export the connection information.

**Note:** Formatting numbers using the Format pane overrides any number formatting applied elsewhere.

**Format a measure as currency**

The view in the following image shows profit over time. Notice that the profit figures on the vertical axis are not formatted as currency.
To format the numbers as currency:

1. Right-click the Profit axis and choose Format.

2. On the Axis tab in the Format pane, under Scale, select the Numbers drop-down list, and then select one of the following:

   Currency (Standard) to add a dollar sign and two decimal places to the figures.
Currency (Custom) to specify the number of decimal places, how to show negative values, the units, whether to include a prefix or suffix, and whether to include a separator character.

Use locale to specify number formats

By default, Tableau uses your computer’s locale and language settings to format numbers. But you can explicitly set a different locale in the Format pane.

The following steps show how to set Swiss German currency, using the same view as in the previous section.

1. Right-click the Profit axis and select Format.
2. On the Axis tab, under Scale, select the Numbers drop-down list and then select Currency (Standard).
3. In the Locale drop-down list, items appear in a Language (Country) format. For this example, select German (Switzerland).
The view updates to show the sales figures in Swiss Francs, formatted for the German language.

**Tip:** You can change the default currency setting so that every time you drag the Profit measure to a view it uses the settings you want. In the Measures pane, right-click Profit (or other monetary measure), and select Default Properties > Number Format. Then format the field as shown above.
Format null values

When a measure contains null values, they are usually plotted in a view as zero. However, sometimes that changes the view and you’d rather just suppress null values altogether. You can format each measure to handle null values in a unique way.

To format null values for a specific field:

1. Right-click the field in the view that has the null values (Control-click on a Mac) and choose Format.
2. Go to the Pane tab.
3. In the Special Values area, specify whether to show the null values using an indicator in the lower right corner of the view, plot them at a default value (e.g., zero for number fields), hide the values but connect lines, or hide and break lines to indicate that null values exist.
4. If you specify text in the **Text** field, it will appear in the view for null values when mark labels are turned on. See **Mark Labels** on page 504.

**Note**: The Special Values area is not available for Date values.

**Format Titles, Captions, Tooltips and Legends**

You can show titles, captions, and tooltips on any sheet. After you add a title or caption you can edit and format the text as well as modify the shading and border. If a title or caption is not
showing, from the top menu, go to the menu for the current sheet type (Worksheet, Dashboard, or Story) and select Show Title or Show Caption.

A legend card appears in the worksheet when you encode marks by dropping them on the Color or Size cards. You can format the legend font, shading, border, and alignment. You can also edit the titles that appear on each legend.

### Format and edit titles, captions, and legend titles

1. Do one of the following:
   - Right-click (control-click on Mac) the item you want to change and select Edit <item>, for example, Edit Title.
   - On worksheets, hover on the title, click the drop-down arrow on the right-hand side and select Edit Title or Edit Caption from the context menu.

2. In the Edit dialog box, modify the text and format the font, size, style, color, and alignment. Use the Insert menu to add dynamic text such as sheet properties and field values. Click OK.

   ![Edit Title Dialog](image)

   To reset the title back to the default, click Reset.

### Format the borders and shading of a title, caption, or legend

1. Right-click (control-click on Mac) the title, caption, or legend and select Format <item>—for example, Format Title.

2. In the Format pane, use the drop-down lists to change the default shading and border.
Format and edit tooltips

Tooltips are details that appear when you rest the pointer over one or more marks in the view. Tooltips also offer convenient tools to quickly filter or remove a selection or view underlying data. You can edit the tooltip to include both static and dynamic text. You can also modify which fields are included in the automatic tooltip.

To edit a tooltip:

1. Select **Worksheet > Tooltip**. Tooltips are specified for each sheet and can be formatted using the formatting tools along the top of the Edit Tooltip dialog box. Use the **Insert** menu at the top of the dialog box to add dynamic text such as field values, sheet properties, and more.
2. Use the formatting tools along the top of the Edit Tooltip dialog box.

3. (Optional): Use the **Insert** drop-down list at the top of the dialog box to add dynamic text such as field values, sheet properties, and more.

   The **All Fields** option on the **Insert** menu adds all field names and values that are used in the view. Inserting the All Fields parameter updates the tooltip as you change the view. You can also use the All Fields option to exclude fields.

4. (Optional): Select the **Include command buttons** option to show filtering and view data options in the tooltip. For example, including command buttons will add **Keep Only**, **Exclude**, and **View Data** buttons to the bottom of the tooltip. These command buttons are available both in Tableau Desktop and when the view is published to the web or viewed on a mobile device.

**Format Filter and Parameter Cards**

You can display filter and parameter cards on your worksheet, and you can format them both to use a different font, style, color, background color, font size, and border. Formatting them allows you to better integrate them into your dashboard or worksheet style.

**Format a filter card**

Filter cards contain controls that let users interact with your view. You can change filter cards to use custom formatting. For example, the body text in the filters below is formatted to use the Tableau Bold font, in aqua.
To format a filter card:

1. Select Format > Filters.
2. In the Format pane, specify the following options:
   
   - **Title**: You can modify the **Font** and **Alignment** of the filter titles. The title formatting only appears when the filters are used on dashboards or when the view is published to the web.
   
   - **Body**: You can modify the body **Font**, **Shading**, and **Border** of the filters. These settings appear on both worksheets, dashboards, and when the view is published to the web.

**Format a parameter control card**

Parameter controls are similar to filter cards in that they contain controls that let users modify the view. If you create a parameter control, you can customize how it looks. For example, in the view below, the Sales Range parameter is formatted so that the sales amount appears in orange.
To format a parameter control card:

1. Select **Format > Parameters.**
2. In the **Format** pane on the left side of the workbook, specify the following options:
   
   - **Title:** You can modify the **Font** and **Alignment** of the parameters titles. The title formatting only appears when the parameter controls are shown on dashboards or when the view is published to the web.
   
   - **Body:** You can modify the body **Font, Shading,** and **Border** around the parameters. These settings appear on worksheets, dashboards, and when the view is published to the web.

**Resize Tables and Cells**

You can change the size of the rows, columns, and cells that compose a table. The best way to resize your table depends on the view type and the table components you want to resize.

**Use commands to resize rows and columns**

By selecting **Format > Cell Size** and then the **Taller, Shorter, Wider,** or **Narrower** menu items you can resize row and columns.

For example, suppose you want to increase the width of the columns and the height of the rows for the view shown below. You can use the **Taller** and **Wider** menu items or the **Shortcuts and Commands for Resizing on page 1006:** Ctrl + up arrow and Ctrl + right arrow (Command-up arrow and Command-right arrow on a Mac). The views below use both these commands to make the view more readable.
Note: For a given field, all members will have the same width and the same height. You cannot resize individual field members.

Manually resize rows and columns
To manually resize the widths or heights of row and column headers or axes:

1. Place your cursor over the vertical or horizontal border of a header or axis.

2. When you see the resize cursor ☛ , click and drag the border left and right or up and down.

Resize an entire table
You can increase or decrease the size of the entire table by selecting Bigger or Smaller on the Format > Cell Size menu. For example, to increase the width of the columns and the height of the rows for the view shown below, you can select Format > Cell Size > Bigger. This option increases both the width and height of the panes in a visually appropriate way. Notice that the size of the row headers increases horizontally when you resize the table.
**Resize cells**

Any table you can create in Tableau has the cell as its basic component. For a text table, the cell is what you would expect. It is the intersection of a row and a column, and is where the text is displayed. For more information, see Cells on page 163.

However, depending on the view you construct, identifying the cell is not always possible or useful, such as in the case of a scatter plot.

Manipulating cells to enhance your data view is useful when dimensions are the inner fields on both the Rows and Columns shelves. In this case, there are two shortcuts you can select on the Format > Cell Size menu:

- **Square Cell** – Adjusts the view so the cell has a 1:1 aspect ratio. This results in a square cell, which is useful for heat maps.
- **Text Cell** – Adjusts the view so the cell has a 3:1 aspect ratio. This is useful for text tables.

For example, you can see the text table below with **Square Cell** and **Text Cell** applied. **Text Cell** enforces a cell aspect ratio of 3:1 and results in a compact table that is easy to read.

<table>
<thead>
<tr>
<th>Square Cell</th>
<th>Text Cell</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image-url" alt="Image of a text table with Square Cell and Text Cell applied" /></td>
<td><img src="image-url" alt="Image of a text table with Text Cell applied" /></td>
</tr>
</tbody>
</table>
The heat map shown below is modified by selecting **Square Cell** on the **Format > Cell Size** menu. This enforces a cell aspect ratio of 1:1 and results in a compact table that is easy to analyze. You can also use the **Size** slider on the **Marks** card to adjust the size of each mark.

After changing the cell size, you can use **Ctrl+B** and **Ctrl+Shift+B** to decrease or increase the table size while maintaining the cell aspect ratio. On a Mac, the keystrokes are Command-B and Shift-Command-B.

**Shortcuts and Commands for Resizing**

Every view you build in Tableau is different, and different types of views require different sizing techniques. Using the keyboard shortcuts to resize rows and columns as well as the entire table makes building views more efficient. The tables below define some keyboard shortcuts and menu commands for common sizing actions.
### Windows Shortcuts

<table>
<thead>
<tr>
<th>Command</th>
<th>Keyboard Shortcut</th>
<th>Menu Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taller</td>
<td>Ctrl+Up</td>
<td>Format &gt; Cell Size &gt; Taller</td>
</tr>
<tr>
<td>Shorter</td>
<td>Ctrl+Down</td>
<td>Format &gt; Cell Size &gt; Shorter</td>
</tr>
<tr>
<td>Wider</td>
<td>Ctrl+Right</td>
<td>Format &gt; Cell Size &gt; Wider</td>
</tr>
<tr>
<td>Narrower</td>
<td>Ctrl+Left</td>
<td>Format &gt; Cell Size &gt; Narrower</td>
</tr>
<tr>
<td>Bigger</td>
<td>Ctrl+Shift+B</td>
<td>Format &gt; Cell Size &gt; Bigger</td>
</tr>
<tr>
<td>Smaller</td>
<td>Ctrl+B</td>
<td>Format &gt; Cell Size &gt; Smaller</td>
</tr>
</tbody>
</table>

### Mac Shortcuts

<table>
<thead>
<tr>
<th>Command</th>
<th>Keyboard Shortcut</th>
<th>Menu Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taller</td>
<td>Command-Up arrow</td>
<td>Format &gt; Cell Size &gt; Taller</td>
</tr>
<tr>
<td>Shorter</td>
<td>Command-Down arrow</td>
<td>Format &gt; Cell Size &gt; Shorter</td>
</tr>
<tr>
<td>Wider</td>
<td>Command-Right arrow</td>
<td>Format &gt; Cell Size &gt; Wider</td>
</tr>
<tr>
<td>Narrower</td>
<td>Command-Left arrow</td>
<td>Format &gt; Cell Size &gt;</td>
</tr>
</tbody>
</table>

- 1007 -
<table>
<thead>
<tr>
<th>Command</th>
<th>Keyboard Shortcut</th>
<th>Menu Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bigger</td>
<td>Shift-Command-B</td>
<td>Format &gt; Cell Size &gt; Bigger</td>
</tr>
<tr>
<td>Smaller</td>
<td>Command-B</td>
<td>Format &gt; Cell Size &gt; Smaller</td>
</tr>
</tbody>
</table>

**Define Table Structure**

In addition to the standard formatting, there are some other settings that define the table structure. You can modify these settings by selecting **Analysis > Table Layout > Advanced** to open the Table Options dialog box. There you can specify the aspect ratio, the default number format, row and column attributes, and the default label orientation for labels along the bottom of the view. While these settings apply to the whole view, some can be overridden using the **Format** pane.

**Set the aspect ratio**

The aspect ratio refers to the ratio of the pane width to the pane height. You can choose to constrain the aspect ratio to a specified amount or not constrain it at all. An unconstrained axis range can be useful because it means that the axes don’t have to be the same length.

Anytime you manually resize a row or column, you are unconstraining the aspect ratio. The aspect ratio setting only applies to views containing continuous axes on both the row and column shelves. Nominative axes are not affected by the aspect ratio settings.

**Set the default number format**

You can define the number of decimal places to appear by default for numbers in the view. If you select **Automatic**, Tableau automatically decides the number of decimal places based on the data in the field. If you select **Manual**, you can decide to show up to 16 decimal places.

**Set row attributes**

Select from the following Row attributes:

- Maximum levels of row labels: determines the number of fields that can be added to the Rows shelf before the headers are combined on the same level.
- Maximum levels of horizontal row labels: determines the number of fields that can be placed on the Rows shelf before headers are automatically oriented vertically rather than horizontally.

**Set column attributes**
Select from the following column attributes:

- Maximum levels of column labels: determines the number of fields that can be placed on the Columns shelf before Tableau begins to combine the labels.

- Show innermost level at bottom of view when there is a vertical axis: displays the innermost level of column headers at the bottom of the view (as opposed to the top) when a vertical axis is added to the view.

- Default orientation of labels at bottom of view: determines whether labels at the bottom of the view are oriented horizontally or vertically by default. You can toggle between the horizontal and vertical options by pressing Ctrl + L on your keyboard (Command-L on a Mac).

Customize Colors and Fonts

Tableau products are designed so that you can create great-looking visualizations that use best practices by default, freeing you from needing to think about things like fonts and colors—unless you want to. If you want to change the defaults, Tableau Desktop provides formatting options that allow you to change the look of almost everything you see in a view. See Change Formatting at the Workbook Level on page 977, Change Formatting at the Worksheet Level on page 980, and Format Parts of a View on page 986 for details.

If the fonts and color palettes available in Tableau Desktop aren’t what you need, you can add your own fonts and create your own color palettes. Use the links below for more information.

Create Custom Color Palettes

Tableau Desktop comes with color palettes that have been carefully designed to work well together and effectively apply color to data in many situations, such as on maps, heat maps, bar charts, etc. You can also create and use your own custom color palettes by modifying the Preferences.tps file that comes with Tableau Desktop. For example, you can create a custom categorical palette that matches your company’s brand.

You can add as many custom palettes as you like, each with as many colors as you want. When you modify Preferences.tps to add colors, use the standard HTML format for the new colors (hexadecimal value #RRGGBB or Red Green Blue format). When you save the workbook, the color information is embedded in Preferences.tps, but it won’t be included as reusable color encoding. This means that any colors that are in use are shown for anybody opening the workbook; however, if they don’t have the modified Preferences.tps file, they can’t use the color information for new color encoding.

Tableau doesn’t test or support custom color palettes, so be sure to back up your workbooks before you continue. Also, there is no guarantee that custom color palettes you create will work with future Tableau Desktop upgrades.

Edit your preferences file

The Preferences.tps file is located in your My Tableau Repository. The file is a basic XML
file that you can open in a text editor to modify. An unedited preferences file looks like this:

```xml
<?xml version='1.0'?>
<workbook>
</workbook>
```

To edit your preferences file:

1. Go to the My Tableau Repository folder in your Documents directory, and open the Preferences.tps file.
2. Between the opening and closing workbook tags, insert opening and closing preferences tags.

```xml
<?xml version='1.0'?>
<workbook>
  <preferences>
  </preferences>
</workbook>
```

3. Follow one of the next three procedures to create a custom color palette.

**Create a custom categorical color palette**

A categorical color palette contains several distinct colors that can be assigned to discrete dimension members. For example, when you put a discrete dimension such as Region on the Color, the categorical color legend is used.
The following is an example of what to add between the `preferences` tags to add a categorical color palette. Note that the `type` attribute is specified as regular, which identifies this palette as a categorical palette.

**To create a custom categorical color palette:**

1. In the `Preferences.tps` file, between the "preferences" tags, paste the following:
   ```xml
   <color-palette name="My Categorical Palette" type="regular">
   <color>#eb912b</color>
   <color>#7099a5</color>
   <color>#c71f34</color>
   <color>#1d437d</color>
   <color>#e8762b</color>
   <color>#5b6591</color>
   <color>#59879b</color>
   </color-palette>
   ```

2. Save the `Preferences.tps` file and then restart Tableau Desktop.

3. Open the Superstore - Sample data source.

4. From the Dimensions pane, drag a discrete dimension, such as Region, to Color.

5. Click the color legend menu arrow and select Edit Colors.

![Image of color legend menu](image)
6. In the Edit Colors dialog box, from the palette drop-down list, select your new custom palette.

7. Click the Assign Palette button to assign the custom colors to each respective field.

8. Click OK.
Create a custom sequential color palette

Another type of palette is the sequential color palette. Typically, this type of palette shows a single color, varying in intensity. This type of color palette is used for continuous fields, typically for measures.
The following is an example of what to add between the preferences tags to add a sequential color palette. Note that the type attribute is specified as ordered-sequential, which identifies this palette as a sequential palette. Also, for sequential palettes you must specify each variant of the color in the sequential color range.

**To create a custom sequential color palette:**

1. In the Preferences.tps file, between the preferences tags, paste the following:

   `<color-palette name="My Sequential Palette" type="ordered-sequential" >
   <color>#eb912b</color>
   <color>#eb9c42</color>
   <color>#ebad67</color>
   <color>#eabb86</color>
   <color>#eacba8</color>
   <color>#ebd8c2</color>
   </color-palette>`

2. Save the Preferences.tps file and then restart Tableau Desktop.

3. Open the Superstore-Sample data source.

4. From the Measures pane, drag the measure (e.g., Sales) to Color.

5. Click the color legend menu arrow, and select Edit Colors.

6. In the Edit Colors dialog box, from the palette drop-down list, select your custom palette.

7. If you want each color gradation to be defined within a box, select the Stepped Color check box, and in the Steps text box, type the number of color steps you want to display in the bar.

8. Click the Advanced button.

9. Select the Start check box, and in the text box, type the low end number you want for the continuum.

10. Click the Apply button to see the result, and make adjustments as needed. The default for sequential color is to make the high end of the continuum pale and the low end intense; select the Reversed check box to make the high end intense and the low end, pale (this is the default when you keep the Automatic palette selection).
Create a custom diverging color palette

The third type of color palette is a diverging color palette. A diverging palette shows two ranges of values using color intensity to show the magnitude of the number and the actual color to show which range the number is from. Diverging palettes are most commonly used to show the difference between positive and negative numbers.

The following is an example of what to add between the preferences tags to add a diverging color palette. Note that the type attribute is specified as ordered-diverging, which identifies this palette as a diverging palette.

To create a custom diverging color palette:

1. In the Preferences.tps file, between the preferences tags, paste the following:

```
<color-palette name="My Diverging Palette" type="ordered-diverging">
    <color>#eb912b</color>
    <color>#59879b</color>
</color-palette>
```
2. Save the Preferences.tps file and then restart Tableau Desktop.
3. Open the Superstore - Sample data source.
4. Click the Assign Palette button. The colors in the palette are used in the order they appear in the Preferences file.

If you add a sequential or diverging palette, remember to change the "type" attribute from "regular" to one of the following:

- ordered-sequential
- ordered-diverging

(Optional): Assign a default custom palette to dimensions and measures and publish as a data source

After you save the workbook, the custom color palette information is embedded in the workbook (for Excel and text file-based workbooks, in the .twbx) and therefore only available for that workbook. This means that colors that are in use are shown for anybody opening the that particular workbook. If they don't have the modified preferences file, they can't use the color information for any new color encoding.

To allow new color encoding using the custom color palette or to standardize a custom color palette for the Tableau workbooks in your organization, you can create the custom color palette using one of the options above, and then publish it as a Tableau Server data source.
1. On the same computer from which you modified the **Preferences.tps** file, open Tableau Desktop.

2. Open the **Superstore - Sample** data source.

3. Right-click a field in the **Data** pane, and select **Default Properties > Color**.

4. In the Edit Colors dialog box, associate the field values with the custom color palette, and then click **OK** when finished.

5. From the **Data** menu, select the data source, select **Publish to Server**, and then complete process to publish the data source.

After publishing the data source to Tableau Server, connect any new workbooks to this data source to use the custom color palette.

**Use Custom Fonts**

Tableau provides a variety of fonts for you to use in your visualizations, including the fonts in its default typeface: Tableau. However you might want to use a font other than what's provided. For example, you may want to use a font that's unique to your company's brand.

To use a custom font in Tableau, the first step is to install it on the computers that are running Tableau. This includes Tableau Desktop and, if you're publishing to Tableau Server, any computers running Tableau Server. To ensure that Tableau Server can render the font correctly, make sure the font is "web safe" in all browsers. If a font specified in Tableau Desktop isn't also installed on Tableau Server, Tableau Server uses a default font.

For more information about installing fonts, see the following links:

- [How to install or remove a font in Windows](https://support.microsoft.com/en-us/help/955108/how-to-install-or-remove-a-font) (Microsoft Knowledge Base)

After you install the font, it appears in the Formatting pane in Tableau Desktop, where you can use it to change fonts at the workbook, worksheet, or individual view part levels. See **Change Formatting at the Workbook Level** on page 977, **Change Formatting at the Worksheet Level** on page 980, and **Format Parts of a View** on page 986 for details.
Actions

Tableau allows you to add context and interactivity to your data using actions. Link to web pages, files, and other Tableau worksheets directly from your analytical results. Use the data in one view to filter data in another as you create guided analytical stories. Finally, call attention to specific results using highlighting.

For example, in a dashboard showing home sales by neighborhood you could use actions to help you quickly see relevant information for a selected neighborhood. Select a neighborhood in one view which then highlights the related houses in a map view, filters a list of the houses sold, and opens a web page showing census data for the neighborhood.

**Note:** Actions behave differently in workbooks that use cube data sources. Cube data sources do not accept actions from relational or other cube data sources. For example, suppose you have a workbook that contains a view that uses a MySQL data source, a second view that uses a cube data source A, and a third view that uses a cube data source B. Actions in a view that use the MySQL data source will not affect the views that use the cube data sources. However, actions in the view that use the cube A data source can affect the view that uses the MySQL data source. The view that uses the cube B data source will not be affected in this case.

There are three kinds of actions in Tableau: Filter, Highlight, and URL actions.

**Filter Actions**

Filter actions are a way to send information between worksheets. Typically a filter action is used to send information from a selected mark to another sheet showing related information. For example, when looking at a view showing the sales price of houses, you may want to be able to select a particular house and show all comparable houses in a different view. You could define a filter action to accomplish this task. First you need to decide what comparable means. In this case, say that comparable houses are houses with a similar sale price and square footage. A filter action to show comparable houses can be defined by selecting a destination worksheet and defining filters on sales price and square footage.

Filter actions work by sending the data values of the relevant source fields as filters to the destination sheet. If you launch the filter action described in this example from a house that sold for $450,000, the destination sheet will have a filter to only show houses that sold for the same amount.

1. On a worksheet, select **Worksheet > Actions**. From a dashboard, select **Dashboard > Actions**.
2. In the Actions dialog box, click **Add Action** and then select **Filter**.
3. In the subsequent dialog box specify a name for the Action.

   Use a name that defines the action. If you choose to run the action using the menu the name is the option that shows on the menu. For example, when sending housing information from one sheet to a map, the name could be “Map all comparable houses sold in February” You can use variables in the name that will be filled in based on the values of the selected field.

4. Use the drop-down list to select a source sheet or data source. When you select a data source or dashboard sheet you can further refine by selecting the individual sheets you want to launch the action from.
5. Then select how you want to launch the action. Select one of the following options:
   - Hover - rest the pointer over a mark in the view to run the action. This option works well for highlight and filter actions within a dashboard.
   - Select - click on a mark in the view to run the action. This option works well for all types of actions.
   - Menu - right-click (control-click on Mac) a selected mark in the view and then select an option on a the context menu. This option works well for filter and URL actions.

6. Use the second drop-down list to select a target sheet. When you select a dashboard sheet you can further refine the target by selecting one or more sheets within the dashboard.
7. Specify what to do when the select is cleared in the view. You can select from the following options:
   - **Leave the filter** - leaves the filter on the target sheets. The target views in the dashboard will show the filtered results.
   - **Show all values** - changes the filter to include all values.
   - **Exclude all values** - changes the filter to exclude all values. This option is useful when you are building dashboards that only show some sheets if a value in another sheet is selected.

8. Setup one or more filters to specify the data that you want to show on the target sheets. You can filter on **All Fields** or define filters on **Selected Fields**.

9. If you are defining filters for specific fields click **Add Filter**.

10. In the Add Filter dialog box, select a source and target data sources and fields. When you run the action from a specific mark on the source sheet, a filter is added to the target sheet that only includes values for the target field that match the values of the source field. In the comparable houses sheet link example, the Source Field is Beds and the Target Field is Beds. That means when you launch the sheet link for a house that has three bedrooms, the destination worksheet will only show houses that also have three bedrooms.
11. When finished, click **OK** three times to close all open dialog boxes and return to the view.

If you are connected to a relational data source, you can add sheet links across data sources even if the field names are not exactly the same. One data source may have a field titled Latitude while another has a Lat field. Using the drop down lists in this dialog box, you can associate the Latitude field to the Lat field. When using a multidimensional data source, the destination sheet must use the same data source as the source sheet. Moreover, the source field names must match the destination field names. In Tableau, multidimensional data sources are supported only in Windows.

The fields available in the Target Field drop-down list are dependent on what you selected as the Source Field. Only fields with the same data type as the source field can be selected as a destination field.

**Highlight Actions**

Highlight actions allow you to call attention to marks of interest by coloring specific marks and dimming all others. You can highlight marks in the view using a variety of tools. For example, you can manually select the marks you want to highlight, use the legend to select related marks, use the highlighter to search for marks in context or create an advanced highlight action.

The following table describes the different methods you can use to highlight marks in a view, dashboard, or story.
<table>
<thead>
<tr>
<th>Highlight method</th>
<th>Benefits</th>
<th>When you might use this</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select marks in a view</td>
<td>• Manually select a group of marks to highlight in a view.</td>
<td>• When you want to manually highlight a selection of marks and dim all others.</td>
</tr>
<tr>
<td></td>
<td>• Your selection is saved with the workbook and can be included in stories and when publishing.</td>
<td>• Works well with small domains or views with a small amount of data.</td>
</tr>
<tr>
<td>Legends</td>
<td>• Supports one-way and two-way highlighting.</td>
<td>• When you want to focus on select members in a view and dim all others.</td>
</tr>
<tr>
<td></td>
<td>• Highlight on color, size, or shape.</td>
<td>• When you want to highlight using only the legend or the legend and the view.</td>
</tr>
<tr>
<td></td>
<td>• You can disable or enable the highlighting action for the workbook or sheets from the toolbar.</td>
<td>• Works well with small domains or views with a small amount of data.</td>
</tr>
<tr>
<td></td>
<td>• Your selection is saved with the workbook and can be included in dashboards and stories and when publishing.</td>
<td></td>
</tr>
<tr>
<td>Highlighter</td>
<td>• Search for data points in a view using keywords or select from a drop-down list.</td>
<td>• When you want to highlight a mark or group of marks for a discrete field that is included in the view.</td>
</tr>
<tr>
<td></td>
<td>• Highlight marks while maintaining the context of the other data points.</td>
<td>• When you want to do ad hoc comparisons with instant highlighting.</td>
</tr>
<tr>
<td></td>
<td>• Values automatically update when the underlying data is updated.</td>
<td>• Works well with large domains and large amounts of data.</td>
</tr>
<tr>
<td></td>
<td>• Highlighters added to worksheets also appear on dashboards and stories.</td>
<td></td>
</tr>
<tr>
<td>Actions</td>
<td>• Highlight data based on criteria that you define.</td>
<td>• When you want to build interactive exploration into a dashboard.</td>
</tr>
<tr>
<td></td>
<td>• Specify the source and target sheets to apply the highlight action to.</td>
<td>• When you want to highlight data points in a dashboard using specific fields.</td>
</tr>
</tbody>
</table>
- Specify the fields to use for highlighting.
- You can specify different types of actions to run on the same click (for example, filter and highlight).

**Selecting Marks to Highlight**

The simplest way to add highlighting to a view is to select the marks you want to highlight. When you manually select a mark in the view, all other marks are dimmed to draw attention to the selection. Your selection is saved with the workbook and can be included in stories or when publishing.

You can select multiple marks by holding down the Ctrl key on your keyboard (Command key on Mac) while you select each mark. You can also use one of the advanced selection tools to select marks within a specific shape. For more information on how to use advanced selection tools, see Select Marks on page 522.
**Legend Highlighting**

Legend highlighting is a powerful analytical mode that you can use to focus on specific members in a legend that is shown in the view. When you turn on legend highlighting you can use the members in the legend to highlight marks associated with the selected items in the legend and dim all other marks.

You can enable either one-way or two-way highlighting to highlight marks in the view. This icon shows at the top of the legend to indicate the mode that you are using.

- One-way highlighting enables you to highlight marks using the values in the legend.
- Two-way highlighting enables you to highlight marks using either the legend or the view. This is the default. When you highlight marks in the view, the matching member in the legend is also highlighted.

You can also turn off highlighting for the workbook or the sheet from the toolbar. This action hides the highlight icon on the legend. For more information about using the toolbar highlighting option, see [Highlight Toolbar Button](#) on page 1030.

In this example, the views below show the relationship between order quantity and profit for several products. The view on the left uses the standard functionality for the color legend, where all marks are colored based on their shipping mode. The view on the right uses legend highlighting to call out the products that were delivered via Second Class shipping.

<table>
<thead>
<tr>
<th>Normal Color Legend</th>
<th>Color Legend Highlighting Enabled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- 1025 -
You can easily switch between legend highlighting and normal modes using the legend card menu. For color legends, if you like how a view is highlighted, you can assign the highlight colors to the color palette. The old colors are replaced with the highlight colors.

To turn on legend highlighting

1. Click the Highlight button at the top of the legend or select Highlight Selected Items on the legend card menu. This example shows highlighting using the color legend. Color legend highlighting is turned on by default.

2. Select an item in the color legend.
After legend highlighting is turned on, you can quickly focus on specific data in the view by selecting different items in the color legend. When you turn on legend highlighting, a highlight action is created that you can modify in the Actions dialog box.

To turn off legend highlighting

- Click the Highlight button at the top of the legend or select Highlight Selected Items on the legend card menu. This changes highlighting to one-way and you can use the legend to highlight matching marks in the view.

When you turn legend highlighting off the action is removed from the Actions dialog box.

If you like how the view is highlighted and want to keep a specific member highlighted even when you turn off legend highlight mode, you can assign the highlight colors to the existing color palette. The original color legend is discarded and the highlight colors become the new color palette for the legend.

To assign the highlight colors to the color palette, select Assign Highlight Colors to Palette on the color legend card menu.

Highlight Data Points in Context

When you have a view with a large amount of data you might want to explore your data interactively and highlight a specific mark or group of marks while still maintaining the context of where those marks show in your view.
To do this you can turn on the Highlighter for one or more discrete fields that are included in your view and that affects the level of detail. For more information about setting the level of detail in a view, see Dimensions and the Level of Detail on page 270.

You can use keywords to search for matching data points. The highlighter immediately highlights the marks that match or partially match your keyword search. If you update the underlying data source for your view the data shown in the highlighter is automatically updated too.

In the example below, the Highlighter is turned on for the College field. Entering a partial keyword search for Public returns two possible matches. In the view, Tableau highlights the group of marks that math the partial search; Public Affairs and Public Health.

You can turn on highlighters for as many discrete fields in our view as you need. However, you can only highlight using one value set at a time. If you want to include the highlight option on dashboards and stories, turn them on in the worksheet before you add them to the dashboard, or select the worksheet on the dashboard, and then select Analysis > Highlighters from the top menu and select from the fields in the list.

If you want to change the format for the highlighter card after you turn it on, select Format > Highlighter.

Note: Highlighters work across worksheets on a dashboard if the same field is included across those worksheets. If the same field is not found, then no match is found for the highlighted value, and the values in those worksheets are dimmed. If you have multiple highlighters showing on a dashboard, only one highlighter can be active at a time. In this situation, the highlight shows for the highlighter that was used last.
To turn on highlighting

1. Right-click on a discrete field (dimension) that is included in the view and impacts the level of detail in the view. Then select **Show Highlighter** from the context menu.

2. Click in the highlighter dialog box and do one of the following:
   - Enter a keyword to search for matching marks to highlight.
   - Enter a partial key word to search for all relevant matches that contain your search text.
   - Select an item in the drop-down list. You can select one item at a time.
   - Hover over items in the drop-down list to highlight marks in the view for an ad hoc analysis experience.
3. Repeat steps 1 and 2 to add additional highlighters.

You can also show mark labels on highlighted marks. To turn on mark labels, on the Marks card, click Label, select the Show mark labels check box and select Highlighted in the Marks to Label section.

**Highlight Toolbar Button**

Another way to add a highlight action is to use the highlight button in the toolbar. Similar to legend highlighting, the toolbar button lets you highlight a collection of related marks in the view and functions the same way that two-way highlighting does. To turn on highlighting, select the fields you want to use for highlighting on the toolbar menu. The drop-down list shows the active fields in the view. Then select a mark in the view to see the related data.
For example, the view below shows **Sales** vs. **Profit** by **Region**. If you turn on highlighting for **Ship Mode**, when a mark is selected, all other marks that were shipped via that mark's ship mode are highlighted. In this example you can quickly see all products from across the United States that were shipped via Second Class.

The toolbar menu also lets you highlight on **All Fields** or **Dates and Times**. **All Fields** considers all fields in the view when identifying matching records; **Dates and Times** considers all date and time fields in the view.
When you use the Highlight toolbar button an action is created in the Actions dialog box. You can modify the action to create more advanced highlighting behavior. For more information about editing actions, see Creating Advanced Highlight Actions below.

Finally, you can use the toolbar button to disable highlighting across the entire workbook or for just the active sheet. These options disable highlighting for legends only. They do not turn off the ability to manually highlight marks or use the Highlighter control.

When you turn off highlighting from the toolbar button, the highlight icon is hidden on the legend, and the Highlight Selected items menu option is grayed out on the context menu for the legend.

Creating Advanced Highlight Actions

You can define more advanced highlight actions using the Actions dialog box. There you can specify source and target sheets and the fields you want to use for highlighting. Follow the steps below to create a highlight action.

To create a highlight action:

1. On a worksheet select Worksheet > Actions. From a dashboard, select Dashboard > Actions.
2. In the Actions dialog box click the Add Action button and then select Highlight.
3. Name the action to identify it in the Actions dialog box. Try to make the name descriptive, such as, *Highlight Products Shipped by Delivery Truck*. You can select variables from a drop-down list and use them in the name. Then they are filled in based on the values of the selected field.

4. Use the drop-down list to select the source sheet or data source. If you select a data source or a dashboard sheet, you can further select individual sheets within them.

5. Select how you want to trigger the action. You can select from the following options:
   - **Hover** - Rest the pointer over a mark in the view to run the action. This option works well for highlight and filter actions within a dashboard.
   - **Select** - Click a mark in the view to run the action. This option works well for all types of actions.
   - **Menu** - Right-click (control-click on Mac) a selected mark in the view and then
select an option on the context menu. This option works well for filter and URL actions.

6. Select a target sheet. If you select a dashboard, you can further select individual sheets within the dashboard.

7. Select the fields you want to use for highlighting. Select from the following options:
   - **Selected Fields** - Marks in the target sheet are highlighted based on select fields. For example, highlighting using the Ship Mode field will result in an action that highlights all marks in the target sheet that have the same ship mode as the selected mark in the source sheet.
   - **Dates and Times** - Marks in the target sheet are highlighted when their date and time match those of the marks selected in the source sheet. All dates and time fields are considered when determining a match.
   - **All Fields** - Marks in the target sheet are highlighted when they match the marks selected in the source sheet. All fields are considered when determining a match.

8. When finished, click **OK** twice to close the dialog boxes and return to the view.

**URL Actions**

A URL action is a hyperlink that points to a Web page, file, or other web-based resource outside of Tableau. You can use URL actions to link to more information about your data that may be
hosted outside of your data source. To make the link relevant to your data, you can substitute field values of a selection into the URL as parameters.

**To add a hyperlink:**

1. On a worksheet, select **Worksheet > Actions.** From a dashboard, select **Dashboard > Actions.**
2. In the Actions dialog box, click **Add Action** and then select **URL.**

3. In the subsequent dialog box, specify a name for the link. Make the name descriptive of the action. If you choose to run the action using the menu, the name you specify here becomes the option that shows on the menu. For example, when linking to more product details, the name could be “Show More Details.” You can use variables in the name, which will be filled in based on the values of the selected field.

4. Use the drop-down list to select a source sheet or data source. If you select a data source or dashboard you can select individual sheets within it.
5. Select the fields you want to use for highlighting. Select from the following options:

- **Hover** - rest the pointer over a mark in the view to run the action. This option works well for highlight and filter actions within a dashboard.

- **Select** - click on a mark in the view to run the action. This option works well for all types of actions.

- **Menu** - right-click (control-click on Mac) a selected mark in the view and then select an option on a the context menu. This option works well for filter and URL actions.

6. Specify the URL. You can use any URL that your browser can recognize including web pages, FTP resources, and files.

   Just as you can use variables in the name of the URL, you can also use field values and filter values as parameters in the URL. That means that you can send information about each selected mark or filter setting to a given website.

   In the URL you specify, include the appropriate prefix to ensure that the resulting hyperlink directs to the correct location. For example, if your URL links to a web page, include the `http://` prefix. If you publish workbooks to a Tableau Server, and your URL includes a protocol other than `http`, `https`, `gopher`, `news`, `ftp`, or `mailto`, you will need a server administrator to add the protocol to the server’s whitelist. For more information, see `tabadmin set options` in the Tableau Server help.
When using a URL action to point to an external file (rather than a web page), use the universal naming convention (UNC) path for the URL action. A UNC path is a full path of a resource or file that is stored on the computer. A UNC path includes the computer name, drive letter, path to the file, and file name. For example, for a file D:\myfile.txt, specify the following UNC path: \workstation1\d$\myfile.txt, where "workstation1" is the computer name in your company domain.

7. (Optional) Select any of the following options:

- **URL Encode Data Values** - select this option if your data contains values that use characters that are not allowable in a URL. For example if one of your data values contains an ampersand, such as “Sales & Finance,” the ampersand must be translated into characters that your browser understands (URL encoded) if you want to include that value in the URL.

- **Allow Multiple Values** - select this option if you are linking to a webpage that can take lists of values as parameters in the link. For example, say you select several products in a view and you want to see each product’s details hosted on a webpage. If the server can load multiple product details based on a list of identifiers (product ID or product name), you could use multi-select to send the list of identifiers as parameters.

When you allow multiple values, you must also define the item delimiter, which is the character that separates each item in the list (for example, a comma). You must also define the Delimiter Escape, which is used if the delimiter character is
used in a data value.

8. When finished, click **OK** twice to close the dialog boxes and return to the view.

URL actions can also point to a web page object in a dashboard. Refer to **Actions and Dashboards on the next page** to learn more about how actions work with dashboards.

**Running Actions**

Depending on how the action is created, you can run an action using one of the following three methods:

- **Hover** - rest the pointer over a mark in the view to run the action. This option works well for highlight and filter actions within a dashboard.
- **Select** - click on a mark in the view to run the action. This option works well for all types of actions.
• **Menu** - right-click (control-click on Mac) a selected mark in the view and then select an option on the context menu. This option works well for filter and URL actions.

<table>
<thead>
<tr>
<th>Hover</th>
<th>Select</th>
<th>Menu</th>
</tr>
</thead>
</table>

Links are not always visible for every worksheet and mark. Because links are mapped to specific fields in the data source, links will only be available for the worksheets that use the mapped fields. For example, if you add a hyperlink that uses both Latitude and Longitude as parameters in the link, the link will only be available to worksheets that use Latitude and Longitude in the view. Additionally, the link is only available on marks and headers that contain relevant values.

**Actions and Dashboards**

Actions often have special behavior when the source or destination is a dashboard. Filter and Highlight actions can affect other views in the dashboard and URL actions can update a webpage object so you don’t have to open your web browser. Finally, you can create simple Filter and Highlight actions using special menu options so you don’t have to open the Actions dialog box.

**Example: Filter Actions in a Dashboard**

This example shows how to create a filter action in a dashboard. The example shows a Sales dashboard with three views. Using the **Use as Filter** option you can set one of the views to act as a filter on all the other views in the dashboard. In this case the bar chart in the upper right is filtering the map view and the text table to show more details about the selected region.

**Note:** The **Use as Filter** command can only apply to one view at a time. A filter action is created that you can modify in the Actions dialog box.

Set a view to act as a filter by selecting the filter button.
You can also select the drop-down arrow and choose **Use as Filter**.

You can also use filter actions to filter the data on a dashboard when the data comes from multiple data sources. For more information, see Clearing the Dashboard with Actions in the Tableau Knowledge Base.
For more information about filter actions, see Filter Actions on page 1018.

Example: URL Actions in a Dashboard

This example shows how a URL action works with a webpage object in a dashboard. Below is a dashboard showing sales information by product for several stores in a coffee franchise. Included in the dashboard is a webpage object that shows nutritional information for a particular drink. The text table has a URL action that points to that webpage. When you launch the action the webpage automatically updates within the dashboard rather than opening a web browser. For more information about URL actions, see URL Actions on page 1034.

Using Field and Filter Values in Actions

When you add an action in Tableau you often want to use values from your data as parameters in the name of the action as well as the action itself. Using fields as variables in the action name makes the menu item that launches the action specific to the selected mark. More commonly, using field and filter values as parameters in the URL of a URL action allows you to send information about a specific data point or filter setting to the destination webpage.

Using Field and Filter Values in URLs

Tableau lets you add field, filter information, and parameter values as variables into URL actions so when you follow the link the values of those fields and filters are included. For
example, when linking to an online mapping service, you can insert the address field into the URL so launching the link from a specific data point shows the address associated with that record on a map.

1. In the Add URL Action dialog box, begin typing the URL for the link.
2. Place the cursor where you want to insert a field, parameter, or filter value.
3. Click the arrow to the right of the text box and select the field, parameter, or filter you want to add to the URL. The field, parameter, or filter name is added to the URL between angle brackets. You can continue adding field and filter values parameters as many times as you need to create the URL.

Note: The list of available fields only includes non-aggregated fields. To use aggregated field values as a parameter in a link, you must first create a calculated field and then use the name of that field in the link. The calculated field must also be used in the view in order for the link to be available. A good way to use these fields is by placing them on the Level of Detail shelf.

When inserting parameter values, the Display As value is what is sent with the URL action. To send the actual value instead, you should add the character ~na after the parameter name. For example, you may have a parameter that includes IP addresses. The Actual Value strings for the parameter include values such as 10.1.1.195 while the Display As strings include more friendly values such as Computer A.
Inserting the parameter into the URL like this:
http://<IPAddress>/page.htm will send the display values so the final
Obviously, that is not likely to create a valid URL. To send the actual value, the parameter
in the URL should look like this: http://<IPAddress-na>/page.htm.

Using Field and Filter Values in Action Names

In addition to using field, parameter, and filter values in URLs, you can use this information as
variables in the action names. The name of the action displays on the context menu when an
action is launched using the menu. Using field and filter variables in the name is useful in
making the action specific to the selected mark. In a view showing real estate information, you
could name a URL action that points at satellite images from an online mapping service, “Show
satellite image of <Address>.” When you right-click (control-click on Mac) a specific mark, the
<Address> tag is replaced with the location value associated with that mark.

1. In the Add Action dialog box, begin typing the name for the action.
2. Place the cursor where you want to insert the field or filter value.
3. Click the arrow to the right of the text box and select the field or filter you want to add as a
   variable. The field or filter name is added between angle brackets.
Dashboards

A dashboard is a collection of several worksheets and supporting information shown in a single place so you can compare and monitor a variety of data simultaneously. For example, you may have a set of views that you review every day. Rather than flipping through each worksheet, you can create a dashboard that displays all the views at once.

Similar to worksheets, dashboards are shown as tabs at the bottom of the workbook and update with the most recent data from the data source. When you create a dashboard, you can add views from any worksheet in the workbook. Each view you add to the dashboard is connected to its corresponding worksheet. That means when you modify the worksheet, the dashboard is updated and when you modify the view in the dashboard, the worksheet is updated.

Best Practices for Effective Dashboards

A well-designed dashboard can align your organization's efforts, help uncover key insights, and speed up decision-making. Use this topic for tips on best practices for creating effective dashboards in Tableau.

What's your goal?

Know your purpose and audience

The best visualizations have a clear purpose and work for their intended audience. What will you be trying to say with this dashboard? Are you presenting a conclusion or a key question?

In addition to knowing what you're trying to say, it's important to know who you're saying it to. Does your audience know this subject matter extremely well or will it be new to them? What kind of cues will they need? Thinking about these questions before you head into the design phase can help you create a successful dashboard.

Leverage the most-viewed spot

Most viewers scan web content starting at the top left of a web page. Once you know your dashboard's main purpose, be sure to place your most important view so that it occupies or spans the upper-left corner of your dashboard. In the dashboard below, the author decided that the map view holds the key message.
Design for the real world

Author at your final display size

By default, Tableau dashboards are set to use a fixed size and if you keep this setting, be sure to construct your visualization at the size it will be viewed at. You can also set Size to Automatic, which makes Tableau automatically adapt the overall dimensions of a visualization based on screen size. This means that if you design a dashboard at 1300 x 700 pixels, Tableau will resize it for smaller displays—and sometimes this results in scrunched views or scrollbars. The Range sizing feature is helpful for avoiding this.
You can also design for specific device layouts, so that on tablets, for example, your dashboard contains one set of views and objects, and on phones it displays another. See Try it: Create Dashboard Device Layouts on page 1052 for steps.

**Limit the number of views**

In general, it’s a good idea to limit the number of views you include in your dashboard to two or three. If you add too many views, visual clarity and the big picture can get lost in the details. If you find that the scope of your story needs to grow beyond two or three views, you can always create more dashboards.

Too many views can also interfere with the performance of your dashboard after it’s published. See Make Visualizations Faster on page 952 for more details on performance.
Be security-savvy

A dashboard can include more than just views, it can include objects—including embedded web pages. If you include web page objects in your dashboard, here are some tips to keep in mind:

- **HTTPS:** When you add a web page object to your dashboard, you're prompted to specify a URL. It's a best practice to use HTTPS (https://) in your URL. This ensures that the connection from your dashboard to the web page is encrypted. Also, if Tableau Server is running HTTPS and you use HTTP in the URL, your users' browsers won't be able to display the web page that the URL points to.

- **Plug-ins:** If the web page object requires a plug-in, such as Adobe Flash, the plug-in must be installed on the computer that's running Tableau. The Tableau component that handles plug-ins requires that Safari be installed as well.

- **Web view security options:** You can control whether the web page object has JavaScript and plug-ins enabled, among other things. To adjust them, select Help > Settings and Performance > Dashboard Web View Security, and then clear one or more of the options listed below:
  - **Enable JavaScript.** Allows JavaScript support in the web view. Clearing this option may cause some web pages that require JavaScript to function improperly in the dashboard.
  - **Enable Plug-ins.** Enables any plug-ins the web page uses, such as an Adobe Flash or QuickTime player.
  - **Block Pop-ups.** When selected, blocks pop-ups.
Enable URL Hover Actions. Allows URL hover actions. For more information, see URL Actions on page 1034.

Note: Any changes you make to the security options apply to all web page objects in your workbook, including new web page objects you create, and all subsequent workbooks you open in Tableau Desktop. To see your changes, you may need to save and reopen the workbook.

Save time

Use the Go to Sheet command

The views in a dashboard are connected to the worksheets they represent. Tableau provides short-cut menus to help you quickly accomplish basic tasks, like jumping from the dashboard you’re working on to the original view, where you can perform other actions.

To jump to a sheet:

1. In your dashboard, select the view you want to go to.
2. Select Go to Sheet.

Hide sheets as you go

When you’re working with a large number of worksheets to build dashboards, as you finish off a dashboard, you can hide the sheets that went into the dashboard. This can make your workbook easier to navigate.

To hide a dashboard’s sheets, right-click (control-click on Mac) the dashboard’s tab at the bottom of the workbook and select Hide All Sheets.
Try it: Create a Dashboard

After you’ve created one or more views, you can pull them into a dashboard, add interactivity, and much more. This topic walks you through the steps.

Open a dashboard sheet

You create a dashboard in much the same way you create a new worksheet. After you create a dashboard you can add views and objects.

To open a new dashboard sheet and start creating a dashboard, click the **New Dashboard** icon at the bottom of the workbook:

The **Dashboard** tab appears on the left and lists the sheets in your workbook.

Add views
After you have a dashboard sheet, click the views you built (listed under **Sheets** on the left) and drag them to your dashboard sheet on the right. A gray, shaded area indicates where you can drop views:

Add objects

In addition to adding views to your dashboard, you can add objects, including web pages, images, text, blank space, and layout containers.

Layout containers are helpful for fine-tuning how your dashboard resizes itself when users interact with it. See *Refine Your Dashboard* on page 1064 for tips on when and how to use layout containers.

To add an object:

Select an item under **Objects** on the left and drag it to the dashboard sheet on the right:
Depending on the object you're adding, you may be prompted for additional information. If you are adding a Web Page object, see Best Practices for Effective Dashboards on page 1044 for tips on web view security options.

**Add interactivity**

Part of the power of dashboards is that you can set up filters and interactivity to associate the different views on your sheet and enhance your users' analysis. The people looking at your dashboard can stay in a single spot—they don't need to click outside the world you've created for them.

In a dashboard you can use the **Use as Filter** option to make one of the views act as a filter on all the other views in the dashboard. To do this, select the filter button.

You can also select the drop-down arrow and choose **Use as Filter**.
There are many other actions you can add to your dashboard as well. For details, see *Actions and Dashboards* on page 1039 and *Using Field and Filter Values in Actions* on page 1041.

**Try it: Create Dashboard Device Layouts**

After you've built a dashboard you can create layouts for it that are specific to particular devices.

You can tailor a dashboard's composition and contents according to different browser window sizes. When you publish the dashboard to Tableau Server or Tableau Online, people who interact with it experience a dashboard expressly designed for their screen display, whether it's a phone, tablet, or desktop. As the author, you only have to create and maintain a single dashboard, and deliver a single URL.

**Preview and add a device layout**

Creating a device layout starts with a preview phase.

1. Open a dashboard.

2. On the **Dashboard** tab on the left, click **Device Preview**.
When a dashboard is in device preview mode, a preview bar appears above the dashboard and a black frame shows you the screen size options. The preview bar displays the **Device type** and **Model**.
3. Take a moment to click through the **Device types** and **Models** and explore the different screen sizes. Setting the **Size** option to **Fit all** is the best way to see the resize behavior. **Default** shows you the dimensions and layout of the dashboard you started with.

   To see how the dashboard will look in landscape vs. portrait mode, click ☐. Usually, landscape is optimal for tablets and portrait is best for phones.

   Select the **Tableau Mobile app** check box to see the screen size you have to work with if the dashboard is viewed on a device where Tableau Mobile is installed. This option is available for some, but not all device models.

4. Choose a **Device type**, such as **Tablet**.
5. After you select the Device type, click the Add Layout button in the upper-right corner (for example, Add Tablet Layout).

After you add a device layout, you’ll see it appear on the Dashboard tab, under Default. The new device layout contains every item that the Default dashboard does and its size and layout are derived from Default as well.
Another change that takes place after you add a device layout is the default dashboard appears.

Think of the default dashboard as the parent dashboard, and the device layouts (desktop, tablet, and phone) as its children.

Any view, filter, action, legend or parameter that you want to add to a device layout must first exist in the default dashboard. Web, image, text, and layout objects can be added independently.

**Customize a device layout**

After you've added a device layout to your dashboard, you can customize it.

1. Click **Custom** and start removing and rearranging views and objects to create the look you want.
Click the image to replay it.

If you remove an item from the device layout, it's only removed from that layout. It still exists on the default dashboard and can be added back to the layout again, or to other device layouts.

Conversely, if a view, legend, filter, or object doesn't exist in the default dashboard, it can't be added to a device layout. Anything you can add to your layout is listed on the left, under Layout. If an item has a blue check mark, it means that it's part of the device layout you're currently working on.
2. Click through the **Device model** options to see how the layout will appear on different models. The Generic models (for example, Generic Tablet (1024 x 768)) are designed to fit most models.

![Device model options](image)

Ultimately, it’s the size of the web browser that loads the dashboard that determines which layout appears on the device. See **Test the dashboard** on page 1063 for details.

3. Click ![landscape vs. portrait](image) to see how the dashboard will look in landscape vs. portrait mode. Usually, landscape is optimal for tablets and portrait is best for phones.

Selecting the **Tableau Mobile app** check box shows you the screen size you have to work with if the dashboard is viewed on Tableau Mobile. This option is available for iOS and Android phones and tablets that support Tableau Mobile.

4. Confirm your sizing choice by exploring the options under **Size**.
**Default**: The height and width of the device layout will mimic whatever the default dashboard is using. For example, if you’re creating a tablet layout and the default dashboard is set to a fixed size of Desktop Browser (1000 x 800), setting Size to Default for the tablet layout will make it use 1000 x 800 as its size.

**Fit all**: All items are automatically resized to fit the device frame size. The device frame size is determined by Device type, Model, orientation (portrait or landscape), and whether Tableau Mobile app is selected.

**Fit width** (recommended for phones): Items are automatically resized to fit the width of the device frame, but the height is fixed. This is a great option for phone layouts and vertical scrolling.

The next procedure describes how to create and optimize a layout for phone.

**Add more content and optimize for phone**

The following procedure steps you through adding a phone layout, including some tips for optimizing it.

1. Add an additional layout by selecting a new **Device type**:

2. Click **Add Layout**.

3. (Optional) Because not every view or object is optimized for mobile viewing, one
technique for creating a dashboard layout for phones is to create duplicates of certain views in the default dashboard—as in, one for viewing on a desktop and laptop and a second for viewing on phones.

For example, to create a duplicate of a map view that has different functionality, go to the worksheet for the view, click its tab, and select **Duplicate Sheet**.

Next, customize the view for mobile viewing. For example, you may want to the map to be zoomed in to a specific region by default, or you may want to disable panning, zooming, and other maps functionality (**Maps > Map Options**).
Finally, add the new view to the default dashboard so that it can be available to the device layouts you’re creating.

4. As you optimize for different layouts, dashboard titles are another area to look at. Short titles work best for mobile viewing. To edit the title, double-click it:

![Dashboard Title Edit](image)

Titles on a phone layout have the added benefit of providing a safe spot for users to initiate scrolling or swiping.

5. White space is another visual element to consider if you’re designing for phones. While screen real estate on a phone is scarce and you want to make the most of it, you may also want to provide additional safe places for your users to tap or initiate scrolling, so they don’t select filters and other items unintentionally. To add white space, drag the **Blank** object onto the layout:
In most cases, you should leave Tiled selected (the default). While floating objects can be used on device layouts, it’s difficult to predict and control their exact position across multiple layouts.

6. Add device layouts until you have all three possible layouts under Default: Desktop, Tablet, and Phone.
Creating a layout for each device type will give you the most control over your users' experience as they view your dashboard from different devices. This is especially true if you've created and added multiple versions of the same view to the default dashboard. After you have all three layouts, the default dashboard isn't viewable when the dashboard is published. Only the device-specific layouts for your dashboard are viewable.

**Publish the dashboard**

To publish the dashboard:

1. Click **Server > Publish Workbook**. If you're not already signed in, you're prompted for your credentials.

2. In the Publish Workbook to Tableau Server dialog box, make sure the **Show sheets as tabs** check box is cleared.

   ![Device Preview](image)

   When this check box is selected for device-specific dashboards, the tabs' sizing requirements interfere with the server's ability to correctly detect the size of the web browser and load the correct layout.

3. Click **Publish**.

**Test the dashboard**

After you publish the dashboard to Tableau Server or Tableau Online, test the dashboard by viewing it from different browser sizes. The best way to test is by using the embed code under **Share**.
To test the dashboard:

1. Open the dashboard on Tableau Server or Tableau Online.
2. In the upper-right corner of the page, click **Share** and copy the contents of the **Link** text box.

3. Paste the string into a web browser URL. The string should include the following:

   embed=y

4. With the embed code string as your browser URL, test the different layouts by changing the size of your web browser window and refreshing it.

   Tableau uses the size of the web browser that loads the dashboard to determine which dashboard layout to display on a device. Specifically, it uses the minimum dimension of the iFrame, whether it’s the height or the width. In a few cases, a device type’s label (Desktop, Tablet, etc.) may not map perfectly to the type of device it will actually display on. For example, a Tablet layout, not a Desktop layout, may display on a desktop device if the web browser is minimized, or if the desktop is simply very small.

<table>
<thead>
<tr>
<th>If the smallest web browser dimension is...</th>
<th>This device layout is loaded...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than or equal to 500 pixels</td>
<td>Phone</td>
</tr>
<tr>
<td>Between 501 and 800 pixels</td>
<td>Tablet</td>
</tr>
<tr>
<td>Greater than 800 pixels</td>
<td>Desktop</td>
</tr>
</tbody>
</table>

**Refine Your Dashboard**

After you’ve created your dashboard, take a moment to step back and evaluate it. This topic lists some areas to check and refine.
Is everything in the right spot?

Confirm placement

Make sure that the view with your key finding or main question spans or occupies the upper-left corner of your dashboard. In your views, the most important data should be on the X or Y axis and your less important data should be on color, size, or shape.

Check label orientation and readability

Important labels should be horizontal so that your viewers can easily read them.
**Review sizing and layout**

**Test your work and adjust sizing**

Once you finish your dashboard, it's a best practice to test it and experience it as your users will. For example, will they be using Tableau Reader on a laptop to view your dashboard, will the dashboard be published on Tableau Server, or will it be embedded in a web application and viewed from a tablet?

After you test your dashboard, you'll probably find some things to change—sizing and how and where items are positioned is usually one of them.

Sizing often needs adjustment. Tableau dashboards are set to a fixed default size that's intended to work well on a typical desktop. However, when you publish (to the web, in a blog, for a presentation, etc.) you may find yourself more limited.

You can specify the overall size of the dashboard using the settings under **Size** in the Dashboard area on the left. Select a new size using the drop-down menu.
Automatic - The dashboard automatically resizes to fill the window it’s displayed in.
Fixed size - The dashboard always remains a specific size. If the dashboard is larger than the window the dashboard becomes scrollable.
Range - The dashboard scales between minimum and maximum sizes that you specify, after which scroll bars or white space display.

Customize image display

When you add an Image object to a dashboard, you can customize how the image displays by selecting an option on the image's menu. For example, you can select whether to Fit Image, which scales the image to the size of image object on the dashboard.

By default, any high-resolution images that you use in a dashboard are displayed in standard resolution and will maintain the same size whether they’re viewed on standard or Retina displays.

To take advantage of high-resolution images in a dashboard that are intended to be viewed on a Retina display, you can use the @2x naming convention:

1. Navigate to the high-resolution image on your computer with Retina display.
2. Rename your high-resolution image to include the @2x modifier by using <image-name>@2x<file-extension> format. For example, logo@2x.png.
3. In your workbook, click and drag an Image object onto your dashboard.
4. When you're prompted, select the image you just renamed using the @2x naming convention and then click Open.

Note: EMF image file formats are not compatible with Tableau Desktop on the Mac.

Use a layout container

A layout container can create a smoother experience for your users by helping dashboard objects reposition and resize when one view is filtering another.

The image below shows how a dashboard behaves when two views are placed in a vertical layout container versus how they behave when they are not placed in a layout container. Notice
how, in the dashboard that uses a layout container, the views adjust vertically as different filters are applied.
1. Drag a horizontal or vertical layout container to the dashboard.

2. Add sheets and objects to the layout container. As you hover over the layout container, a blue box indicates that the object is being added to the flow of the layout container.
Buy space with a floating layout

Tableau uses a tiled layout by default in dashboards, which means that each view, legend, and object is arranged in a single-layer grid, similar to a tiled floor.
If you want an item to overlap another, you can use a **Floating** layout for one or more items instead:

Legends can sometimes be floated over other items instead of remaining tiled.
See *Tiled and Floating Layouts* on page 1076 for more details.

If you create device layouts for a dashboard, use a **Tiled** layout. It will give you the most control over where objects appear. See *Try it: Create Dashboard Device Layouts* on page 1052 for steps on how to create device layouts.

**Highlight the essentials**

**Show just what your users need**

Legends, titles, captions, and filters can be helpful for your viewers. Make sure you give your users what they need and no more.

To change what's displayed for your users:

1. Select a view in the dashboard.
2. Click the drop-down menu in the upper-right corner of the selected view and select the items you want to show. For example, you can show the title, caption, legends, and a variety of filters.
3. Alternatively, you can right-click (control-click on Mac) an item in the **Layout** section of the **Dashboard** pane to access all of these same commands.
Note: Filters are only available for the fields used in the original view.

Eliminate clutter

In general, you should try to use no more than two color palettes in a single dashboard, and ideally, just one palette if your data is quantitative. Remove unnecessary text, lines, or shading that don't provide actionable information for your viewers. Make sure every legend you provide is really needed, remembering to take into account the final, published size of your dashboard.
A sheet sorter can be a time-saver for the people viewing your dashboard. It allows them to quickly display individual worksheets on the dashboard. For information, see Creating a Sheet Selector for a Dashboard.
Tiled and Floating Layouts

Each object in a dashboard can use one of two types of layouts: tiled or floating. Tiled objects are arranged in a single layer grid that adjust in size based on the total dashboard size and the objects around it. Floating objects can be layered on top of other objects and can have a fixed size and position.

Tiled Layout

All objects are tiled on a single layer. The top three views are in a horizontal layout container.

Floating Layout

While most objects are tiled on this dashboard, the map view is floating. It's layered on top of the bar chart, which uses a tiled layout.

Switch Between Layouts

By default, objects in a dashboard use the Tiled layout. Tiled is selected by default when you drag views and objects onto your dashboard sheet:
To switch an object that’s already in your dashboard to floating:

Select the **Floating** option from the object’s short-cut menu:

You can also hold down **Shift** on your keyboard while dragging a view or object.

**Reorder and Resize Floating Objects**

All of the items in a dashboard are listed on the **Layout** tab. This area displays tiled objects and any floating objects in a hierarchy.
Click, hold, and drag items in the hierarchy to change the order that they are layered in the dashboard. Items shown at the top of the list are in the front while items at the bottom of the list are in the back. **Note:** Tiled layout items cannot be reordered.

![Hierarchy Diagram]

Use the **Position** field at the top of the **Layout** pane to specify exact position and sizing for objects, and whether or not they're floating and display a title. Define the position in pixels as an offset from the top left corner of the dashboard. The \( x \) and \( y \) values specify the location of the top left corner of the object.

For example, to place an object in the top left corner of the dashboard, you would specify \( x = 0 \) and \( y = 0 \).  

![Position Field](dashboard_layout DashBoard-01.png)

To move the object to the right 10 pixels, change the \( x \) value to 10. Similarly, to move it down 10 pixels you would change the \( y \) value to 10. The values you enter can be positive or negative but must be whole numbers.

The **Show title** check box displays or hides the title of the object you have selected. The **Show dashboard title** check box on the Dashboard pane controls just the dashboard title.
Use the **Size** field at the bottom of the **Dashboard** pane to specify the exact dimensions for floating objects. Define the size in pixels where \( w \) equals the width of the object and \( h \) equals the height of the object. You can also resize floating objects by clicking and dragging an edge or corner of the selected object in the dashboard.
**Stories**

A *story* is a sheet that contains a sequence of worksheets or dashboards that work together to convey information. You can create stories to show how facts are connected, provide context, demonstrate how decisions relate to outcomes, or simply make a compelling case.

A story is a sheet, so the methods you use to create, name, and otherwise manage worksheets and dashboards apply to stories. For more information, see Sheets on page 233. At the same time, a story is also a collection of sheets, arranged in a sequence. Each individual sheet in a story is called a *story point*.

Tableau stories are not collections of static screen captures—your story points remain connected to the underlying data and change as the data changes—or as the views and dashboards that you use in your story change. When you share a story—for example, by publishing a workbook to Tableau Server or Tableau Online—users can interact with the story to reveal new findings or ask new questions of the data.

There are many different ways to use stories. For example:

- **Use stories for collaborative analysis**: You can use stories to assemble a sequenced analysis, for yourself or for collaboration with your colleagues. Visualize the effects of data changes over time, or perform what-if analysis.

- **Use stories as presentation tools**: You can use stories to present a narrative to an audience. Just as dashboards provide spatial arrangements of views that work together,
stories present sequential arrangements of views or dashboards that create a narrative flow for your audience.

There are different ways to build a story. For example, each story point in a story can be based on a different worksheet or dashboard. Conversely, each story point can be based on a single worksheet or dashboard, which you customize for each story point, perhaps adding more information in each new story point. Often you will want to combine these approaches, using new sheets for some story points, and customizing the same sheet for other story points.

**The Story Workspace**

As you work on a story, you can use the following controls, elements, and features. Descriptions are listed below.

![Image of Story Workspace](image)

**A. The Sheets pane**

In the Sheets pane you can do the following.

- Drag dashboards and worksheets to your story.
- Add a description to a story point.
- Select to show or hide the navigator buttons.
- Configure the story size.
- Select to show the story title.

**B. The Story Menu**
When you select the Story menu, you can do the following.

- Open the Format Story pane.
- Copy the current story point as an image.
- Export the current story point as an image.
- Clear the entire story.
- Show or hide the navigator buttons and the story title.

C. The Navigator

The navigator serves as a way to edit, organize, and annotate all the points in your story. You can also move through the story using the navigator buttons.

Navigator buttons

Click the forward arrow on the right of the navigator to move forward one story point, and the backward arrow on the left of the navigator to move back one story point. You can also use the slider that appears when you hover over the navigator to quickly scroll through all the points in the story, and then select one to view or edit.

Story Points

The current story point in the navigator highlights a different color to indicate it is selected.

When you add or make changes to a story point, you can choose to update the story point to save the changes, revert any changes, or delete the story point. For more information, see Customizing a Story Point on page 1086.

D. Options for Adding a New Story Point

After you create a story point, you have several different options for adding another point. To add a new story point, you can do the following.
• Add a new blank point.
• Save the current story point as a new point.
• Duplicate the current story point.

For more information on these options, see Creating a Story below.

Creating a Story
You create a story from existing worksheets and dashboards.

To create a story:
1. Click the New Story tab.

Tableau opens a new story as your starting point:

2. In the lower-left corner of the screen, choose a size for your story. Choose from one of the predefined sizes, or set a custom size, in pixels:
3. To add a title to your story, double-click **Story Title** to open the Edit Title dialog box. You can type your title in the dialog box, as well as choose a font, color, and alignment. Click **Apply** to view your changes.

4. Drag a sheet from the **Dashboards and Worksheets** area to the story, and drop it into the center of the view:
5. Click **Add a Caption** to summarize the story point.

   **Note:** You can add descriptions and annotations within each story point if you want to provide more information.

6. Customize the story point. For more information, see **Customizing a Story Point** on the next page.

7. Click **Update** above the navigator box to save your changes to the story point:

8. Add another story point. There are several way to add an additional story point:
• Click **New Blank Point** if you want to use a different sheet for the next story point.

• Click **Duplicate** if you want to use the current story point as the starting point for a new story point. Then customize the view or worksheet in the second story point to make it different in some way from the original.

• Click **Save as a New Point**. This option only appears when you begin customizing a story point. After you do so, the **Duplicate** button becomes the **Save as a New Point** button. Click **Save as a New Point** to save your customizations as a new story point. The original story point remains unchanged.

9. Continue adding story points until your story is complete.

**Customizing a Story Point**

You can customize a story point in any of the following ways:

- By selecting a range of marks
- By filtering a field in the view
- By sorting on a field in the view
- By zooming in or panning on a map
- By adding a description box
- By adding annotations
- By changing the value of a parameter in the view
- By editing a dashboard text object
- By drilling down or up in a hierarchy in the view

After you modify a story point, do one of the following:

- Click **Update** to save your changes.
- Click the (circular arrow) to revert the story point to its previous state.
**Note:** When you drag a sheet from the **Dashboards and Worksheets** pane to a story point, that sheet remains connected to the original sheet. If you modify the original sheet, your changes will automatically be reflected on the story points that use it. Changes you make in a story point do not automatically update the original sheet, however.

**Adding a Description**

You can add descriptions to a story point. To add a description, double-click **Description** in the **Sheets** pane. You can add as many descriptions to a story point as you want.

Note that descriptions:

- Do not attach to marks, points, or areas in the story point. You can position them wherever you like.
- Exist only on the story point where you add them. They do not affect the underlying sheet nor any other story point in the story.

After you add a description box, click it to select and position it. When you select a description box, you can open the menu by clicking the drop-down arrow:

Use the commands on this drop-down menu to edit the description, format the description text, set its floating order relative to any other description boxes it may overlap, deselect it, or remove it from the story point.
Format a Story
You can format a story in any of the following ways.

Re-Size Captions
Sometimes the text in one or more of your captions is too long to fit inside the height of the navigator. In this case, you can re-size the captions vertically and horizontally.

1. In the navigator, select a caption.
2. Drag the border left or right to resize the caption horizontally, down to resize vertically, or select a corner and drag diagonally to resize the caption both horizontally and vertically.

All captions in the navigator update to the new size.

Note: When resizing a caption, you can only select the left, right, or bottom border of the caption.

Fit a Dashboard to a Story
You can fit a dashboard to the exact size of a story. For example, if your story is exactly 800 by 600 pixels, you can shrink or expand a dashboard to fit inside that space. To fit a dashboard to a story, in the dashboard, click the Size drop-down menu and select the story you want the dashboard to fit inside.
Format Story Pane

To open the Format Story pane, select Format > Story. In the Format Story pane, you can format any of the following parts of the story.

Story Shading

To select a shading for your story, in the Format Story pane, click the Story Shading drop-down control. You can select a color and transparency for the story.
Story Title

You can adjust the font, alignment, shading, and border of the story title. To format the title, click one of the drop-down controls in the Story Title section of the Format Story pane.
The Navigator

You can adjust the font and shading of the navigator in the Navigator section of the Format Story pane.

Font

To adjust the navigator font, click the Font drop-down control. You can adjust the style, size and color of the font.
Shading

To select a shading for the navigator, click the Shading drop-down control. You can select a color and transparency for the navigator.
As you move through the navigator, the caption color and font updates to indicate the currently selected story point.

Descriptions

If your story contains any descriptions, you can format all the descriptions in the Format Story pane. You can adjust the font and add shading and border to the description.

Clear All Formatting

To reset the story to the default format settings, click the Clear button at the bottom of the Format Story pane.

To clear a single format setting, right-click (control-click on Mac) the format setting you want to undo in the Format Story pane, and then select Clear. For example, if you want to clear the alignment of the story title, right-click (control-click on Mac) Alignment in the Story Title section, and then select Clear.
Updating a Story

You can update a story in any of the following ways.

Revising an Existing Story Point

To revise an existing story point, click it in the navigator, and then make changes. For more information, see Customizing a Story Point on page 1086. You can even replace the underlying sheet by dragging a different sheet from the Sheets area onto the story pane.

Deleting a Story Point

To delete a story point, click it in the navigator, and then click the × (delete icon) just above the box.
If you delete a story point by accident, click the Undo button to restore it.

**Inserting a Story Point**

To insert a new story point somewhere other than at the end of a story, add a story point, then drag it to the desired location in the navigator and drop it.

Alternatively, if you are dragging a sheet into the story, you can just drop it in the navigator between two existing story points.

**Rearranging Story Points**

You can use the navigator to drag and drop story points within a story as needed.

**Presenting a Story**

To present a story, use presentation mode. To switch in and out of presentation mode, click the Presentation Mode button on the toolbar. To exit Presentation Mode, press Esc or select the Presentation Mode button in the bottom right corner of the view. For more information on Presentation Mode, see *Reorganizing the Workspace* on page 246.

You can also publish a workbook that contains a story to Tableau Server, Tableau Online, or save it to Tableau Public. For more information on publishing workbooks, see *Publish Data Sources and Workbooks* on page 1104. Once you publish a story, the user can then open the story and navigate from story point to story point, or interact with stories just as they would interact with views and dashboards. Web users cannot, however, author stories, or permanently modify published stories.
Example – Earthquake Trend Story

This example shows how you can use Tableau to tell a story with data. The story described below considers the question: Are serious earthquakes becoming more common, or is it just that some strong earthquakes in recent years are creating that impression?

This story is available on Tableau Public: https://public.tableau.com/profile/tableau.docs.team#!/vizhome/EarthquakeTrendStoryExample/Earthquakestory

The story was built from three simple dashboards:

- A map of earthquakes recorded around the world since 2004.
- A line chart showing the number of earthquakes recorded, by year, since 1973 (timeline).
- A different version of same timeline visualization, with earthquakes broken out by region, and with trend lines added.

**Story Point 1**

The first story point shows the map with all data included—all earthquakes, across the entire planet.

**Story Point 2**

The second story point compresses the time frame and filters out smaller earthquakes—everything below magnitude 7. The map pans to show the Pacific "Ring of Fire," where the majority of the large earthquakes occurred.
Story Point 3

In story point 3, the magnitude filter is adjusted to show only "megaquakes" (megathrust earthquakes of magnitude 8 or greater). The words work with the pictures to move the narrative forward.
Story Points 4 and 5

Story points 4 and 5 revisit the two most deadly earthquakes in recent history: the 2004 Indian Ocean earthquake and tsunami, and the 2001 Japanese earthquake and tsunami. You can view them below.

The first five story points have all used the same underlying dashboard—the author is creating a compelling visual story just by filtering the data and zooming and panning the map.
Story Point 4

Earthquakes: Are they on the rise?

The 2004 Indian Ocean earthquake was an undersea magnitude earthquake that occurred on December 26, 2004. It is the third largest earthquake ever recorded and had the longest duration of faulting ever observed, between 8.3 and 10 minutes.

Magnitude 9.3 off the west coast of northern Sumatra

According to the U.S. Geological Survey, a total of 227,898 people died.
Story Point 5

**Earthquakes: Are they on the rise?**

More thousands of earthquakes are recorded every year. About two quakes each year qualify as “major earthquakes.” Those “megaseismic” events draw a lot of attention. The Indian Ocean earthquake and tsunami of 2004. The Japanese earthquake and tsunami of 2011. More and more earthquakes are being detected. The 2011 quake off the coast of Tohoku was a magnitude 9.0 (Mw) undersea megathrust earthquake. It was the most powerful known earthquake ever to have hit Japan, and the fifth most powerful earthquake ever recorded.

Since 1973 there has been a steady increase in the number of earthquakes recorded. Since 2000, the trend seems to be accelerating.

Story Point 6

Story point 6 uses a line chart to show that more quakes are being reported over time since 1973—a three-fold increase.
**Story Point 7**

Story point 7 adds two kinds of detail to the simple line chart from story point 6: it breaks out earthquakes by region, and it adds trend lines, which reduce the variability in the data.

[Image of earthquake chart]

Specifically, the author has duplicated his original worksheet and then dragged region to color and added a trend line. Here is what the underlying worksheet looks like:
Story Point 8

The final story point filters out weaker earthquakes and shows that what appeared to be a very clear trend is maybe not so clear. Yes, more earthquakes have been reported in recent years, especially in the Asia-Pacific region, but could that just be natural variation? Can we be confident that the trend will continue into the future?
Earthquakes: Are they on the rise?

Is the trend real or just the result of a small number of exceptionally strong recent earthquakes?
Publish Data Sources and Workbooks

When you’ve created your masterpiece—whether it’s a data source for others to connect to, or a workbook containing illuminating vizzes—you can share your creation with the rest of your team by publishing it to Tableau Online or Tableau Server.

You and your team can access published content securely through your web browser or the Tableau mobile app. Sharing your content by publishing it can also help you to implement centralized, governed data management.

**Note:** If you do not have Tableau Online or Server, you can share analysis on Tableau Public, a free cloud service. As the name suggests, views published to Tableau Public are publicly accessible. For more information, see public.tableau.com.

In this topic

- Why publish below
- What you can publish on the next page
- Who can publish on the next page

In other resources

For the steps on how to publish, see either of the following topics:

- Publish a Data Source on page 1122
- Publish a Workbook on page 1127

**Why publish**

You can publish data sources and workbooks when you want to widen the audience for your data analysis within your organization. By publishing you can begin to do the following:

- Collaborate and share with others
  
  Allow people in your organization to view, interact with, download, subscribe to, share, edit, and save published views, even if they do not use Tableau Desktop. Incorporate views into blog posts or websites.

- Enable centralized data management
  
  Create and publish data models that everyone can use. Centralized data management allows for sharing a single source for your Tableau data. All workbooks connected to the published data reflect updates to it.

- Support mobility
Access your data from a different computer or location, through a web browser or the Tableau Mobile iOS app. Sign in to your organization’s Tableau Server from a private network offsite.

**What you can publish**

Content types you can publish include:

- **Data sources**: You can publish data sources that others can use to build new workbooks. A data source can contain a direct (or live) connection to your database or an extract you can refresh on a schedule.

  For information, see [Best Practices for Published Data Sources](#) below.

- **Workbooks**: Workbooks contain your views, dashboards, and stories, and data connection. You can include local resources, such as background images and custom geocoding, if they reside in a location that the server or other Tableau users cannot access.

**Who can publish**

To publish to Tableau Server or Tableau Online, your server or site administrator must grant you the following capabilities:

- A *site role* of **Publisher** on the site you’re publishing to.

- **View** and **Save** capabilities set to **Allowed** on the project into which you publish.

If you use Tableau Desktop and are not sure whether you can publish to a server, or you are having trouble publishing, see your Tableau administrator. If you’re an administrator, see *Control Access to Content* in the Tableau Server help (or the Tableau Online version) for more information about site roles and permissions.

**Best Practices for Published Data Sources**

Publishing data sources to Tableau Online or Tableau Server is integral to maintaining a single source for your data. Publishing also enables sharing data among colleagues; including those who don't use Tableau Desktop, but have permission to edit workbooks in the web editing environment.

Updates to a published data source flow to all connected workbooks, whether the workbooks themselves are published or not.

**In this topic**

- [What makes up a published data source](#) on the next page

- [Preparing a data source for publishing](#) on the next page
• When to publish an extract on the next page
• Publishing data sources separately or embedded in a workbook on page 1108
• Making sure extracts stay current on page 1109
• Additional resources on page 1109

What makes up a published data source

A Tableau data source consists of the following:

The data connection information that describes what data you want to bring in to Tableau for analysis. When you connect to the data in Tableau Desktop, you can create joins, including joins between tables from different data types. You can rename fields on the Data Source page to be more descriptive for the people who work with your published data source.

An extract, if you decide to create one. Guidelines for when to create an extract are included below, as well as in the additional resources.

Information about how to access or refresh the data. The connection also includes access information. Examples of this type of information include:

• The path to an original Excel file.
• Embedded credentials or OAuth access tokens for accessing the data directly.
• Alternatively, no credentials, so that users are prompted to enter them when they want to access the data (whether it’s to view a workbook that connects to it, or to connect a new workbook to it).

For more information, see Set Credentials for Accessing Your Published Data on page 1134.

Customization and cleanup that helps you and others use the data source efficiently. When you’re working with your view, you can add calculations, sets, groups, bins, and parameters; define any custom field formatting; hide unused fields; and so on.

All of these refinements become part of the metadata contained in the data source that you publish and maintain.

Preparing a data source for publishing

When you publish a data source, consider these best practices:

• Create the connection for the information you want to bring into Tableau and do any cleanup that will help you and others use the data source efficiently.

  If you read Tableau blogs, you might see this process described as creating your data model.

• If appropriate, create an extract of the data you want to publish. For more information, see the following section, When to publish an extract on the next page.
• Develop a data source naming convention.

After publishing a data source you cannot rename it directly. Instead, you need to publish a new copy with the new name, and then update all workbook connections. A well-considered naming convention can also help other users of the data deduce which data source to connect to.

• Consider designating the following roles among your Tableau users:
  ○ A data steward (or team) who creates and publishes the data sources in Tableau Desktop that others will use.
  ○ A data administrator who manages published data sources on the server you publish to (Tableau Server or Tableau Online).

Central management avoids data source proliferation, so the data published to the server maintains its integrity.

When to publish an extract

Under the following conditions you might be required or choose to publish an extract instead of connecting live.

Publishing data to Tableau Online that it cannot reach directly

Tableau Online in the cloud cannot reach data sources that you maintain on your local network. For these data sources, you must publish an extract and set up a refresh schedule using the Tableau Online sync client.

Some cloud-hosted data sources always require extracts. These include Google Analytics, Salesforce.com, Oracle, OData, and some ODBC data sources. You can set up refresh schedules for some of these data sources directly on Tableau Online; for others you use the sync client.

Web data connector data sources always require extracts. If you connect to the data source using standard user name and password authentication, you can refresh it using the sync client. If you connect to the data source using OAuth authentication, you will need to republish the data source to refresh it.

For more information, see Get your Data to Tableau Online in the Tableau Online Help.

Limiting access or improving performance

Even if the server supports live connections to your data, an extract might make more sense. For example, for exceptionally large databases, or those that contain fields that aren’t relevant to Tableau analysis, you can extract a subset that includes only the pertinent information. The extract can be easier and faster to work with than connecting live.

In cases where you can use a live connection or an extract that you refresh on a schedule, you might want to experiment with both options to see which works best for you.
### Enabling functionality the data source does not inherently support

For example, suppose you want to use the Median function with SQL Server data.

To learn more about creating data extracts, see Extract Your Data on page 409.

### Publishing data sources separately or embedded in a workbook

When you publish a workbook, you need to decide whether to embed the data sources in the workbook or publish them separately. When you publish a data source separately, the workbook’s local connection is replaced by a connection to the published data source. If the data source connects to an extract, this enables the workbook to show updates when the extract is refreshed.

The table below shows a few common points of comparison for the different types of publishing. It is not a comprehensive list, and these are generalizations. How these and other issues not listed apply to you might be specific to your environment.

<table>
<thead>
<tr>
<th>Published separately</th>
<th>Embedded in workbook</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enables central data management and governance; avoids data source proliferation.</td>
<td>Each embedded data source has a disparate connection to the data. Each has the potential to show something different than the other at any given time (and data source proliferation is common).</td>
</tr>
<tr>
<td>Meant to be shared; becomes available for other Tableau users to connect to.</td>
<td>Data is available only inside the workbook; it is not available for other Tableau Desktop users to connect to.</td>
</tr>
<tr>
<td>Extracts can be refreshed on a schedule. You need to set up only one refresh schedule for the extract, and all workbooks that connect to it always show the most current data.</td>
<td>Embedded extracts that aren’t refreshed can be useful for showing snapshots in time. If you want to keep the data fresh, each workbook must have its own refresh schedule.</td>
</tr>
<tr>
<td>Generally helps you to optimize performance on the server or site.</td>
<td>Performance might be affected when the server contains multiple workbooks that connect to the same original data, and each workbook has its own refresh schedule.</td>
</tr>
</tbody>
</table>
Making sure extracts stay current

When you publish a data source with an extract, you can refresh it on a schedule. The way you schedule refreshes depends on the data source type and whether you’re publishing to Tableau Server or Tableau Online.

For more information, see the following topics:

- [Keep Data Fresh](#) in the Tableau Online Help
- [Scheduled Refresh Tasks and Subscriptions](#) in the Tableau Server Help

Additional resources

- [Data Server](#)—Training video by Tableau, with a helpful overview of data sources and publishing.
- [Understanding Tableau Data Extracts](#)
  A version-agnostic, three-part series by Gordon Rose on the Tableau blog. It includes an in-depth look at the extract's file structure, guidelines for when to use extracts, and best practices.
- [O Extract, Where Art Thou? and TDE or Live? When to Use Tableau Data Extracts (or not)](#)
  Posts by Tableau Zen Master Jonathan Drummey on his blog Drawing with Numbers. Includes tips on extracts, explains the different file types, describes different publishing scenarios. (Read the comments, too.)
- [Tableau Extracts—What / Why / How etc](#)
  From the blog maintained by The Information Lab, a Tableau Gold Partner.

**Disclaimer:** Although we make every effort to ensure these links to external websites are accurate, up to date, and relevant, Tableau cannot take responsibility for the accuracy or freshness of pages maintained by external providers. Contact the external site for answers to questions regarding its content.

Control Who Can See What in a Published View

As you prepare to publish your workbook, you can apply a type of filter that allows you to specify which data any given person signed in to the server can see in the published view. For example, in a sales report that is shared with regional managers, you might want to allow the Western Regional Manager to see only the western sales, the Eastern Regional Manager to see the eastern sales, and so on. Rather than creating a separate view for each manager, you can define a *user filter* that allows each manager to see the data for his or her particular region.
A user filter is defined for an individual field. Users or groups are given permission to see a subset of the members in that field. In the sales report example above, the user filter is defined for the Region field, and each manager is given permission to see a corresponding region.

You can define a user filter for any dimension or multidimensional hierarchy. In addition you can define user filters for sets, binned fields, and groups that you’ve created. The user list comes from the Tableau Server or Tableau Online site you’re signed in to.

When you publish a workbook with user filters, you specify which user’s view to apply to thumbnail images that Tableau creates for browsing the workbook and its sheets on the server. When a user signed in to the server opens the view, it shows only the data you allowed that user to see when you created the filter.

In addition to user filters, you can create similar data source filters, based on a user name field in the data the workbook is connected to. The topics in this section describe how to create and apply each type of filter before you publish the workbook.

For more information, sign in to the Tableau website, and watch the learning video Data Security with User Filters.

Create a User Filter and Apply it in a View

This topic uses an example scenario to walk you through creating a user filter and applying it in a view. It also includes some additional procedures for working with user filters more generally.

In this scenario, you are the Data Analyst, creating a sales report in Tableau Desktop. You want to publish this workbook and allow the regional managers who are tracking the sales to see only the data relevant to their respective regions.

The following image shows a quarterly sales report for a set of products over several years, in different geographic regions.
Using this example view, the remaining sections of this topic show you how to filter data by user.

- **Create a user filter below**
- **Apply the user filter in a view** on page 1113

**Create a user filter**

1. Select **Server > Create User Filter**. Then select the field you want to use for filtering the view. This example uses **Region**.
2. If prompted, sign in to your server or site. For information, see Sign in to Tableau Server or Online on page 1119.

3. In the User Filter dialog box, type a name for the set of rules you are creating.

   In this example, we’ll use Regional Managers.

4. In the list on the left, select a user or group. On the right, select the individual members of the field you selected earlier, that you want the selected users to be able to see.

   For this example, selected user Andrew Allen is the manager of the Eastern region, so in the field member list, you would select East.
Repeat this process for each user or group, and click OK when you’re done.

Tips

- Users or groups that you do not map to field members (regions in this case) will not be able to see data for any of the regions.
- If you have a large list of users and groups to look through, you can click in the list on the left and start typing the group’s or user’s name to jump to the name that matches the characters as you type.
- If the field you select has a large number of members, click Find to search for matching members, and select from the results.

Apply the user filter in a view

After you create the user filter, it appears in the Sets area of the Data pane. You can now apply it in a view you want to publish.

- Drag the user filter to the Filters shelf.
  The filter becomes a context filter.
**Note:** When you apply a user filter to a view, the view might appear as a blank canvas. This happens if you have not allowed yourself or a group you are a member of to see any of the regions.

To change this, you can edit the user filter and add yourself to it. In the **Sets** area of the **Data** pane, click on the drop-down arrow on the user filter and select **Edit Set** from the context menu.

**Preview how your filter will work in the published view**

Before you publish the view, you can check how your users will see it.

- In the lower-right corner of the workbook, open the **Filter as User** menu, and select the user or group from the list.
To return to viewing the workbook as yourself, click **Reset** in the top right corner of the **Filter as User** menu.

**Note:** Previewing user filters is not available for connections to Tableau Server data sources.

**Copy member selections from other users**

As you specify which members each user or group can see, you might want to duplicate the member selections you already set for another user or group.

1. In the Data pane, in the Sets section, select a User filter. Click the drop-down arrow and select **Edit Set**.
2. In the User Filter dialog box, select the user or group that you want to copy the member selection to.
3. Click the **Copy From** button at the bottom of the member list.
4. Select the user or group that you want to copy the member selection from.

![User Filter](image)

**Create a User Filter Based on a Field in Your Data**

If your data contains a list of your Tableau users, you can create a user filter to show only the data relevant to the user signed in to Tableau. For example, in a view showing employee sales performance, a filter could show only the performance data for the employee signed in to the server.

The remaining sections describe how to use a calculated field and user functions to create a filter based on a user-name field in your data.

**Create a filter based on a user name field and apply it in the view**

The view below shows annual sales performance for a list of managers.
This data source includes a field that contains employee names, in this case regional manager names. The following steps describe how to create a filter so that, when a manager displays the published view, the view contains only his or her own sales numbers.

1. If you are not signed in to a server, select **Server > Sign In**, and enter your server name and credentials.

   For information see **Sign in to Tableau Server or Online** on page 1119.

2. Create a calculated field that, when evaluated, returns the full name of each member of the Manager field.

   a. Select **Create Calculated Field**.

   b. Name the field. This example uses **Current Manager**.

   c. Enter a formula similar to the following: `[Manager]=FULLNAME()`, and click
The calculated field appears in the **Dimensions** area of the **Data** pane.

**Note:** Confirm that the manager names in the data source match the names returned by the `FULLNAME()` function in Tableau. If your filter is not working as expected, a discrepancy here might be the cause.

3. Drag the calculated field to the **Filters** shelf.

   If you are one of the members of the field being filtered (that is, one of the managers), you can select **True**, to include only the managers who match the current user.

   If you are not one of managers, the only option in the **Filter** dialog box will be **False**. If that’s the case, select nothing and click **OK**. Then preview as another user and edit the filter to include **True**.
To preview the view as a particular user, in the bottom right corner of the workbook, open the **Filter as User** menu, and select the user or group.

The example view below shows data about Andrew Allen as if he were signed in.

![Example view](image)

**Include the User Filter in a Tableau Server data source**

To include the user filter in a Tableau Server data source, you must create a data source filter before publishing. The steps below create a data source filter that relies on the user filter that you created earlier in this topic, based on the user name field in the data source.

**Create a data source filter based on the user filter**

1. On the **Filter** shelf, right-click the user filter, and then select **Apply to Worksheets > All Using This Data Source**.
2. In the **Data** pane, right-click the data source, and then select **Edit Data Source Filters**.
3. Check that the user filter you created in earlier in this topic is listed under **Filter**, and then click **OK**.
   
   If the user filter is not listed, click **Add**, select the user filter from the list, and then click **OK**.
4. Publish the data source.
   
   For more information, see **Publish a Data Source** on page 1122.

**Sign in to Tableau Server or Online**

To publish data sources or workbooks, or to access data sources or workbooks that are already published, you need to sign in to your Tableau Server or Tableau Online site. The specific steps...
you take to sign in depend on the type of authentication your Tableau administrator has configured.

This topic describes the basic sign-in steps, includes variations for different authentication types, and links you to steps for clearing saved server sign-ins.

**Basic sign-in steps**

- Select **Server > Sign In**, and enter your server name, and user name and password.
  
  For the Tableau Online server name, enter [https://online.tableau.com](https://online.tableau.com).

![Server Sign In dialog box](image)

**Variations on signing in to Tableau Server**

**Note:** For Tableau Online, see [Sign In to Tableau Online](https://help.tableau.com) in the Tableau Online Help.

With some Tableau Server configurations your sign-in experience varies from the basic steps. The sections here describe variations for single sign-on (SSO) and special issues related to working in a Kerberos environment.

**Active Directory**

If Tableau Server is configured to use Active Directory, enter your Windows user name. If you work in a multi-domain environment, and you are not currently on the default domain, enter your Tableau Server user name and password.

**SAML or SAP HANA single sign-on**

- If Tableau Server is configured to use SAML, your user name and password are managed by a third-party identity provider. When you enter your user name for Tableau Server, you are directed to the sign-in page for the identity provider.
If Tableau Server is configured for SAP HANA SSO, Tableau connects to the server, and you do not need to provide credentials.

**Mutual SSL**

If Tableau Server is configured for mutual SSL and you have more than one client certificate, you are prompted to select which certificate to use the first time you connect.

**Kerberos environment**

If Tableau Server is Kerberos-enabled and you are signed in to your computer using Active Directory credentials, Tableau Desktop connects to the server, and you do not need to provide credentials.

**Switching user accounts (typically for testing purposes)**

If Kerberos authentication does not succeed, you are prompted to provide a user name and password. If this occurs, and you need to change the user you're signed in as on Tableau Server, complete the following steps:

1. On the Server menu, select **Switch User**.

2. In the Tableau Server Sign In dialog box, provide the new user name and password.

If you sign in as a different user and then need to sign back in using your normal credentials, on select **Server > Switch to Self**.
Clearing saved server sign-ins

When you sign in to a server, Tableau Desktop stores your credentials in a secure token that remembers your Tableau Desktop connection with the server. When this token is in place, you can access the server directly, without having to sign in.

- If you want to forget a server connection, select Server > Sign Out.
- To remove all of you existing server connections, select Help > Settings and performance > Clear saved server sign-ins.

For more information, see Quick Start: Stay Connected with Automatic Sign-In on page 1621.

If you never want server sign-ins to be saved, a Tableau Server administrator can change the server settings to disallow connected clients. This setting also affects Tableau Mobile and other Tableau clients. For information, see Authentication for Connected Devices in the Tableau Server Help.

Note: Automatic sign-in is available for servers configured for Windows Authentication only. Servers configured for Kerberos or SAML authentication cannot use automatic sign-in.

Publish a Data Source

When you are ready to make a data source available to other Tableau Desktop users, you can publish it to Tableau Server or Tableau Online.

Note: If you haven't yet read about best practices for creating data sources and when to create an extract, see Best Practices for Published Data Sources on page 1105.

In this topic

- Publishing steps below
- Publishing with a Web Data Connector on page 1126
- Using hidden fields in workbooks on page 1126

Publishing steps

The following steps give an overview of the publishing flow you will use regardless of the type of data or the server you publish to. After these steps you can find supplemental information for authentication types and using the Tableau Online sync client to refresh extracts of local data sources.
1. Select **Server > Publish Data Source**.
   If your workbook is connected to multiple data sources, select the one you want from the submenu.

2. If you’re not already signed in to Tableau Server or Tableau Online, sign in now.
   How you sign in depends on how your administrator set up your environment. For information, see **Sign in to Tableau Server or Online** on page 1119.

3. In the **Publish data source to Tableau Server** dialog box, do the following:
   - Select the project you want to publish to and enter the data source name.
   - Add a description and tags that will help you and other users find it.
     Separate tags using either a comma or a space. To add a tag that contains a space, put it in quotation marks (e.g., “Sales Quotes”).
- Under **Permissions**, select **Edit** to change permissions indicated.

**Note:** Do this only if you are confident that they need to be something different than what is shown, which is the default setting on the server.

For more information, see *Set Permissions as You Publish a Data Source or Workbook* on page 1130.

- For **Authentication**, if you need to provide credentials to access your data, you can specify how authentication should be handled when the data is published to the server.

The options available for accessing the data source depend on the type of data you publish and whether you are publishing to Tableau Server or Tableau Online.
Information appears at the bottom of the dialog box to let you know whether you need to take further action, such as adding Tableau Online to your data provider's authorized list.

For information about the authentication types, see Set Credentials for Accessing Your Published Data on page 1134.

4. If you are publishing file-based data that is on a Windows mapped drive, or use images that will not be available from the server, select Include External Files.

When you include external files, copies of them are put on the server as part of your data source.

If you do not want to publish the external files to the server, change the connection information so that the data source references a full UNC path. For example, rather than connecting to D:\datasource.xls, you would connect to \filesrv\datasource.xls.

5. By default, during the publishing process, Tableau updates the workbook connection to use the new published data source. It also closes the local data source.

To continue using the local data source instead, clear the Update workbook to use the published data source check box.

For more information, see Quick Start: Automatically Update Workbook to Use Published Data Source on page 1451

Note: If you select Undo after publishing the data source, Tableau will revert to using the local data source, but the data source will remain published. In addition, Tableau does not replace a local data source when you publish a cube (multidimensional) data source to an on-premises Tableau Server. (Tableau Online does not support publishing cube data sources.)

6. Click Publish.

7. (Optional) Set up a refresh schedule on the server.

After you click Publish, you are redirected to the site you published to, open in the web browser. There, you are prompted to set up the refresh schedule. If you published to Tableau Online an extract of a data source Tableau Online cannot reach directly, such
as a SQL Server data source you maintain on your local network, you schedule refreshes using the sync client.

For more information about refreshes and schedules, see any of the following topics:

- Schedule Refreshes on Tableau Server
- Schedule Refreshes on Tableau Online
- Schedule Refreshes through the Sync Client

**Publishing with a Web Data Connector**

To publish a web data connector data source, you need to *import* the web data connector to the server before you can set up a refresh schedule. You can do this only on Tableau Server.

To refresh web data connector data sources on Tableau Online, you need to use the sync client.

For information, see Web Data Connectors in Tableau Server in the Tableau Server Help or Refreshing Data Using the Sync Client in the Tableau Online Help.

**Using hidden fields in workbooks**

Workbooks connected to a published data source respect the state of hidden fields in the published data source.

- If you create a new workbook that uses a published data source with hidden fields, those fields remain hidden in the workbook and cannot be used in calculations, sets, groups, and other object creation.
- If you work with an existing workbook that uses a published data source with hidden fields, those hidden fields are displayed in red in the workbook to indicate that the fields, and therefore the views and calculations that use those fields, are invalid.

You can address this issue in one of the following ways:

- Show (unhide) the relevant fields in the data source, and then republish it.
- Update the relevant workbooks to exclude the hidden fields.

For information, see Hide or Unhide Fields on page 306.

**See also**

- Allow Direct Connections to Data Hosted on a Cloud Platform (Tableau Online)
- Keep Data Fresh (Tableau Online)
- Data Sources (Tableau Server)
Publish a Workbook

While you step through publishing a workbook, you make decisions about how others in your organization can access your workbook and the data it connects to.

This topic gives you an overview of the publishing steps, followed by a more detailed discussion of the decisions you make during the process.

If you have an administrator or content manager for the server, ask them whether your organization already has guidelines for publishing. If you don’t have them yet, share this information with your administrator to help create guidelines for your organization.

Start the publishing steps

This section provides an overview of publishing process. Use the information you gather in the next section, Decisions you make when publishing a workbook below to make your selections in the Publish Workbook dialog.

1. Select Server > Publish Workbook
   If necessary, complete the sign-in process.

2. In the Publish Workbook dialog box, make your selections, and then click Publish.
   If you published extracts as part of the process, you are prompted to schedule extract refreshes.

3. Set up a refresh schedule for each extract you published.
   If your data source is on your internal network, and you published an extract to Tableau Online, the publishing process starts the sync client on your computer.

   For more information, see Schedule Extract Refreshes as You Publish a Workbook on page 1136.

Decisions you make when publishing a workbook

This section helps you make selections in the Publish Workbook dialog box. Use this section to gather the information you need before you initiate the publishing process.

In this section

- Publishing data sources separately or embedded in a workbook on page 1108 (opens separate topic)
- Sign in to Tableau Server or Tableau Online on the next page
- Select a project and name for the workbook, consider revision history on the next page
- Set Permissions as You Publish a Data Source or Workbook on page 1130
(opens a separate topic)

- **Specify how to generate thumbnails for workbooks with user filters** on the next page
- **Show or hide sheets when you publish** on the next page
- **Make additional decisions** on the next page
  - **Show sheets as tabs** on the next page
  - **Show selections** on page 1130
  - **Include external files** on page 1130

**Sign in to Tableau Server or Tableau Online**

You need to be able to sign in to the site you want to publish to. Make sure you know how your administrator set up authentication on your server or site. To sign in to Tableau Online, enter [https://online.tableau.com](https://online.tableau.com). For more information, see **Sign in to Tableau Server or Online** on page 1119.

**Select a project and name for the workbook, consider revision history**

Projects serve as containers in which you organize related workbooks or data sources. Permissions set on the project determine who will be able to access your workbook, so make sure you know which one to publish to.

Select a unique name for the workbook unless you want to overwrite an existing one that you own. If you are publishing to a site that is set to save workbook revision history, publishing a workbook with an identical name will save a new revision of the existing workbook.

**Add metadata keyword tags**

Enter keywords that describe the workbook. Tags help users find related workbooks when they browse the server.

Separate tags using a comma or space. To add a tag that contains a space, put the tag in quotation marks.
Specify how to generate thumbnails for workbooks with user filters

On the server where you publish, one of the options for browsing content is by thumbnail view. In this view, thumbnails are generated based on the workbook and its sheets. If your workbook contains user filter (that is, you set which users can see which data based on criteria such as location or department), you can specify which user’s filter to use for creating the thumbnails.

For example, if you want the thumbnail image to show all regions of a sales forecast, you can generate thumbnails per the user who is allowed to see all regions.

If the user you select does not have permissions to see the data, a generic image appears in place of the view thumbnail.

Make additional decisions

These options appear when they’re appropriate for the workbook you’re publishing.

Show or hide sheets when you publish

You can specify which sheets to include. Showing or hiding sheets is useful when you want to publish a dashboard or story without publishing the worksheets that were used to create it.

Important: Hiding sheets is not a security measure. Anyone who has the Download/Web Save As permission can access the hidden sheets, either by opening the workbook on the server, or by downloading it from the server. Other editing permissions also can allow access to hidden sheets. For more information, see Control Access to Published Content in the Tableau Server Help.

Show sheets as tabs

If your workbook contains multiple sheets, you can specify how users navigate it.
• If you selected multiple sheets under **Sheets to Publish** and want to provide tab-based navigation across multiple sheets, select this check box.

• If you want to hide any sheets in the workbook, make sure the **Show Sheets as Tabs** check box is cleared.

**Show selections**

If you made selections in the workbook, these can be retained after the workbook is published to the server. When others view the workbook, your selections will appear by default.

**Include external files**

If your views contain any information that isn’t available to the server, or to other users who access the workbook on the server, the Publish Workbook dialog box will include a setting you can select to include that information when you publish.

For example, you might use an Excel, CSV, or other data source local to your computer; image files; and so on.

If you are publishing to Tableau Server, and the workbook references data sources or images on a mapped drive, you can include external files when you publish, or you can change the connection information so that the workbook references the UNC path to the data source. For example, you could change `D:\datasource.xls` to `\filesrv\datasource.xls`.

If you are publishing to Tableau Online, and the workbook connects to a data source that Tableau Online cannot connect to directly, such as one that is stored on your local network, select the **Include External Files** check box.

**Set Permissions as You Publish a Data Source or Workbook**

As the publisher of a workbook or data source, you can set permissions as part of the publishing process. Permissions allow or deny other users access to your published content on Tableau Server or Tableau Online. For example, who can interact with views in a workbook, edit them, or save changes to them, who can download a copy of a data source, and so on.

Permissions are separate from the type of access you set on the connection to the data. Accessing some data types requires signing in using a database name and password or embedding database credentials into the connection. For information about that, see **Set Credentials for Accessing Your Published Data** on page 1134.

Back to permissions, with few exceptions, your best choice will be to accept the default settings in the publishing dialog box. If you agree, you can return to the **Decisions you make when publishing a workbook** on page 1127, and save some time not reading the rest of this topic.

The remaining sections give context and tips for when you think your workbook or data source might be an exception to the default settings, and shows you how to change the permissions.
About setting permissions during publishing

When you start the publishing process, the dialog shows the permissions that will be applied. By default, the content you publish takes the capabilities that are already set on the server, typically as they’re set on the project you are publishing to.

When you change permissions in the publishing dialog, you are setting capabilities *explicitly* for the content you’re publishing. The effect is that the workbook or data source you publish no longer inherits changes made at its parent level, such as the project. Depending on your environment, this might be as you intend, or it might conflict with the guidelines your administrator has set and have unintended consequences.

**Tips for deciding whether to set permissions explicitly**

- **Learn your organization’s practices**
  
  Consult with your Tableau administrator to learn the guidelines for your organization. It’s common (and recommended) practice for an administrator to manage permissions on
your Tableau Server or Online site. If you work in such an environment, even if you set permissions during publishing, the person who manages permissions on the server might change these settings afterward.

- **Know the consequences of setting explicit permissions**
  In addition to the potential conflicts described earlier, explicit permissions on some content requires extra maintenance to keep track of which content has exceptions, and which exceptions are applied.

- **Publish quickly by accepting the default permissions settings**
  If necessary, you or your administrator can update permissions on the server afterward, where you have a more comprehensive view into the effects of your changes.

**How to set explicit permissions during publishing**

1. In the publishing dialog box, next to the summary that indicates the current settings, click **Edit**.

2. In the popup that appears, do one of the following:
   - To set custom capabilities or assign a role explicitly, select an existing user or group and click **Edit**, or click **Add**.
     
     In the **Add/Edit Permissions** dialog box, make your changes.
     
     Click **Apply** to save changes and keep the dialog open to configure another user or group. Click **OK** to close the dialog.
To remove roles or capabilities that are set explicitly, select the user or group, and then click Remove.

Predefined roles you can assign

When you publish a workbook, you can assign any of the following predefined roles to a selected user or group:

- **Viewer**: Allows the user or group to view the workbook on the server, as well as add and view comments.
- **Interactor**: Allows the user or group to view the workbook on the server, edit workbook views, apply filters, view underlying data, export images, and export data. All other capabilities are inherited from the user’s group and project permissions.
- **Editor**: Allows all capabilities to the user or group.

When you publish a data source, you can select from these roles:

- **Data Source Connector**: Allows the user or group to connect to the data source on the server.
- **Data Source Editor**: Allows the user or group to connect to the data source on the server and to publish, edit, download, delete, set permissions, and schedule refreshes for the data source.

**Note**: If you are not the content owner or an administrator, you cannot schedule refreshes directly on the server.
See also

- Set Permissions on a Data Source
- Permissions Rules and Resulting Permissions

Set Credentials for Accessing Your Published Data

When you publish a workbook to Tableau Online or Tableau Server, you can publish the data it connects to as an integrated part of the workbook (embedded into the workbook), or as separate, standalone data sources. In addition, if the data you’re publishing requires anyone who wants to view it to enter a user name and password, you specify how others get access to the data when they open the workbook.

The latter is true also when you publish a data source on its own.

This type of authentication to your data is independent of how people sign in to your Tableau Online or Tableau Server site. For example, to give people direct access to the data in a workbook, you would embed a database user’s credentials into the data source’s connection. But others would still need to be able to sign in to the Tableau Online or Tableau Server site to open your workbook.

This topic describes how to set authentication on data connections as part of the publishing process.

In this topic

- **Set the authentication type** below (most connection types)
  - **Kerberos environments** on the next page
  - **SAP HANA or Impala single sign-on** on page 1136
  - **Salesforce, Google Analytics, or Google BigQuery connections** on page 1136
  - **Workbook connections to Tableau data sources** on page 1136

**Note:** This topic does not apply to connections to that do not require authentication, such as text files or Excel files. However, you can set authentication when you publish extracts of those data types.

Set the authentication type

For many types of connection you can embed a database user’s name and password, or set a type of impersonation. For specific exceptions, see the remaining sections in this topic.
The following steps describe how to set authentication as part of publishing a data source or workbook. You can do this for each connection in the data source.

1. In the publishing dialog box, go to the **Data Sources** area, which lists the workbook’s connections, and click **Edit**.

2. In the **Manage Data Sources** popup, after you decide whether to publish the data source separately or as part of the workbook, select an authentication type for each connection in the data source.

   The available authentication types depend on the connection type, and they can include one or more of the following:

   - **Prompt user**: Users must enter their own database credentials to access the published data.
   - **Embedded password**: The credentials you used to connect to the data will be saved with the connection and used by everyone who accesses the data source or workbook you publish.
   - **Server run as account**: Tableau Server only. The server’s Run As user account will authenticate all users.
   - **Viewer credentials** or **Publisher credentials**: Tableau Server only. In a Kerberos, SAP HANA, or Impala environment, the user’s domain user name and password are used. These are explained in more detail in the sections below this list.
   - **Impersonate via embedded account** or **Impersonate via server Run As account**: (Available only when publishing SQL Server data to Tableau Server.) You can embed credentials through which SQL Server creates the connection and then impersonates the signed-in Tableau Server user. To create the connection you can specify the server’s Run As account or a different database user that has the appropriate permissions for impersonation.

   For more information, see the topics under **SQL Server Impersonation** in the Tableau Server Help.

   - **Refresh not enabled** or **Allow refresh access**: These options appear when you publish an extract of cloud data such as from Salesforce.com, and database credentials are needed to access the original data. **Allow refresh access** embeds the credentials in the connection, so that you can set up refreshes of that extract on a regular schedule. Setting **Refresh not enabled** prompts users when they open the workbook.

**Kerberos environments**

(Tableau Server on-premises only.) Select **Viewer credentials** to use the user’s domain user name and password to access a Kerberos-enabled Teradata, PostgreSQL, Microsoft SQL Server, or Microsoft Analysis Services data source.
SAP HANA or Impala single sign-on

(Tableau Server only) Select **Viewer Credentials** to authenticate users who access the data source in these environments:

- You use single sign-on to SAP HANA and Tableau Server is configured for SAP HANA SSO.
- You use Impala with Cloudera Hadoop, and Tableau Server is configured for single sign-on.

**Salesforce, Google Analytics, or Google BigQuery connections**

Salesforce and Google connections use a type of authentication in which the data provider sends a secure access token, so that the credentials themselves are not stored with Tableau. You need to create and embed these credentials after publishing, from the Data Connections page on the server.

- If you publish to Tableau Server, see **Edit Data Source Connections** in the Tableau Server Help.
- If you publish to Tableau Online and the workbook connects to Salesforce.com, see **Refresh Salesforce Extracts** in the Tableau Online Help.
- If you publish to Tableau Online and the workbook connects to Google Analytics or Google BigQuery data, see **Refresh Google Data** in the Tableau Online Help.

**Workbook connections to Tableau data sources**

When you publish a workbook that connects to a Tableau Online or Tableau Server data source, rather than setting the credentials to access the original data, you set whether the workbook can access the published data source it connects to. Regardless of the original data type, the choice for server data sources is always embedded password or prompt users.

If you select to prompt users, a user who opens the workbook must have **View** and **Connect** permissions on the data source to see the data. If you select embed password, users can see the information in the workbook even if they don’t have View or Connect permissions.

**See also**

*Publish a Workbook* on page 1127

**Schedule Extract Refreshes as You Publish a Workbook**

When you publish workbooks that connect to extracts, you can set up a schedule for updates (refreshes) for those extracts, so the views in those workbooks stay current.

The ways you can set up and manage extract refresh schedules depends on where you publish and the original data type.
- When you publish to **Tableau Server**, the schedule runs and is managed on the server.

- When you publish to **Tableau Online**:
  - If extracts are from cloud data (for example, Google Analytics or Salesforce), schedules run and are managed on Tableau Online.
  - If extracts are from *on-premises* data (data you maintain on your internal network) or web data connector data, you set up and manage refresh schedules using the Tableau Desktop sync client.

**Note:** In many organizations a server content manager or administrator manages all refresh schedules. We recommend that, before you publish, you find out from your administrator whether they have guidelines for these schedules.

**Set up a schedule as you publish content**

During the publishing process, after you click the **Publish** button, the scheduling options appropriate for your data types and publishing destination appear.

If you are publishing a multi-connection data source, you need to set a refresh schedule for each extract connection in the data source.

To use refresh schedules with connections to a database that requires you to sign in to it, you must store (embed) a database user’s credentials with the connection. For more information, see **Set Credentials for Accessing Your Published Data** on page 1134.

**Publish and refresh on Tableau Online**

For the subtleties around refreshing each type of data you publish to Tableau Online, see **Keep Data Fresh**. Here are examples of things you need to know:

- If your workbook connects to cloud data, add Tableau Online to your cloud data provider’s authorized list (whitelist). The IP address range for your site location is listed in **Keep Data Fresh**.

- The Online sync client starts during the publishing process if your data source or workbook connects to on-premises data.

  The sync client supports standard database authorization and cannot refresh data you connect to through OAuth. To learn more, see **Refresh Data Using the Tableau Online Sync Client**.

- When you publish a multi-connection data source to Tableau Online, if any one connection requires using the sync client, you must use the sync client to refresh *all* connections in the data source.

  For example, say you publish a data source with connections to an extract of MySQL data hosted in the cloud, and one of a SQL Server database on your local network.
Although Tableau Online supports refreshing hosted MySQL data, in this case, you would need to refresh both the SQL Server and MySQL connections through the sync client.

**Refreshing web data connector extracts**

When you publish a workbook with a web data connector (WDC) data source, you need to *import* the web data connector to Tableau Server before you can set up a refresh schedule. You can do this only on Tableau Server. For information, see Web Data Connectors in Tableau Server in the Tableau Server Help.

For information about refreshing web data connector data sources published to Tableau Online, see Schedule Refreshes Using the Sync Client in the Tableau Online Help.

**Save Workbooks to Tableau Public**

If you want to share your data discoveries with the world outside of your organization, you can save your workbook to Tableau Public, a free cloud service. On Tableau Public, anyone can interact with your views, download your workbooks or data sources. For information, go to the Tableau Public website.

When you save workbooks to Tableau Public, the publishing process will create an extract of your data source.

**Save a workbook**

1. Select Server > Tableau Public > Save to Tableau Public.
2. Sign in using your Tableau Public account.

If you don’t have one, select the link to create a new one.
3. Type a name for the workbook and click **Save**.

**Tip:** The title becomes part of your view’s metadata. Use a unique title that will help others find it when they search. (The title shown in the image is a good example of how *not* to name your workbook.)

After the workbook is published, you are redirected to your account on the Tableau Public website.

On the Tableau Public site, you can select a featured view, hide views, customize metadata and otherwise manage content you publish.

To get a link to share on social media or code to embed in a web page, display a view, and then click **Share** at the bottom of the view. (You can get links and embed code for other Tableau Public users’ views this way, too.)

### Opening Workbooks from the Server

If you have been granted the **Download/Web Save As** permission for a workbook, you can use Tableau Professional to open the workbook from the server. When you open a workbook from the server and make changes, you can either save it to your hard drive or, if you have been allowed the **Write/Web Save** permission, you can republish the workbook to the server.

**To open a workbook from the server:**

1. Select **Server > Open Workbook**.
2. If you are not already signed in to Tableau Server, you see the Tableau Server Sign In dialog box.

![Tableau Server Sign In dialog box](image)

Enter the server name or URL (for example, sales_server, or https://sales_server) and click **Connect**.

If Tableau Server is Kerberos-enabled and you are on a machine with valid Active Directory credentials, you will connect automatically to the server. In this case, you can skip step 3. If Kerberos authentication fails, you will be prompted to provide a user name and password for authentication.

3. Next, enter your user name and password and click **Sign In**.

![Tableau Server Sign In dialog box](image)

If Tableau Server is configured to use Active Directory, enter your Windows user name (the domain is not required—except in multi-domain environments where the user is not in the default domain); otherwise, enter your Tableau Server user name.

If Tableau Server is configured to use SAML for user authentication, you won’t see the above dialog box. Instead, you’ll see a sign in prompt from an external identity provider.

4. In the Open Workbook from Tableau Server dialog box, select the workbook you want to open.
You can find workbooks using the **Find** drop-down lists. You can search all workbooks on the server or find by tags, publisher, project, or workbooks that you published.
If you choose **Search** from the drop-down list, you can then enter a search string in the search box to the right. If you type an unquoted string in the search box, Tableau will search for workbook names that begin with the string that you type. If you type a quoted string, Tableau will search for workbook names that contain the string.

6. Click **Open**.
Save, Export, and Print

After you create views in Tableau, you may want to save or share your work. You can export your work in a number of different formats to be used in different applications such as Microsoft PowerPoint and Microsoft Excel.

Saving Your Work

After you create useful views of your data, you should save the results. Tableau provides three ways for you to save your work:

- **Workbooks** – Saves all open worksheets.
- **Packaged Workbooks** – Saves the workbook along with all referenced local file data sources and images into a single file.
- **Bookmarks** – Saves the current worksheet.

You can share workbooks and bookmarks with your co-workers, provided they can access the relevant data sources. If your co-workers do not have access to the data sources, you can save a packaged workbook.

Custom fields such as binned measures, calculated fields, groups, and sets are saved with workbooks and bookmarks.

Workbooks

When you open Tableau, it automatically creates a new workbook. Workbooks hold the work you create and consist of one or more worksheets. Each worksheet contains a particular view of your data.

To save a Tableau workbook:

1. Select **File > Save** or type **Ctrl + S** (**⌘ S** on a Mac).
2. Specify the workbook file name in the **Save As** dialog box.

By default, Tableau saves the file with the .twb extension. The default location is the **Workbooks** folder in the Tableau repository. However, you can save Tableau workbooks to any directory you choose.

Tableau file names cannot include any of the following characters: forward slash (/), backslash (\), greater-than sign (>), less-than sign (<), asterisk (*), question mark (?), quotation mark ("), pipe symbol (|), colon (:), or semicolon (;).

To save an extra copy of a workbook that you already have open, select **File > Save As** and proceed by saving the file with a new name.
Packaged Workbooks

Workbooks often reference external resources. For example, workbooks might reference background images, or local file data sources such as Excel, Access, and Extract files.

When you save a workbook, links to these resources are also saved. The next time you open the workbook, the views are automatically updated with any changes that may have occurred to the data and images. In most cases, you will want to save the workbook in this way. But if you plan to share the workbook with someone who does not have access to the referenced resources, or to publish the workbook to Tableau Server, you might want to save a packaged workbook instead.

Packaged workbooks contain the workbook along with a copy of any local file data sources and background images. The workbook is no longer linked to the original data sources and images. These workbooks are saved with a .twbx file extension. Other users can open the packaged workbook using Tableau.

To save a packaged workbook:

1. Select File > Save As.
2. Specify a file name for the packaged workbook in the Save As dialog box.
3. Select Tableau Packaged Workbooks on the Save as type drop-down list.
4. Click Save.

The default location is the Workbooks folder of the Tableau repository. However, you can save packaged workbooks to any directory you choose.

The following files are included in packaged workbooks:
If you are sharing packaged workbooks that contain Microsoft Excel or Access 2007 data sources, the people opening the workbook must either have Microsoft Excel and Access 2007 or the Office 2007 Data Connectivity Components installed on their machines. The data connectivity components are available on the Tableau Tableau Drivers page.

Packaged Workbooks can be unpackaged.

**To unpack a workbook:**
- On a Windows computer, right-click the packaged workbook file (.twbx) in Windows Explorer and select Unpackage.
- On a Mac computer, rename the file with a .zip extension (for example, from myfile.twbx to myfile.zip) and then double-click it.

When you unpack a workbook, you will get a regular workbook file (.twb), along with a folder, that contain the data sources and images that were packaged with the workbook.

**Bookmarks**

You can save a single worksheet as a Tableau bookmark. Bookmarks can be accessed from any workbook using the Bookmarks menu. Bookmarks are convenient when you have worksheets that you use frequently.

**To save a Tableau bookmark:**
1. Select Window > Bookmark > Create Bookmark.
2. Specify the bookmark file name and location in the Create Bookmark dialog box.

Tableau saves the file with a .tmb extension. The default location is the Bookmarks folder in the Tableau Repository. However, you can save bookmarks to any location you choose. Bookmarks that are not stored in the Tableau repository do not appear on the Bookmark menu.

You can organize bookmarks into folders in the same way you organize files or documents. This can be useful when you have a large number of bookmarks to manage. For example, you
might organize bookmarks based on employee name, product types, or sales results. You can organize bookmarks by creating a new folder, renaming an existing folder, renaming existing bookmark files, and so on.

Delete bookmarks the same way you would delete any other file on your computer. After you delete a bookmark from the Bookmarks folder in the Tableau Repository, it is removed from the Bookmarks menu the next time you start Tableau.

While bookmarks are generally a snapshot of the worksheet and include the data connection, formatting, etc., a bookmark does not include parameter values and the current page setting on the Pages shelf.

Reverting Workbooks

To revert a workbook is to undo all of the changes you’ve made to a workbook since you last saved it. You could click through your history using the Undo button, but there is an easier way.

To revert to the last saved state of a workbook:

1. Select File > Revert to Saved.

2. Click Revert in the warning dialog box.

Or, just press F12.

The Revert to Saved command is only available for workbooks (.twb) that do not have connections to Extract data sources.

Exporting Your Work

After you have created some data views, you might want to export your results to other applications. Tableau provides several methods for you to export your work:
• Export Data – Copy the data from a view to an Excel worksheet or export as an Access database.

• Export as an Image – Copy images of your views into other applications such as Microsoft Office or PowerPoint. You can also include the images in web pages.

Exporting your results is a convenient way to share your work with coworkers who do not have access to Tableau, or to include your work as part of a presentation or document. You can also use Tableau to present your data.

**Note:** You can also export selected sheets to incorporate your results into other Tableau workbooks. For information, see *Export and Import Sheets* on page 1156.

### Export Data

If you want to export data from Tableau to another application, or create a new data source that contains a portion of the records in your original data source, there are several options in Tableau.

When exporting data, you should keep these rules in mind:

- You can select any portion of a data view to export. If you want to export all data in a view, right-click (control-click on Mac) in the view and choose **Select All**. Copying and exporting to a crosstab always exports all data in the view regardless of what you have selected.

- The fields that are exported to the new data source come from the fields on the worksheet shelves. The exception is fields that are external filters—i.e., fields that appear only on the **Filters** shelf.

- If you want to include other fields (either dimensions or measures) with the exported data without changing the basic view, place those fields on the **Level of Detail** shelf.

### Copy Records To Clipboard

Typically this function is used to copy records from Tableau into Microsoft Excel. To create an Excel spreadsheet from Tableau data, follow these three steps:

1. Select the desired data in Tableau.

   Right-click (Control-click on Mac) the view and click **Select All**.
2. Select Worksheet > Copy > Data, or right-click (control-click on Mac) the view and select Copy > Data from the context menu.

3. Open an Excel worksheet and paste the data into a new sheet. Notice that the fields placed on the Rows, Columns, and Color shelves are copied into the sheet. However, the Customer Segment field is not copied because it is an external filter (it appears only on the Filters shelf).

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Customer Name</td>
<td>Product Category</td>
<td>Region</td>
<td>SUM(Sales Total)</td>
</tr>
<tr>
<td>2</td>
<td>Maurice Satty</td>
<td>TECHNOLOGY</td>
<td>CENTRAL</td>
<td>19,214.25</td>
</tr>
<tr>
<td>3</td>
<td>Victor Price</td>
<td>TECHNOLOGY</td>
<td>CENTRAL</td>
<td>12969.78</td>
</tr>
<tr>
<td>4</td>
<td>Deanna Eno</td>
<td>TECHNOLOGY</td>
<td>EAST</td>
<td>10455.7</td>
</tr>
<tr>
<td>5</td>
<td>Speros Gurantis</td>
<td>TECHNOLOGY</td>
<td>EAST</td>
<td>14272.76</td>
</tr>
<tr>
<td>6</td>
<td>Meg Tillman-Sach</td>
<td>FURNITURE</td>
<td>WEST</td>
<td>14584.2</td>
</tr>
<tr>
<td>7</td>
<td>Skye Norling-Chri</td>
<td>TECHNOLOGY</td>
<td>WEST</td>
<td>11106.19</td>
</tr>
<tr>
<td>8</td>
<td>Noel Staavos</td>
<td>TECHNOLOGY</td>
<td>WEST</td>
<td>29689.57</td>
</tr>
<tr>
<td>9</td>
<td>Stephanie Uprigh</td>
<td>TECHNOLOGY</td>
<td>EAST</td>
<td>51280.73</td>
</tr>
</tbody>
</table>

**Copy Underlying Records to Clipboard**

Copying underlying data can be used to copy the disaggregated data behind a view.

To copy underlying records:

1. Select the desired data in Tableau.
Right-click (Control-click on Mac) the selected records and select **View Data** on the context menu.

2. The resulting dialog box shows the Summary data along with the Underlying Data. Select the data you want to copy and then click **Copy** in the upper right corner of the dialog box.

4. Open an Excel worksheet and paste the data into a sheet. Notice that the fields placed on the Rows, Columns and Color shelves are copied onto the worksheet.
Export Records To Microsoft Access

This topic describes how to create an Access database from Tableau data.

**Note:** Access is not available on the Mac.

1. Select the desired data in Tableau. Right-click (Control-click on Mac) the view and then select **Select All**.
2. Select **Worksheet > Export > Data**.

3. Select a location and name for your Access database. Access databases end with a .mdb file extension.

4. Type a name for the database and click **Save**. The Export Data to Access dialog box is now displayed. The Connect after export option allows you to immediately connect to the new data source and continue working in Access without interrupting your work flow.
Copy Crosstab to Clipboard

You can copy a crosstab (text table) version of a view to your local Clipboard and transfer it from the Clipboard to another application. For instance, you might want to transfer a crosstab in Tableau to a crosstab in Microsoft Excel. Or you might want to transfer the data behind a graphical view in Tableau to Excel in a crosstab format. Copying a crosstab to the Clipboard is restricted by the following general rules:

- You must copy all records in the view. You cannot copy a subset of records.
- This option is valid for aggregated views only. It cannot be used on disaggregated views of data, because a crosstab is by definition an aggregated view of data. In other words, the Aggregate Measures option on the Analysis menu must be selected in order for this option to work properly.

Other restrictions may apply depending on the data in your view. You cannot copy a crosstab if the view contains continuous dimensions such as continuous dates and times.

**To copy a view as a crosstab to the clipboard:**
1. Right-click (Control-click on Mac) any view in Tableau and select **Copy > Crosstab**.

![Copy options in Tableau](image)

2. Open an Excel worksheet and select Paste from Excel's Edit menu or press Ctrl-V (⌘V on a Mac).

![Excel worksheet with data](image)

The pasted data always appears as a crosstab in Excel, even if the initial view of the data in Tableau was not in a crosstab format.

**Export Crosstab to Excel**

There is a more direct way to transfer a cross-tab view of data to Microsoft Excel on a Windows computer. Select **Worksheet > Export > Crosstab to Excel**.

Tableau automatically pastes a crosstab version of the current view into a new Excel workbook. This option automatically opens a new instance of the Excel application.

Although this is more direct, it can decrease performance because it is copying the formatting as well as the data. If the view you are exporting contains a lot of data, a dialog box opens asking whether you want to copy the formatting options. Disregarding the format can enhance performance.

On a Mac computer, **Export Crosstab to Excel** opens a dialog box where you can save the file. You must then manually open the file in Excel.
Extracting Data

Another way to export all data or a subset of your data to a new data source is to use Tableau Extracts. For details, see Extract Your Data on page 409.

Export as an Image

If you want to transfer your Tableau results into a presentation, report or web page, Tableau provides the following several options.

Copy your View to Another Application

You can copy your view as an image and paste it into another application such as Microsoft PowerPoint, Word, or Excel. If you’re using Tableau Desktop on a Mac, a TIFF (Tagged Image File Format) is created for pasting. On Windows, a BMP (Bitmap) is created. Either image format will include everything in your view, including Tableau fonts.

If you’re running Windows, you can create an EMF (Enhanced Metafile) image instead of a BMP, but if your view includes a Tableau font (such as Tableau Regular, Tableau Semibold, etc.), a font that's similar to the Tableau font will be substituted. See (Windows only): Create an EMF of your view below below for steps.

To create a vector-based file of your view that embeds the Tableau fonts, you can use File > Print to PDF. See Print to PDF on page 1162 for details.

Create an image of your view

1. Select Worksheet > Copy > Image.
2. In the Copy Image dialog box, select what you want to include in the image, along with the legend layout (if the view contains a legend).
3. Click Copy. Tableau copies the current data view as a BMP (Windows) or a TIFF (Mac) and places it on the Clipboard.
4. Open the target application and paste the image from the Clipboard.

(Windows only): Create an EMF of your view

You can create an EMF of your view instead of a BMP by using the Export command. If your view uses a Tableau font, it will be substituted with a similar (non-Tableau) font.

1. Select Worksheet > Export > Image.
2. In the Export Image dialog box, select what you want to include in the image, along with the legend layout.
3. Click Save and in the Save Image dialog, save the image as Enhanced Metafile (*.emf).
Export to an Image File

The export image command saves the current view as an image file. You can export to an image file with the following three steps.

1. Select Worksheet > Export > Image.
2. In the Copy Image dialog box, select the contents you want to include in the image and the legend layout (if the view contains a legend).
3. Click Save.
4. In the Save Image dialog box, navigate to where you want to save the image file and type a file name into the text box. Select a file format from the Save as type drop-down menu.
5. Click Save.

Print to PDF

You can publish one or more views to PDF by selecting File > Print to PDF.

When printing a sheet, filters in the view are not included. To show filters, create a dashboard containing the sheet and print the dashboard to PDF. Note, when printing a dashboard to PDF, the contents of web page objects are not included.

Exporting the Data Source

After connecting to data, you can save the data source to your repository. Saving the data source creates a shortcut to the data and lets you avoid having to create a new connection every time you want to use that data source. Exporting the data source is useful if you have added custom fields such as groups or sets to the Data pane. See Export Data Sources on page 431.

Copying Information Between Workbooks

You can combine resources from different workbooks into one, or pull information from a larger workbook into a standalone subset. To share or extract a subset of information, you can use any of the following actions on worksheets, dashboards, and stories:

- Copy and paste selected sheets to another workbook.
- Import a saved workbook into your current workbook.
- Export selected sheets to a new workbook.

What gets Copied or Saved with Selected Sheets

When you copy, save, or export selected sheets, other workbook items that the views in those sheets depend on are also included:
- Any associated visible or hidden sheets.
- Data sources for fields used in the selected sheets.
- Calculations, parameters, groups, sets, actions, custom shapes, and so on.

**How Tableau Handles Duplicate Items**

When you paste or import sheets from a different workbook, some items might already exist in the destination workbook, or some items might have the same name in both places. If Tableau encounters an exact duplicate item in the Data pane, such as a calculation, it does not paste or import that item into the destination workbook. However, if an item in the Data pane has the same name but is defined differently, Tableau imports and renames it.

Tableau also pastes or imports sheets and data sources with duplicate names—whether only the name is identical, or their names and contents are identical—and it renames the newer copy.

**Export and Import Sheets**

If you want to extract a subset of information from a larger workbook to maintain as a standalone file, you can export or save selected sheets to a new workbook. You can then import that workbook into an existing one to incorporate its sheets and other objects into the existing workbook.

**Note:** These steps describe how to share your work among Tableau workbooks. You can also export views to use outside of Tableau. For information, see [Exporting Your Work](#) on page 1146.

1. Open the workbook that contains the sheets you want to export to a new file.
2. Using the tabbed worksheet, filmstrip view, or sheet sorter view, right-click (Control-click on Mac) the sheet tabs or thumbnail views, and then select **Export Sheet** to export a single sheet. Use Shift + click or Ctrl + click to select multiple sheets.
3. In the Save As dialog box, specify the file format you want to save (.twb or .twbx), select the location for the new workbook file, give it a name, and then click **Save**.
**Import a Tableau Workbook**

After you save or export selected sheets to a new workbook (.twb) file, you can import the information into another workbook.

1. With the existing workbook open, select **File > Import Workbook**.
2. Select the workbook that contains the sheets you saved from another workbook, and click **Open**.
The following image shows the result of importing a workbook that contains a sheet with the same name as a sheet in the existing workbook. Tableau adds a number after the name of the imported sheet.

Copy and Paste Sheets

Copying and pasting sheets is a quick way to combine information from different workbooks or create a new workbook. You can copy one or more sheets from the tabbed sheet view, filmstrip view or sheet sorter view. Use Shift + click or Ctrl + click to select multiple sheets.

To copy and paste a worksheet using the filmstrip view, do the following:

1. Open a workbook and click the **Filmstrip** button in the status bar.

2. Select the thumbnails of the sheets you want to copy, then right-click (Control-click on Mac) and select **Copy Sheet**.
Tableau copies the information in the file format (.twb or .twbx) of the workbook.

3. Open the destination workbook, or create a new workbook. Right-click (Control-click on Mac) on the tab for any sheet, and select **Paste Sheet**. Pasted sheets are placed after existing worksheets, dashboards, and stories.

   **Note:** The **Paste Sheet** option is not available when the active sheet is a story.

4. Save the changes.

For information about what gets copied when you copy and paste sheets, see **Copying Information Between Workbooks** on page 1155.

**Print**

After creating a view or several views in Tableau you can print them. The first thing you should do before printing is specify how you want the printed page to look using the Page Setup dialog box. Then you can print to a printer or publish to a PDF. You can also print the Tableau Help directly from your web browser or to a PDF.

**Printing Results**

Once you have a view or several views created in Tableau, you can print them or publish them as a PDF.

**Page Setup**

Before you print, there are several options you can set to specify how the worksheet will look when it is printed. For example, you can select which elements to include, set the printed page orientation, specify where you want to put the legend, margins, and more. You define these settings in the Page Setup dialog box. You can set different page setup options for each worksheet in the workbook. That way you can have different titles, captions, legend settings, etc., for each worksheet you want to print. To open the Page Setup dialog box, select **File > Page Setup**.
The Page Setup dialog box has the following tabs:

General

Use the General tab to select the elements you want to show when you print. You can show or hide the title, view, caption, color legend, shape legend, size legend, and map legend.

Specify how to handle headers and breaks. The headers refer to the headers in each of your views. When you select **Repeat headers and legends on each page**, the row and column headers will appear at the top of each printed page when a view breaks across several pages.

Select **Break pages on pane boundaries** to prevent page breaks in the middle of a cell in a table.

If you have used the Pages Shelf to build your view, you can select whether to print the current page only or all pages.

Layout

Use the Layout tab in the Page Setup dialog box to specify the layout legend, page margins, and centering options for printing.

Legend Layout

If you include one or more legends, you can select one of the options for how you want the legends to appear on the printed page.

Margins

Specify top, bottom, left, and right margins by typing values into the text boxes.

Centering

Optionally, select whether to center the view horizontally or vertically--or both--on the page.

Print Scaling

Use the Print Scaling tab to fit the view to a certain size or to change the page orientation. These options only affect printed documents. The scaling options you specify here will not affect exported images or PDFs. However, the orientation settings will be used as the default when you publish the workbook to Tableau Server or Tableau Public.

Print Scaling

You can scale your view to fit within a single page or scale it across multiple pages. Select from the following options:

- Automatic – Scales the view automatically based on the paper size.
- Scale to – Scales the view to the specified percentage of its original size.
- Fit to – Scales the view to fit within the specified area. Select the number of printed pages
across and down. For example, if you have a really wide view that is not very tall, you can specify three pages across by one page down.

**Page Orientation**

Use the page orientation settings to specify how you want the view oriented on the printed page. For example, if you have a view that is very wide but not very high, select **Landscape**. Select from the following page orientation options:

- **Use Printer Setting** – Use the page orientation that is already specified by the printer.
- **Portrait** – Presents the view so that it is oriented vertically on the printed page.
- **Landscape** – Presents the view so that it is oriented horizontally on the printed page.

The following diagram shows the difference between portrait and landscape page orientations.

These page orientation settings are used as the default settings when you publish the workbook to Tableau Server or Tableau Public.

**Printing**

After you have configured the **Page Setup** on page 1159 settings, you can print by selecting **File > Print**. In the Print dialog, select a printer, decide whether to show selections, specify a print range, and select the number of copies you want to print.

The following options in the Print dialog box are unique to Tableau.

**Show Selections**

When this option is selected any selections you’ve made in the views will be maintained while printing.
Changing the Print Range

When you print from a workbook with multiple worksheets, each worksheet represents one or more printed pages, depending on the page setup.

Select from the following print ranges:

- **Entire Workbook** - Prints all the worksheets in the workbook.
- **Active Sheet** - Prints only the sheet currently displayed in the workbook.
- **Selected Sheets** - Prints the selected sheets.

You can select multiple worksheets in a workbook by holding down the CTRL or Shift keys (or the ⌘ key on a Mac) while clicking the worksheet tabs that you want to select.

Print to PDF

In Tableau, you can publish views as PDF files rather than printing them as hard copies. You do not need to have Adobe Acrobat installed on your computer.

**Publish as a PDF using a Windows computer**

1. Specify **Page Setup** on page 1159 options for each sheet in your workbook.
2. Select **File > Print to PDF**.

3. In the Print to PDF dialog box, select the print Range:
   - **Entire Workbook** - Publishes all the sheets in the workbook.
   - **Active Sheet** - Publishes only the sheet currently displayed in the workbook.
   - **Selected Sheets** - Publishes the selected sheets.
4. Select a **Paper Size**. If you select Unspecified, the paper size will expand to the
necessary size to fit the entire view on a single page.

5. Select **View PDF File After Printing** if you want to automatically open the PDF after creating it. This option is only available if you have Adobe Acrobat Reader or Adobe Acrobat installed on your computer.

6. Select whether to **Show Selections**. When this option is selected the selections in the views are maintained in the PDF.

7. Click **OK** and specify where you want to save the PDF. Then click **Save**.

**Publish as a PDF using a Mac computer**

1. Specify **Page Setup** on page 1159 options for each sheet in your workbook.

2. Select **File > Print**.

3. In the Print dialog box, click **Show Details** to select a print range:
   - Entire Workbook - Publishes all the sheets in the workbook.
   - Active Sheet - Publishes only the sheet currently displayed in the workbook.
   - Selected Sheets - Publishes the selected sheets.

4. Click **PDF > Save as PDF**.
5. Specify where you want to save the PDF, then click **Save**.

**Printing the Help**

You can print an individual Help topic using the print options in your Web browser.

In addition to printing individual help topics, you can also download an offline help system and a printable PDF.
Reference

This section contains reference information for using Tableau. Learn how to use functions and operators when writing calculation formulas. Also, see tips and tricks that can help you become more efficient with the product.

Connector Examples

Follow the link below for information on how to connect to your specific data source. Connectors are listed in the order that they appear on the Connect pane.

Access

This topic describes how to connect Tableau to a Microsoft Access file (*.mdb, *.accdb) and set up the data source. Tableau supports all Access data types except OLE Object and Hyperlink.

Before you begin, gather this connection information:

- Access file name.
- If the file is password protected, you need the Database password.
- If the file has workgroup security, you need Workgroup security credentials:
  - Workgroup Information File name
  - User
  - Password

Use this connector with Tableau Desktop on a Windows computer.

Make the connection and set up the data source

1. On the start page, under Connect, click Access, select the Access file that you want to connect to, and then click Sign In.

   **Password protected**

   If the Access file is password protected, select Database Password, and then enter the password.

   **Workgroup security**

   If the Access file is protected by workgroup security, select Workgroup Security, and then enter the Workgroup Information File name, User, and Password into the corresponding text fields.

2. On the data source page, do the following:
1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to. The default name is automatically generated based on the file name.

2. Drag a table to the canvas. You can drag a table or query.

3. Click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Optional Settings**

You can set the following options before building your view.

**Review the data and change data types**

The first 1,000 rows of the data in the data source is automatically displayed below the canvas. If you add tables, remove tables, or make changes to the join conditions, the grid updates. You can also do the following in the grid:

- Change the data type of a column by clicking the data type icon.
- Rename or hide the column by clicking the column header drop-down menu and selecting the respective option.

**Manage metadata**

Click the metadata area button to perform routine management tasks.

**Rename or hide columns**

Rename or hide a column by clicking the column header drop-down menu and selecting the respective option.

**Connect live or use an extract**

At the top of the data source page, select a live or extract connection to the data source. If you choose to take an extract, an Edit link will display allowing you to set up filters that define the subset of the data to include in the extract.

**Add data source filters**

Add data source filters to restrict the visibility and use of the fields in the data source.

**Access data source example**

Here is an example of an Access data source:
Note: If the Access file contains columns that are more than 254 characters wide, Tableau will not be able to use these fields. Either remove the columns from the table or modify them to fit within 254 characters prior to connecting with Tableau.

Excel

This topic describes how to connect Tableau to Microsoft Excel file data and set up the data source. Tableau connects to .xls and .xlsx files.

Make the connection and set up the data source

1. On the start page, under **Connect**, click **Excel**.
2. Select the Excel workbook you want to connect to, and then click **Open**.
Alternatively, in Tableau Desktop on Windows, to connect to the Excel file using the Microsoft Jet-based connection, in the Open dialog box, click the Open drop-down menu, and then select Open with Legacy Connection. The Data Source page appears.

3. On the Data Source page, do the following:

1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

2. If your Excel file has one table, click the sheet to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

   You can also connect to a named range or an Excel table (also known as an Excel list) in the same way you connect to a worksheet. Both the named range and Excel table function as a table in Tableau.

   You create named ranges in Excel by selecting a range of cells and then selecting Define Name on the Formulas tab. Similar to named ranges, you can create an Excel table in Excel by selecting a range of cells, and then selecting Insert > Table. When you connect to a named range or Excel table in Tableau, an icon appears next to the sheet in the Data Source page as shown below.

   ![Sheet Icons](image)

   You can connect to multiple Excel workbooks at the same time as long as each connection in the data source has a unique name.

   **Note:** Tableau does not support pivot tables in Excel.

**Optional settings**

You can set the following options before you build the view.
Set Excel table options

On the canvas, click the table drop-down arrow and then specify whether the data includes field names in the first row. If so, these names will become the field names in Tableau. If field names are not included, Tableau generates them automatically. You can rename the fields later.

Turn on Data Interpreter

Sometimes, the format of the data in your Excel data makes it difficult to analyze in Tableau. For example, your Excel data might include additional tables, sub-tables, hierarchical headers, extraneous headers and footers, or empty rows and columns. Data Interpreter detects these sub-tables so that you can work with a subset of your data independently of the other data. It also removes the extraneous information to help prepare your data source for analysis.

After you set up the data source, if Tableau detects sub-tables, unique formatting, or that the data contains some extraneous information, it prompts you to use Data Interpreter.

![Image of a spreadsheet with options for using Data Interpreter]

**Note:** When you clean your data with Data Interpreter, Data Interpreter cleans all the data associated with a connection.

To turn on Data Interpreter and review results

1. After you have connected to your Excel data and set up your data source, select the **Clean with Data Interpreter** check box.
2. Click **Review results**. A copy of your data source opens in Excel on the **Key for the Data Interpreter** tab.
3. Review the annotation key to find out how to read the results.
4. Click the subsequent tabs to review how Data Interpreter interpreted the data source. You can also review Data Interpreter results directly in the grid below Data Interpreter.

   If Data Interpreter does not provide the expected results, you can clear the **Clean with Data Interpreter** check box to use the original data source.

5. If Data Interpreter detects additional tables in your data, replace the current table with the found table by dragging it to the canvas.
If Data Interpreter has misidentified the range of the found table, click the table drop-down arrow on the canvas and then select **Edit Found Table** to adjust the corners of the found table.

**Review and manage the data source**

In addition to setting table options and cleaning your data, you can make the following configuration changes to the data source before you start your analysis:

- **View the data in the Tableau data source** – In the grid, click **Update Now** to preview the first 1000 rows of your live or extract data source. If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes. If you want changes to automatically appear in the grid, click **Automatically Update**.

- **Manage metadata** – Click the metadata grid button to quickly examine the general structure of the Tableau data source and its fields and to perform routine management tasks like sorting fields and rows, hiding multiple fields at once, or quickly renaming or resetting fields.

- **Sort fields and rows** – From the **Sort fields** drop-down list, select how you want to sort the columns in the grid or metadata grid. You can sort the columns by data source or table order. Sort the row values by clicking the sort button next to the column name.

- **Hide fields** – Hide a field by clicking the column drop-down arrow and selecting **Hide**.

- **Rename fields and reset field names** – To rename the field, in the data preview grid, double-click the field name, or in the metadata grid, click the field name. You can also select a column or multiple columns, click the column drop-down, and then select **Reset Name** to revert back to the original name of the field.

- **Pivot columns** – Pivot fields to transform data in a crosstab format into a columnar format. This is only available for non-legacy connection types. For more information, see **Pivot Data from Columns to Rows** on page 398.

- **Split columns** – Split a string field into multiple fields. This is only available for non-legacy connection types. For more information, see **Split a Field into Multiple Fields** on page 403.

- **Create calculations** – Create a new calculation based on existing fields in the Tableau data source. Click the column drop-down arrow and select **Create Calculated Field**.

- **Copy values** – Copy values in the grid by selecting the values and then pressing Ctrl+C on Windows or Command-C on a Mac. Alternatively, to copy values in the metadata grid, select the values, right-click on Windows or Control-click on a Mac, and then select **Copy**.

- **Connect live or use an extract** – At the top of the data source page, select a live or extract connection to the data source. If you choose to take an extract, an **Edit** link displays that you can use to set up filters that define a subset of the data to include in the
extract.

- Add data source filters – At the top of the data source page, add data source filters to restrict the visibility and use of the fields in the data source.

Microsoft Excel data source example

An example of a Microsoft Excel data source is shown below.

Note: If the Excel file contains columns that are more than 254 characters wide, Tableau Desktop can't use these fields for workbooks that were created before Tableau Desktop 8.2. Also, you cannot use the legacy connection to connect to this data. Either remove the columns, modify them to fit within 254 characters prior to connecting in Tableau Desktop, or upgrade the Excel data source. For more information about upgrading data sources, see Upgrade Data Sources on page 434.

Text File

This topic describes how to connect Tableau to a text file data and set up the data source. Tableau connects to delimited text files (*.txt, *.csv, *.tab, *.tsv).

Make the connection and set up the data source

1. On the start page, under Connect, click Text File.
2. Select the file you want to connect to, and then click Open.
Alternatively, when using Tableau Desktop on Windows, to connect to the text file using the Microsoft Jet-based connection, in the Open dialog box, click the Open drop-down menu, and then select Open with Legacy Connection. The data source page appears.

3. On the data source page, do the following:

1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to. The default name is automatically generated based on the file name.

2. Click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

Note: For text files, custom SQL is available only when using the legacy connection or in workbooks that were created before Tableau Desktop 8.2.

Optional settings

You can set the following options before building the view.

Set text file options

On the canvas, click the table drop-down arrow and then select whether the first row contains column names. This option is selected by default. Alternatively, you can have Tableau generate names when you connect. These names can be changed later. You can also select Text file properties to specify the following:

- Select the character that is used to separate the columns. Select from the list of characters or select Other to type in a custom character.

- Select the text qualifier that encloses values in the text file.

- Select a character set that describes the text file encoding. The available encodings are based on the operating system you are using. For example, on Windows, ANSI is listed as windows-1252 and OEM is listed as 437.

Note: In workbooks created prior to Tableau Desktop 8.2 or that use the legacy connection, you can select ANSI, OEM, UTF-8, UTF-16, or Other. When you select Other, you must specify the character set in the provided text field. This value is verified when the connection is attempted.

- Select the locale by which the file should be parsed. This option tells Tableau which decimal and thousands separator to use.
Review the data, pivot, split, and create calculations

The first 1,000 rows of the data in the data source are automatically displayed below the grid. If you add tables, remove tables, or make changes to the join conditions, the grid updates. You can also do the following in the grid:

- Change the data type or geographical role of a column by clicking the data type icon.
- Hide a field by clicking the column drop-down arrow and selecting **Hide**.
- Rename a field by double-clicking the column name to rename it.
- Reset a field name by clicking the column drop-down arrow and selecting **Reset Name**.
- Sort fields in both the grid and metadata grid by selecting a sort option from the **Sort fields** drop-down list.
- Sort rows in the grid by clicking the sort button next to the column name.
- Pivot fields to transform data in a crosstab format into a columnar format. This is only available for non-legacy connection types. For more information, see **Pivot Data from Columns to Rows** on page 398.
- Split a string field into multiple fields. This is only available for non-legacy connection types. For more information, see **Split a Field into Multiple Fields** on page 403.
- Create new calculations based on existing field in the Tableau data source. Click the column drop-down arrow and select **Create Calculated Field**.
- Copy values in the grid by selecting the values and then pressing Ctrl+C (Command-C on a Mac). Alternatively, to copy values in the metadata grid, select the values, right-click (Control-click on a Mac), and then select **Copy**.

Examine the data source structure and perform management tasks

Use the metadata area to quickly examine the general structure of the Tableau data source and its fields. If you are working with a particularly large data source, use the metadata area to perform routine data management tasks such as hide multiple fields at once or quickly rename or reset fields.

Connect live or use an extract

At the top of the Data Source page, select **Live** or **Extract** mode. If you choose to create an extract, the **Edit** link displays. Click **Edit** to set up filters that define a subset of the data that you want to include in the extract.

Add data source filters

Add data source filters to restrict the visibility and use of the fields in the Tableau data source.
**Best practices**

**Collect files in a single directory**

Collect all relevant text files for a multi-table connection in a single directory, with nothing else in that directory, so that users cannot inadvertently select a file that is not appropriate for the connection.

**Text file column width and size considerations**

If the text file contains columns that are more than 254 characters wide, Tableau cannot use these fields for workbooks that were created before Tableau Desktop 8.2 or that use the legacy connection. Either remove the columns, modify them to fit within 254 characters prior to connecting in Tableau, or upgrade the text file data source.

Large text files often perform poorly as a data source, because the queries can take a long time.

**Text file data source example**

Here is an example of a text file data source:

![Image of Tableau interface with a text file data source]

**Statistical File**

This topic describes how to connect Tableau to a statistical file and set up the data source. Tableau connects to SAS (*.sas7bdat), SPSS (*.sav), and R (*.rdata, *.rda) data files.
1. On the start page, under Connect, click Statistical File, select the file that you want to connect to, and then click Open.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Click the sheet tab to start your analysis.

Note the following:

- The Statistical File connector does not support value labels.
- The Statistical File connector supports only one table per statistical file.
  If an error message appears, "An error occurred while communicating with the data source," make sure that your statistical file contains only one object, and that the object is a data frame or a matrix. R files may contain hidden objects in what appears to be a clean workspace. To check for hidden objects, run `ls(environment(), all.names=TRUE)` from RStudio.
- You can change the character encoding for a statistical file. For information, see Change the Character Encoding for Statistical Files in the Tableau Knowledge Base.

R data file object and format support

R data files should contain only one of the following types of objects:

- Two-dimensional matrices
- Vectors
- Factors
- Data frames

Note that if the R data file contains more than one object, Tableau will connect to the first one.

Supported R file formats are binary or ASCII. Compressed files are not supported in Tableau Desktop. You must decompress files first with another program, such as Gzip or WinZip, before you connect with Tableau.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases
• Click Add next to Connections. For more information, see Join Your Data on page 349.

• If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

• In the grid, click Update Now to preview the first 1,000 rows of your data.

• If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.

• To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

• Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.

• In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

• Double-click the field name.

• To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select Copy.
Connect to live data or use an extract

- If your data supports it, select Live or Extract under Connection at the top of the data source page.

- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click Add at the top of the data source page, to add data source filters.

Statistical file data source example

Here is an example of a statistical file data source using Tableau Desktop on a Windows computer:

Other Files

This topic describes how to connect Tableau to supported file types, including Tableau Data Extract files and Tableau Workbooks.

1. On the start page, under Connect, click Other Files.

2. In the Open dialog box, navigate to and select a file.

3. Click Open.
4. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

5. Click the sheet tab to start your analysis.

**Tableau Data Extract data source example**

Here is an example of a Tableau Data Extract file data source using Tableau Desktop on a Windows computer:

![Tableau Data Extract example](image)

**Tableau Server**

This topic describes how to connect to a data source published to Tableau Server.

1. On the start page, under **Connect**, click **Tableau Server**.
2. Enter the name of the server and then click **Connect**.
Connected Desktop

You can stay connected to your Tableau Server and Tableau Online servers. Tableau Desktop saves each connection from session to session if you don't sign out. Next time you launch Tableau Desktop, you are signed in to your most recent server connection. In this case, you can skip step 3.

You can also sign in to another Tableau Server and quickly switch between servers and sites from the Tableau Desktop Server menu. For more information, see Quick Start: Stay Connected with Automatic Sign-In on page 1621.

Kerberos environment

If Kerberos is enabled on Tableau Server and you are on a computer with valid Active Directory credentials, you will connect automatically to the server. In this case, you can skip step 3. If Kerberos authentication fails, you will be prompted to provide a user name and password for authentication. If you need to change the user you're signed in as, see Switch Kerberos User.

3. Enter your user name and password, and then click Sign In.
4. Select a data source from the list of published data sources.

You can sort the list of data sources by clicking the column headers. Alternatively, search for a data source by using the search box. Click the refresh button to refresh the list and show any new data sources.
Note: If you select a cube (multidimensional) data source, the Create Local Copy dialog box appears, and you must create a local copy of the data before you can start your analysis.

5. Click the sheet tab to start your analysis. Tableau Server data sources are shown in the Data pane with a Tableau icon.

You may want to download a local copy of the data source so that you can, for example, work offline or make changes to a data source without modifying the original. To download a local copy, on the Data menu, select the data source, and then select Create Local Copy. A duplicate of the data source is added to the Data pane.

Sign in on a Mac

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.
Actian Matrix

This topic describes how to connect Tableau to an Actian Matrix (formerly ParAccel) database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- User name and password

Use this connector with Tableau Desktop on a Windows computer.

Make the connection and set up the data source

1. On the start page, under Connect, click Actian Matrix, and then do the following:
   1. Enter the name of the server that hosts the database and the name of the database that you want to connect to.
   2. Enter the user name and password, and then click Sign In.

      If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, select a schema.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag a table to the canvas, and then click the sheet tab to start your analysis.

      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data
source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select Copy.

Connect to live data or use an extract

- If your data supports it, select Live or Extract under Connection at the top of the data
source page.

- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**Actian Matrix data source example**

Here is an example of an Actian Matrix data source:

![Image of Actian Matrix data source](image-url)

**Actian Vector**

This topic describes how to connect Tableau to an Actian Vector database and set up the data source.
Before you begin, gather this connection information:

- Virtual node name for the database you want to connect to
- Database name
- Authentication method: Authentication defined in the virtual node, or user name and password

Use this connector with Tableau Desktop on a Windows computer.

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **Actian Vector**, and then do the following:
   1. Enter the name of the virtual node for the database and the name of the database you want to connect to.
   2. Specify whether to use authentication defined in the virtual node, or a specific user name and password.
   3. Click **Sign In**.
      
      If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Schema** drop-down list, select a schema or use the text box to search for a schema by name.
   3. Under **Table**, select a table or use the text box to search for a table by name.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data
source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data
If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**Actian Vector data source example**

Here is an example of an Actian Vector data source:

![Actian Vector data source example](image)

**Amazon Aurora**

This topic describes how to connect Tableau to an Amazon Aurora database and set up the data source.
Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- User name and password
- Are you connecting to an SSL server?

**Make the connection and set up the data source**

1. On the start page, under Connect, click Amazon Aurora, and then do the following:
   1. Enter the name of the server that hosts the database.
   2. Enter the user name and password, and then click Sign In.
      
      Select the Require SSL check box when connecting to an SSL server.

      If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Database drop-down list, select a database or use the text box to search for a database by name.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**
- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.
Connect to live data or use an extract

- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click Add at the top of the data source page, to add data source filters.

Amazon Aurora Data Source Example

Here is an example of an Amazon Aurora data source using Tableau Desktop on a Windows computer:
Amazon EMR

This topic describes how to connect Tableau to an Amazon EMR (Elastic MapReduce) database and set up the data source. For information about connecting to Hadoop data, see Connecting to Hadoop Hive in the Tableau Knowledge Base.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to and port number
- Type of database: Hive Server, Hive Server 2, Impala
- (Optional) Initial SQL statement to run every time Tableau connects

Make the connection and set up the data source

1. On the start page, under Connect, click Amazon EMR, and then do the following:
   1. Enter the name of the server that hosts the database and the port number to use.
   2. Select how to connect to the database. Depending on the version of Amazon EMR and the drivers you have installed, you can connect using one of the following:
      - Hive Server
      - Hive Server 2
      - Impala
   3. (Optional) Click Initial SQL to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run Initial SQL on page 343.
   4. Click Sign In.

      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the schema.
   3. In the Table text box, click the search icon or enter the table name and click the search icon, and then select the table.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.
Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the DNS tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click Add next to **Connections**. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select Hide.

**Rename a field**
• Double-click the field name.
• To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns
If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source
Click the column drop-down arrow and select Create calculated field.

Copy values
Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid
Select the values, right-click, and then select Copy.

Connect to live data or use an extract
• If your data supports it, select Live or Extract under Connection at the top of the data source page.
• If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source
Click Add at the top of the data source page, to add data source filters.

Query limit for Amazon EMR and Impala
When connecting to Amazon EMR using Impala, the queries are limited to 100,000 rows of data when the query includes an ORDER BY clause. This limit can be configured either by modifying the "order-by-limit" value in the workbook xml or using a TDC customization such as <customization name="order-by-limit" value='10' />

Amazon EMR data source example
Here is an example of an Amazon EMR data source connecting to an Impala server using Tableau Desktop on a Windows computer:
Amazon Redshift

This topic describes how to connect Tableau to an Amazon Redshift database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- User name and password
- Are you connecting to an SSL server?
Make the connection and set up the data source

1. On the start page, under Connect, click Amazon Redshift, and then do the following:
   1. Enter the name of the server that hosts the database and the name of the database you want to connect to.
   2. Enter the user name and password, and then click Sign In.
      Select the Require SSL check box when connecting to an SSL server.
      If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, select a schema or use the text box to search for a schema by name.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.
      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

Sign in on a Mac

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.
View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select Copy.

Connect to live data or use an extract

- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that
define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**Amazon Redshift data source example**

Here is an example of an Amazon Redshift data source using Tableau Desktop on a Windows computer:

![Amazon Redshift data source example](image)

**Aster Database**

This topic describes how to connect Tableau to Aster Database data and set up the data source.

Before you begin, gather this connection information:
• Name of the server that hosts the database you want to connect to
• Database name
• User name and password
• (Optional) Initial SQL statement to run every time Tableau connects

In Aster, initial SQL can be used to generate an output table, which can improve performance of subsequent database access. Initial SQL in Aster also supports SQL-MapReduce, a framework created by Teradata Aster to enable developers to write powerful and highly expressive SQL-MapReduce functions. For more information, see MapReduce, SQL-MapReduce Resources & Learning on the Teradata website.

Use this connector with Tableau Desktop on a Windows computer

Make the connection and set up the data source

1. On the start page, under Connect, click Aster Database, and then do the following:
   1. Enter the name of the server that hosts the database and the name of the database that you want to connect to.
   2. Enter the user name and password.
   3. (Optional) Click Initial SQL to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run Initial SQL on page 343.
   4. Click Sign In.

   If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, select a schema or use the text box to search for a schema by name.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag a table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.
(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values
Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**
Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**
Click **Add** at the top of the data source page, to add data source filters.

**Aster Database data source example**
Here is an example of an Aster Database data source:
This topic describes how to connect Tableau to a Cisco Information Server virtual database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the data you want to connect to
- (Optional) Domain name
- Datasource name
- Authentication method: LDAP or user name and password

Use this connector with Tableau Desktop on a Windows computer.

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **Cisco Information Server**, and then do the following:
   1. Enter the name of the server that hosts the data you want to connect to.
   2. (Optional) Enter the name of the domain.
   3. Enter the name of the **Datasource** you want to connect to.
   4. Select how you want to sign in to the server. Specify whether to use **LDAP** or a user name and password.
   5. Click **Sign In**.
   
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Catalog** drop-down list, enter the catalog name in the text box, or select the catalog from the list.
   3. From the **Schema** drop-down list, enter the schema name in the text box, or select the schema from the list.
   4. Under **Table**, enter the table name in the text box, or select the table from the list.
   5. Drag the table to the canvas, and then click the sheet tab to start your analysis.
Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source
Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**Cisco Information Server data source example**

Here is an example of a Cisco Information Server data source:
Cloudera Hadoop

This topic describes how to connect Tableau to a Cloudera Hadoop database and set up the data source. For more information about connecting to Hadoop data, see Connecting to Cloudera Hadoop in the Tableau Knowledge Base.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to and port number
- Type of database: Hive Server, Hive Server 2, Impala
- Authentication method choices depend on the type of database, and can include the following:
• No Authentication
• Kerberos
• User Name
• User Name and Password
• User Name and Password (SSL)
• Microsoft Azure HDInsight Emulator
• Microsoft Azure HDInsight Service
• HTTP
• HTTPS

• Sign in credentials depend on the authentication method you choose, and can include the following:
  • User name
  • Password
  • Realm
  • Host FQDN
  • Service Name
  • HTTP Path

• (Optional) Initial SQL statement to run every time Tableau connects

Make the connection and set up the data source

1. On the start page, under Connect, click Cloudera Hadoop, and then do the following:
   1. Enter the name of the server that hosts the database and the port number to use. If you are connecting using Cloudera Impala, you must use port 21050; this is the default port if you are using the 2.5.x driver (recommended).
   2. In the Type drop-down list, select the type of database to connect to. Depending on the version of Hadoop and the drivers you have installed, you can connect using one of the following:
      • Hive Server
      • Hive Server 2
      • Impala

3. In the Authentication drop-down list, select the authentication method to use.

4. (Optional) Click Initial SQL to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run
5. Click **Sign In**.

If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:

1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

2. From the **Schema** drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the schema.

3. In the **Table** text box, click the search icon or enter the table name and click the search icon, and then select the table.

4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

**Note:** This database type only supports equal (=) join operations.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the **DNS** tab.

**Optional** Review and manage the data source

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.

- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

**View the data in the Tableau data source**
In the grid, click **Update Now** to preview the first 1,000 rows of your data.

If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.

To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.
Add data source filters to restrict the visibility and use of the fields in the data source

Click Add at the top of the data source page, to add data source filters.

Hadoop and Impala Query Limits

When connecting to Hadoop using Impala, the queries are limited to 100,000 rows of data when the query includes an ORDER BY clause. You can configured this limit by using a TDC customization such as `<customization name="order-by-limit" value='10'/>`.

Cloudera Hadoop data source example

Here is an example of a Cloudera Hadoop data source using Tableau Desktop on a Windows computer:
DataStax Enterprise

This topic describes how to connect Tableau to DataStax Enterprise database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- (Optional) Initial SQL statement to run every time Tableau connects

Use this connector with Tableau Desktop on a Windows computer.
Make the connection and set up the data source

1. On the start page, under **Connect**, click **DataStax Enterprise**, and then do the following:
   
   1. Enter the name of the server that hosts the database.
   
   2. (Optional) Click **Initial SQL** to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see **Run Initial SQL** on page 343.
   
   3. Click **Sign In**.
      
      If the connection is unsuccessful, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   
   2. From the **Schema** drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the schema.
   
   3. In the **Table** text box, click the search icon or enter the table name and click the search icon, and then select the table.
   
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.
      
      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.

- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.

- If you add tables, remove tables, or make changes to the join conditions, click **Update**
Now again to see your changes.

- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**
Click **Add** at the top of the data source page, to add data source filters.

**DataStax Enterprise data source example**

Here is an example of a DataStax Enterprise data source:

![DataStax Enterprise data source example](image)

**EXASolution**

This topic describes how to connect Tableau to data stored in the EXASolution platform and set up the data source. Tableau can connect to EXASolution version 4.2 and later.

Before you begin, gather this connection information:

- Name of the server you want to connect to
- User name and password

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **EXASolution**, and then do the following:
   1. Enter the name of the server that you want to connect to.
   2. Enter the user name and password, and then click **Sign In**.
2. On the data source page, do the following:
1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

2. From the Schema drop-down list, select a schema or use the text box to search for a schema by name.

3. Under Table, select a table or use the text box to search for a table by name.

4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

Sign in on a Mac

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows
Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.

- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**EXASolution data source example**

Here is an example of an EXASolution data source using Tableau Desktop on a Windows computer:
Firebird

This topic describes how to connect Tableau to a Firebird database and set up the data source. Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Location of the database
- User name and password

Make the connection and set up the data source

1. On the start page, under Connect, click Firebird, and then do the following:
   1. Enter the name of the server that hosts the database.
   2. Enter the database, or browse to the location of the database.
   3. Enter the user name and password, and then click Sign In.

   If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.
2. On the data source page, do the following:

1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

2. Select a table, drag it to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**
- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**Firebird data source example**

Here is an example of a Firebird data source using Tableau Desktop on a Windows computer.
Google Analytics

This topic describes how to connect Tableau to Google Analytics (GA) and set up the data source, and explains when a query returns all data or sampled data.

Before you begin, gather this connection information:

- GA email address and password

Make the connection and set up the data source

1. On the start page, under **Connect**, click **Google Analytics**, and then do the following:
1. Sign in to GA using your email address and password.

2. Click **Allow** to let Tableau Desktop access your GA data.

2. On the data source page, do the following:

1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

2. Follow the steps at the top of the data source page to complete the connection.

   **Step 1** – Select an Account, Property, and Profile using the drop-down menus.

   **Step 2** – Select filters for a date range and a segment.

   - For **Date Range**, you can select one of the predefined date ranges or select specific dates. When selecting a date range, GA can provide complete data only up to the previous full day. For example, if you
choose Last 30 days, data will be retrieved for the last 30-day period ending yesterday.

- For Segment, select a segment to filter your data. Segments are preset filters that you can set for a GA connection. Default Segments are defined by Google, and Custom Segments are defined by the user on the GA website. Segments also help prevent sampling to occur by filtering the data as defined by the segment. For example, with a segment, you can get results for a specific platform, such as tablets, or for a particular search engine, such as Google.

**Note:** GA restricts the amount of data that it returns in a query. When you attempt to retrieve more data than GA allows in a single query, GA returns sampled data instead. If Tableau detects that your GA query might return sampled data, Tableau attempts to bypass the query restriction to return all data instead. For more information, see [All Data vs. Sampled Data](#) on the next page below. For more information about data sampling and the associated risks, see [Sampled Data from Google Analytics](#) in the Tableau Knowledge Base.

**Step 3** – Add dimensions and measures by using the Add Dimension and Add Measure drop-down menus, or select a predefined set of measures from the Choose a Measure Group drop-down menu. Some dimensions and measures cannot be used together. For more information, see [Dimensions & Metrics Reference Guide](#) on the Google developer website.

3. Click the sheet tab to start your analysis. After you click the sheet tab, Tableau imports the data by creating an extract. Note that Tableau Desktop supports only extracts for Google Analytics. You can update the data by refreshing the extract. For more information, see [Extract Your Data](#) on page 409.

**Change your Google account**

If Google bypasses the sign-in screen when you connect, it means that you are already signed in to a Google account. If you are signed in, make sure that you are using the account that provides access to your Google Analytics data. To sign out of an account, click the drop-down arrow next to the account name, and then click Sign out. You can then sign in using the correct credentials.
All Data vs. Sampled Data

GA restricts the amount of data that it returns from a query and provides sampled data instead. Sampled data is a random subset of your data. When performing analysis on sampled data, you can miss interesting outliers, and aggregations can be inaccurate. If Tableau detects that your query might return sampled data, by default, Tableau creates multiple queries from your query, and then combines the results from the queries to return all data.

You see the following message when Tableau returns all data.

Query returns: All data. Sample data

Note: If the query stays within the boundaries of the query restrictions, GA doesn't return sampled data and you do not see the above message.

Troubleshoot issues with returning all data

If your query continues to return sampled data, consider the following:

- **Missing date dimension** – You must use the date dimension in your query to return all data.

- **Too much data** – Your query might contain too much data. Reduce the date range. **Note:** The minimum date range is one day.

- **Non-aggregatable dimensions and measures** – Some dimensions and measures cannot be separated into multiple queries. If you suspect a problematic dimension or measure in your query, hover over the All data button to see the tooltip that shows which dimensions or measures to remove from your query. For more information about these types of dimensions and measures, see Sampled Data from Google Analytics in the Tableau Knowledge Base.

- **Legacy workbooks** – Workbooks created in Tableau Desktop 9.1 and earlier cannot
return all data. Open the legacy workbook in Tableau Desktop 9.2 and save the workbook.

Return sampled data

In cases when workbook performance is critical or there are specific dimensions and measures you want to use in your query that are not supported by Tableau’s default query process, use sampled data instead. To return sampled data, click the Sample data button.

Google Analytics data source example

Here is an example of a Google Analytics data source connection using Tableau Desktop on a Windows computer:
**Google BigQuery**

This topic describes how to connect Tableau to Google BigQuery and set up the data source, and how to use customization attributes to improve query performance.

Before you begin, gather this connection information:

- Google BigQuery email address and password

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **Google BigQuery**, and then do the following:
   1. Sign in to Google BigQuery using your email address and password.
   2. Click **Accept** to let Tableau Desktop access your Google BigQuery data.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Project** drop-down list, select a project. Alternatively, select **publicdata** to connect to sample data in BigQuery.
3. From the **Dataset** drop-down list, select a data set.

4. Under **Table**, select a table.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

**Change your Google account**

If Google bypasses the sign-in screen when you connect, it means that you are already signed in to a Google account. If you are signed in, make sure that you are using the account that provides access to your Google BigQuery data. To sign out of an account, click the drop-down arrow next to the account name, and then click **Sign out**. You can then sign in using the correct credentials.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.

- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.

- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.

- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**
Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see [Split a Field into Multiple Fields on page 403](#).

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters .

**Note:** Because of the large volume of data in BigQuery, Tableau recommends that you connect live.
Google BigQuery data source example

Here is an example of a Google BigQuery data source using Tableau Desktop on a Windows computer:

Use customization attributes to improve query performance

You can use customization attributes to improve the performance of large result sets returned from BigQuery to Tableau Online and Tableau Server, and on Tableau Desktop.

You can have the customization attributes included in your published workbook or data source, as long as you specify the attributes before you publish the workbook or data source to Tableau Online or Tableau Server.

Use Google BigQuery customization attributes

Customization attributes accept integer values and affect both live queries and extract refreshes for the specified connection.

The following attributes help the most to increase performance of large result sets:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq-fetch-tasks</td>
<td>Number of parallel background tasks to use when fetching data using HTTP. The default is 10.</td>
</tr>
<tr>
<td>bq-large-fetch-rows</td>
<td>Number of rows to fetch in each batch for spool queries. The default is 50000.</td>
</tr>
</tbody>
</table>

The following attributes are also available and are primarily used for small queries:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bq-fetch-rows</td>
<td>Number of rows to fetch in each batch for non-spool queries. The default</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>bq-response-rows</td>
<td>Number of rows returned in non-spool non-batched queries. The default is 10000.</td>
</tr>
</tbody>
</table>

This capability setting accepts yes or no values and can be useful when testing:

| CAP_BIGQUERY_FORCE_SPOOL_JOB | Force all queries to use the temp table approach. The default value is “no.” Change the value to “yes” to turn this attribute on. |

**How Tableau returns rows from Google BigQuery**

Tableau uses two approaches to return rows from BigQuery: the default non-spool approach, or the temp table (spool) approach:

- On the first attempt, queries are executed using the default, non-spool query, which uses the bq-fetch-rows setting.
- If the result set is too large, the BigQuery API returns an error and the Tableau BigQuery connector retries the query by saving the results into a BigQuery temp table. The BigQuery connector then reads from that temp table, which is a spool job that uses the bq-large-fetch-rows setting.

**How to specify the attributes**

You can specify attributes in one of two ways: in a TDC file, or in the workbook or data source XML.

**Specify attributes in a TDC file**

To specify customization attributes during a publish workbook or publish data source operation from Tableau Desktop, follow these steps:

1. Create an XML file that contains the customization attributes.
2. Save the file with a .tdc extension, for example, BigQueryCustomization.tdc.
3. Save the file to the My Tableau Repository\Datasources folder.

The customization attributes in the TDC file are read and included by Tableau Desktop when the data source or workbook is published to Tableau Online or Tableau Server.

**Example of a .tdc file with recommended settings for large extracts**

```xml
<connection-customization class='bigquery' enabled='true' version='8.0' >
    <vendor name='bigquery' />
    <driver name='bigquery' />
</connection-customization>
```
<customizations>
  <customization name='bq-fetch-tasks' value='10' />
  <customization name='bq-large-fetch-rows' value='10000' />
</customizations>
</connection-customization>

Manually embed attributes in the XML of the workbook or data source file

You can manually embed customization attributes inside the 'connection' tag in the workbook .twb file or the data source .tds file. The BigQuery customization attributes are bold in the following example to make them easier for you to see.

Example of manually embedded attributes:

```
<connection CATALOG='publicdata' EXEC/catalog='some-project-123'
  REDIRECT_URI='some-url:2.0:oob'
  SCOPE='https://www.googleapis.com/auth/bigquery
  https://www.googleapis.com/auth/userinfo.profile
  https://www.googleapis.com/auth/userinfo.email'
  authentication='yes' bq-fetch-tasks='10' bq-large-fetch-rows='10000'
  class='bigquery'
  connection-dialect='google-bql'
  connection-protocol='native-api'
  login_title='Sign in to Google BigQuery'
  odbc-connect-string-extras=''
  project='publicdata'
  schema='samples'
  server='googleapis.com/bigquery'
  server-oauth=''
  table='wikipedia'
  username=''>
```

Google Cloud SQL

This topic describes how to connect Tableau to a Google Cloud SQL database instance and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- User name and password
- Are you connecting to an SSL server?

Make the connection and set up the data source

1. On the start page, under Connect, click Google Cloud SQL, and then do the following:
   1. Enter the name of the server that hosts the database.
   2. Enter the user name and password, and then click Sign In.
Select the **Require SSL** check box when connecting to an SSL server. If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Database** drop-down list, select a database or use the text box to search for a database by name.
   3. Under **Table**, select a table or use the text box to search for a table by name.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see *Connect to a Custom SQL Query* on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the **DNS** tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see *Join Your Data* on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, *Blend Your Data* on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.
Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select Copy.

Connect to live data or use an extract

- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click Add at the top of the data source page, to add data source filters.
Google Cloud SQL data source example

Here is an example of a Google Cloud SQL data source using Tableau Desktop on a Windows computer.

Google Sheets

This topic describes how to connect Tableau to Google Sheets and set up the data source, lists optional settings available to you, and covers troubleshooting Google Sheets issues.

Before you begin, gather this connection information:

- Google account email and password

Make the connection and set up the data source

1. On the start page, under **Connect**, click **Google Sheets**, and then do the following:
   1. Sign in to Google Sheets using your Google account email address and password, if you’re not already signed in.
   2. Click **Allow** to let Tableau Desktop access your Google Sheets data.
3. Select a Google Sheet from the list or use the text box to search for a Google Sheet by name or by URL, and then click Connect.
2. On the data source page, do the following:

1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data figure out which data source to connect to.

2. If your Google Sheets file has one table, click the sheet tab to start your analysis.

**Note:** Tableau doesn't support pivot tables in Google Sheets.

**Select Your Google Sheet dialog box functionality**

The Select Your Google Sheet dialog box includes the following functionality:

- The list of sheets that you can select from includes your private sheets, sheets shared with you, and the public sheets that you’ve accessed in the past.

- If you search by URL and the URL doesn't exist or you don't have access to it, an error displays.

- You can click the **Name** and **Last opened by me** column names to sort the Google Sheets, and when you select a sheet you can preview it in the right pane. You cannot sort by **Owned by**.

**Connect to more data**

You can connect to more than one table by using join. For more information, see **Join Your Data** on page 349.
You can also connect to a named range the same way you connect to a worksheet. The named range functions as a table in Tableau.

You create named ranges in Google Sheets by highlighting a range of cells and then selecting Data > Named ranges. When you connect to a named range in Tableau, an icon appears next to the sheet in the Data Source tab as shown below.

Change your Google account

If Google bypasses the sign-in screen when you connect to Google Sheets and goes directly to the approval screen shown in step 3 above, it means that you are already signed in to a Google account. If you are signed in, make sure that you are using the account that provides access to your Google Sheets data. To sign out of an account, click the drop-down arrow next to the account name, and then click Sign out. You can then sign in using the correct credentials.

Optional settings

You can set the following options before you build the view.

Set table options

On the canvas, click the table drop-down arrow and then specify whether the data includes field names in the first row. If so, these names will become the field names in Tableau. If field names are not included, Tableau generates them automatically. You can rename the fields later.
Clean your data with Data Interpreter

Sometimes, the format of the data in your Google Sheets data makes it difficult to analyze in Tableau. For example, your Google Sheets data might include additional tables, sub-tables, hierarchical headers, extraneous headers and footers, or empty rows and columns. The Tableau Data Interpreter detects these sub-tables so that you can work with a subset of your data independently of the other data. It also removes the extraneous information to help prepare your data source for analysis.

After you set up the data source, if Tableau detects sub-tables, unique formatting, or that the data contains some extraneous information, it prompts you to use Data Interpreter.

To clean your data with Data Interpreter and review results

1. After you have connected to your data and set up your data source, on the data source page, select the Clean with Data Interpreter check box.

2. Click Review data. A copy of your data source opens in Excel on the Key for the Data Interpreter tab.

3. Review the annotation key to find out how to read the results.

4. Click the subsequent annotation tabs to review how Data Interpreter interpreted the data source. You can also review Data Interpreter results directly in the grid below Data Interpreter.

   If Data Interpreter does not provide the expected results, you can clear the Clean with Data Interpreter check box to use the original data source.

5. If Data Interpreter detects additional tables in your data, you can replace the current table with the found table by dragging it to the canvas.

   If Data Interpreter has misidentified the range of the found table, click the table dropdown arrow on the canvas, and then select Edit Found Table to adjust the corners of the found table (the top-left cell and bottom-right cell of the table).
Review and manage the data source

In addition to setting table options and cleaning your data, you can make the following changes to the data source before you start your analysis:

- **View the data in the Tableau data source** – In the grid, click **Update Now** to preview the first 1,000 rows of your live or extract data source. If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes. If you want changes to automatically appear in the grid, click **Automatically Update**.

- **Manage metadata** – Click the metadata grid button to quickly examine the general structure of the Tableau data source and its fields and to perform routine management tasks like sorting fields and rows, hiding multiple fields at once, or quickly renaming or resetting fields.

- **Sort fields and rows** – From the **Sort fields** drop-down list, select how you want to sort the columns in the grid or metadata grid. You can sort the columns by data source or table order. Sort the row values by clicking the sort button next to the column name.

- **Hide fields** – Hide a field by clicking the column drop-down arrow and selecting **Hide**.

- **Rename fields and reset field names** – To rename the field, in the data preview grid, double-click the field name, or in the metadata grid, click the field name. You can also select a column or multiple columns, click the column drop-down, and then select **Reset Name** to revert back to the original name of the field.

- **Pivot columns** – Pivot fields to transform data in a crosstab format into a columnar format. For more information, see **Pivot Data from Columns to Rows** on page 398.

- **Split columns** – Depending on the data source, you can split the columns in the data source into new fields. For more information, see **Split a Field into Multiple Fields** on page 403.

- **Create calculations** – Create a new calculation based on an existing field in the data source. Click the column drop-down arrow and select **Create Calculated Field**.

- **Copy values** – Copy values in the grid by selecting the values and then pressing Ctrl+C. Alternatively, to copy values in the metadata grid, select the values, right-click, and then select **Copy**.

- **Connect live or use an extract** – At the top of the data source page, select a live or extract connection to the data source. If you choose to take an extract, an **Edit** link displays that you can use to set up filters that define a subset of the data to include in the extract.

- **Add data source filters** – At the top of the data source page, add data source filters to restrict the visibility and use of the fields in the data source.
Troubleshoot Google Sheets issues

Data limit in Google Drive

You can store up to 2 million cells for spreadsheets that are created in or converted to Google Sheets. For more information, see Files you can store in Google Drive in the Google Drive Help.

Error message: Internal Error - An unexpected error occurred and the operation could not be completed.

If there are errors in your Google Sheet, such as #DIV/0! or #N/A, Tableau is unable to create an extract and an error message will appear. To resolve this issue, wrap the function with `iferror()` and have it return a blank, or any value that's appropriate.

For example, the sheet below includes a #DIV/0! error.

![Error_message](image)

The solution is to wrap the calculation in an `iferror()` calculation.

![Calculation](image)

Google Sheets data source example

Here is an example of a Google Sheets data source:
Hortonworks Hadoop Hive

This topic describes how to connect Tableau to a Hortonworks Hadoop Hive database and set up the data source. For more information about connecting to Hadoop data, see Connecting to Hadoop Hive in the Tableau Knowledge Base.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Type of database: HiveServer, HiveServer2
- Authentication method
  
  HiveServer doesn't require authentication. HiveServer2 authentication choices include the following:

  - No Authentication
  - Kerberos
  - User Name
  - User Name and Password
  - User Name and Password (SSL)
  - Microsoft Azure HDInsight Emulator
  - Microsoft Azure HDInsight Service
  - HTTP
  - HTTPS
- Sign-in credentials
  Credentials depend on the authentication method you choose, and can include the following:
  - User name
  - Password
  - Realm
  - Host FQDN
  - Service Name
  - HTTP Path
- Are you connecting to an SSL server?
- (Optional) Initial SQL statement to run every time Tableau connects

Make the connection and set up the data source

1. On the start page, under Connect, click Hortonworks Hadoop Hive, and then do the following:
   1. Enter the name of server that hosts the data base.
   2. In the Type drop-down list, select the type of database to connect to:
      - HiveServer
      - HiveServer2
   3. In the Authentication drop-down list, select the authentication method to use.
   4. (Optional) Click Initial SQL to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run Initial SQL on page 343.
   5. Click Sign In.
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, click the search icon or enter the schema name
in the text box and click the search icon, and then select the schema.

3. In the **Table** text box, click the search icon or enter the table name and click the search icon, and then select the table.

4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

**Note:** This database type only support equal ( = ) join operations.

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**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the **DNS** tab.

**Optional** Review and manage the data source

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.

- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.

- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.

- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button **to perform routine management tasks.**

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see *Split a Field into Multiple Fields* on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**Hortonworks Hadoop Hive data source example**

Here is an example of a Hortonworks Hadoop Hive data source using Tableau Desktop on a Windows computer:
This topic describes how to connect Tableau to an HP Vertica database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- User name and password
- (Optional) Initial SQL statement to run every time Tableau connects
Make the connection and set up the data source

1. On the start page, under Connect, click HP Vertica, and then do the following:
   1. Enter the name of the server that hosts the database and the name of the database that you want to connect to.
   2. Enter the user name and password.
   3. (Optional) Click Initial SQL to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run Initial SQL on page 343.
   4. Click Sign In.

      If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, select a schema or use the text box to search for a schema by name.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

Sign in on a Mac

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases
- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button 📝 to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.
Connect to live data or use an extract

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click **Add** at the top of the data source page, to add data source filters.

**HP Vertica data source example**

Here is an example of an HP Vertica data source using Tableau Desktop on a Windows computer:
IBM BigInsights
This topic describes how to connect Tableau to an IBM BigInsights database.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to and port number
- Database name
- User name and password
- (Optional) Initial SQL statement to run every time Tableau connects

Use this connector with Tableau Desktop on a Windows computer.

Make the connection and set up the data source

1. On the start page, under Connect, click IBM BigInsights, and then do the following:
   1. Enter the name of the server that hosts the database and the port number to use.
   2. Enter the name of the database you want to connect to.
   3. Enter your user name and password.
   4. (Optional) Click Initial SQL to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run Initial SQL on page 343.
   5. Click Sign In.

If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, select a schema or use the text box to search for a schema by name.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.
(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
  - In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
  - To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values
Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select Copy.

**Connect to live data or use an extract**

- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click Add at the top of the data source page, to add data source filters.

**IBM BigInsights data source example**

Here is an example of an IBM BigInsights data source:
IBM DB2

This topic describes how to connect Tableau to an IBM DB2 database and set up the data source. You can also use this connector to connect to an IBM DB2 for z/OS database. Refer to the Technical Specifications to confirm which DB2 databases are supported.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to and port number
- Database name
- User name and password
- (Optional) Initial SQL statement to run every time Tableau connects

The port number is dependent on the type of server you are connecting to and whether you are connecting to an encrypted port. Generally, use 50000 for a non-encrypted port and 60000 for an encrypted port. It is possible that your server is configured to use a non-standard port. Contact your administrator if you don’t know which port to connect to.

Use this connector with Tableau Desktop on a Windows computer.
Make the connection and set up the data source

1. On the start page, under Connect, click IBM DB2, and then do the following:
   
   1. Enter the name of the server that hosts the database and the name of the database that you want to connect to.
   
   2. Enter your user name and password, and then click Sign In.
      
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.
   
   3. (Optional) Click Initial SQL to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run Initial SQL on page 343.

2. On the data source page, do the following:
   
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   
   2. From the Schema drop-down list, select a schema or use the text box to search for a schema by name.
   
   3. Under Table, select a table or use the text box to search for a table by name.
   
   4. Drag a table to the canvas, and then click the sheet tab to start your analysis.
      
      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update
Now again to see your changes.

- To have changes automatically reflect in the grid, click **Automatically Update**.

### Manage metadata

Click the metadata grid button to perform routine management tasks.

### Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

### Hide a field

Click the column drop-down arrow and select **Hide**.

### Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

### Split columns

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

### Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select **Create calculated field**.

### Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

### Copy values in the metadata grid

Select the values, right-click, and then select **Copy**.

### Connect to live data or use an extract

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

### Add data source filters to restrict the visibility and use of the fields in the data source
Click **Add** at the top of the data source page, to add data source filters.

**IBM DB2 data source example**

Here is an example of an IBM DB2 data source:

![IBM DB2 data source example](image)

**IBM PDA (Netezza)**

This topic describes how to connect Tableau to an IBM PDA (PureData System for Analytics) database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- User name and password

Use this connector with Tableau Desktop on a Windows computer.
Make the connection and set up the data source

1. On the start page, under **Connect**, click **IBM PDA (Netezza)**, and then do the following:
   1. Enter the name of the server that hosts the database.
   2. Enter the name of the database that you want to connect to.
   3. Enter the user name and password, and then click **Sign In**.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Under **Table**, select a table or use the text box to search for a table by name.
   3. Drag a table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

View the data in the Tableau data source

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

Manage metadata

Click the metadata grid button 📊 to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields**
drop-down list. You can sort the columns by data source or table order.

- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**
Click the column drop-down arrow and select **Hide**.

**Rename a field**
- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**
If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**
Click the column drop-down arrow and select **Create calculated field**.

**Copy values**
Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**
Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**
- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**
Click **Add** at the top of the data source page, to add data source filters.

**IBM PDA (Netezza) data source example**
Here is an example of an IBM PDA (Netezza) data source:
Kognitio

This topic describes how to connect Tableau to a Kognitio database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- User name and password
- Are you connecting to an SSL server?

Make the connection and set up the data source

1. On the start page, under **Connect**, click **Kognitio**, and then do the following:
   1. Enter the name of the server that hosts the database you want to connect to.
   2. Enter the user name and password, and then click **Sign In**.
Select the **Require SSL** check box when connecting to an SSL server.

If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Schema** drop-down list, select a schema or use the text box to search for a schema by name.
   3. Under **Table**, select a table or use the text box to search for a table by name.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the **DNS** tab.

**Optional** Review and manage the data source

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.

- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.

- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.

- To have changes automatically reflect in the grid, click **Automatically Update**.
Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select Copy.

Connect to live data or use an extract

- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click Add at the top of the data source page, to add data source filters.
Kognitio Data Source Example

Here is an example of a Kognitio data source using Tableau Desktop on a Windows computer:

MapR Hadoop Hive

This topic describes how to connect Tableau to a MapR Hadoop Hive database and set up the data source. For more information about connecting to Hadoop data, see Connecting to Hadoop Hive in the Tableau Knowledge Base.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Type of database: HiveServer, HiveServer2
- Authentication method. HiveServer doesn't require authentication. HiveServer2 authentication choices include the following:
- No Authentication
- Kerberos
- User Name
- User Name and Password
- User Name and Password (SSL)
- Microsoft Azure HDInsight Emulator
- Microsoft Azure HDInsight Service
- HTTP
- HTTPS

- Sign-in credentials. Your choices depend on the authentication method you choose, and can include the following:
  - User name
  - Password
  - Realm
  - Host FQDN
  - Service Name
  - HTTP Path

- (Optional) Initial SQL statement to run every time Tableau connects

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **MapR Hadoop Hive**, and then do the following:
   1. Enter the name of the server that hosts the database.
   2. In the **Type** drop-down list, select the type of database to connect to. You can select one of the following:
      - **HiveServer**
      - **HiveServer2**
   3. In the **Authentication** drop-down list, select the authentication method to use.
   4. (Optional) Click **Initial SQL** to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run **Initial SQL** on page 343.
   5. Click **Sign In**.
If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the schema.
   3. In the Table text box, click the search icon or enter the table name and click the search icon.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

   Note: This database type supports only equal (=) join operations.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click Add next to Connections. For more information, see Join Your Data on page 349.

- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**

- In the grid, click Update Now to preview the first 1,000 rows of your data.

- If you add tables, remove tables, or make changes to the join conditions, click Update
Now again to see your changes.

- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button 📋 to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**
Click **Add** at the top of the data source page, to add data source filters.

**MadR Hadoop data source example**

Here is an example of a MapR Hadoop Hive data source using Tableau Desktop on a Windows computer.

![MapR Hadoop Hive data source example](image)

**Marketo**

This topic describes how to connect Tableau to Marketo data and set up the data source. It also describes how date range selections can impact performance.

Before you begin, gather this connection information:
- Custom Service Endpoint
- Client ID
- Client Secret

For details about how to create the custom service information you need from Marketo to connect, see the **Custom Service** topic on the Marketo website.

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **Marketo**, and then do the following:
   1. Enter your Custom Service Endpoint, Client ID, and Client Secret.
   2. Click **Sign In**.
   3. Select **Filter Type: Relative date range** or **Fixed date range**, and then select or specify the range.
   4. Click **Connect** to authorize Marketo to securely share your data with Tableau Desktop.

   If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network or Marketo administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Under **Table**, select a table and drag it to the top of the canvas.
   3. Click the sheet tab to start your analysis.

   After you click the sheet tab, Tableau imports the data by creating an extract. Note that Tableau Desktop supports only extracts for Marketo. You can update the data by refreshing the extract. For more information, see **Extract Your Data** on page 409.

   Creating extracts may take some time depending on the amount of data that is included.

**Date range selections can impact performance**

It's tempting to gather as much data as possible when you do an analysis, however, retrieving records from Marketo can be time-consuming. Tableau doesn't know how much data there is in a particular date range until it retrieves the data. For this reason, you should restrict your date range at first, and then expand after you evaluate performance.
To give you a rough idea of how much time it might take to retrieve data from Marketo, tests were conducted using a high-speed connection. This table shows how long it took in the test environment to retrieve a given number of records.

<table>
<thead>
<tr>
<th>Number of records</th>
<th>Time to retrieve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000</td>
<td>4.5 seconds</td>
</tr>
<tr>
<td>10,000</td>
<td>45 seconds</td>
</tr>
<tr>
<td>100,000</td>
<td>8 minutes</td>
</tr>
<tr>
<td>1,000,000</td>
<td>75 minutes</td>
</tr>
</tbody>
</table>

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**
• Double-click the field name.

• To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Marketo data source example**

Here is an example of a Marketo data source using Tableau Desktop on a Windows computer:
MarkLogic

This topic describes how to connect Tableau to a MarkLogic database and set up the data source.

Before you begin, gather this connection information:
- Name of the server that hosts the database you want to connect to
- Port number for the ODBC server process
- User name and password

Use this connector with Tableau Desktop on a Windows computer.

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **MarkLogic**, and then do the following:
   1. Enter the name of the server that hosts the database you want to connect to.
   2. Enter the port number for the ODBC server process of the database you want to connect to.
   3. Enter your user name and password, and then click **Sign In**.
      
      If the connection is unsuccessful, verify that your user name and password are correct and that the port number correctly identifies the MarkLogic database configured by your database administrator. If the connection continues to fail, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Schema** drop-down list, select a schema or use the text box to search for a schema by name.
   3. Under **Table**, select a table or use the text box to search for a table by name.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.
      
      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.
View the data in the Tableau data source

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select **Hide**.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

Split columns

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select **Create calculated field**.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select **Copy**.

Connect to live data or use an extract

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that
define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**MarkLogic data source example**

Here is an example of a MarkLogic data source:

![MarkLogic data source example](image)

**MemSQL**

This topic describes how to connect Tableau to a MemSQL database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- User name and password
- Are you connecting to an SSL server?
Make the connection and set up the data source

1. On the start page, under Connect, click MemSQL, and then do the following:
   1. Enter the name of the server that hosts the database.
   2. Enter the user name and password, and then click Sign In.
      Select the Require SSL check box when connecting to an SSL server.
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Database drop-down list, select a database or use the text box to search for a database by name.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag a table to the canvas, and then click the sheet tab to start your analysis.
      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

Sign in on a Mac

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source
• In the grid, click **Update Now** to preview the first 1,000 rows of your data.

• If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.

• To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button  to perform routine management tasks.

**Sort fields and rows**

• Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.

• In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

• Double-click the field name.

• To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

• If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.

• If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.
Add data source filters to restrict the visibility and use of the fields in the data source

Click Add at the top of the data source page, to add data source filters.

**MemSQL data source example**

Here is an example of a MemSQL data source using Tableau Desktop on a Windows computer:

In order to use your net services definitions in Tableau, you must set either TNS_ADMIN or ORACLE_HOME as an environment variable. To set TNS_ADMIN as the environment variable use the full path of the directory that contains the tnsnames.ora file. To set ORACLE_HOME as an environment variable use the path to the main Oracle directory.

**Microsoft Analysis Services**

This topic describes how to connect Tableau to a Microsoft Analysis Services database and set up a data source.
Before you begin, gather this connection information:

- For a remote cube file: Server name, or URL if connecting to the server using HTTP
- For a local cube file: File name
- Authentication method: Windows Authentication or user name and password

Use this connector with Tableau Desktop on a Windows computer.

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **Microsoft Analysis Services**, and then do the following:
   
   1. Select whether to connect to a remote cube file on a server or to a local cube file.
   
      To connect to a remote cube file, select **Server** and enter the name of the server in the text box. If you are connecting to the server using HTTP, you can enter the URL as the server name.

      To connect to a local cube file, select **Local cube file** and click **Browse** to navigate to the cube file on your computer.

   2. Select how you want to sign in to the server. Specify whether to use Windows Authentication or a specific user name and password. If the cube is password protected, and you are not in a Kerberos environment, you must enter your user name and password.

   Specify whether to use Windows Authentication or a specific user name and password.

   3. Click **Sign In**.

      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:

   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

   2. Select a database.

   3. Select a cube from the database.

   4. Click the sheet tab to start your analysis.

**Microsoft Analysis Services data source example**

Here is an example of a Microsoft Analysis Services data source:
Microsoft PowerPivot

This topic describes how to connect Tableau to a Microsoft PowerPivot database.

Before you begin, gather this connection information:

- SharePoint URL, or SharePoint, UNC, or local Excel file name

If you plan to publish the workbook to Tableau Server, make sure to connect to a PowerPivot file on SharePoint. Tableau Server does not support connections to local PowerPivot files.

PowerPivot data may contain one or more perspectives. Perspectives are subsets of objects from the model that define sets of data. Typically perspectives are defined for a particular group of users or business scenario. Using perspectives can make it easier to navigate large data sources.

Use this connector with Tableau Desktop on a Windows computer.

Note: Tableau Desktop supports Microsoft PowerPivot 2010 and 2013.
Make the connection and set up the data source

1. On the start page, under Connect, click Microsoft PowerPivot, and then do the following:
   1. Select whether to connect to a PowerPivot file using a SharePoint URL, a SharePoint UNC (file path), or a local Excel file.
   2. Click Sign In.
2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. The file name appears under Select a File. Note that there is one file per connection. Select a perspective available in that file.
   3. Click the sheet tab to start your analysis.

Microsoft PowerPivot data source example

Here is an example of a Microsoft PowerPivot data source:
Microsoft SQL Server

This topic describes how to connect Tableau to a Microsoft SQL Server database and set up the data source.

**Note:** Use the Microsoft SQL Server connector to connect to Microsoft SQL Server Parallel Data Warehouse (PDW), Microsoft Azure SQL Data Warehouse, or Microsoft Azure SQL Database.

Before you begin, gather this connection information:

- Name of the server you want to connect to
- (Optional) Database name if you want to connect to a contained database
- Authentication method: Windows Authentication or user name and password
- Are you connecting to an SSL server?
- Do you want to set the database isolation level to read uncommitted data?
- (Optional) Initial SQL statement to run every time Tableau connects

**Make the connection and set up the data source**

1. On the start page, under *Connect*, click *Microsoft SQL Server*, and then do the following:
   1. Enter the name of the server you want to connect to.
   2. (Optional) Enter a database name if you want to connect to a contained database.
   3. Select how you want to sign in to the server. Specify whether to use Windows Authentication or a specific user name and password. If the server is password protected, and you are not in a Kerberos environment, you must enter the user name and password.
      
      Select the **Require SSL** check box when connecting to an SSL server.
   4. Specify whether to **Read uncommitted data**. This option sets the database isolation level to Read Uncommitted. Long queries from Tableau, including extract refreshes, can lock the database and delay transactions. Select this option to allow queries to read rows that have been modified by other transactions even when they have not been committed yet. When this option is cleared, Tableau uses the default isolation level specified by the database.
   5. (Optional) Click **Initial SQL** to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see *Run Initial SQL* on page 343.
6. Click **Sign In**.

   If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:

   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

   2. From the **Database** drop-down list, select a database or use the text box to search for a database by name.

   3. Under **Table**, select a table or use the text box to search for a table by name.

      You can also specify a stored procedure in the database. For more information about stored procedures, including a list of constraints specific to SQL Server databases, see **Use a Stored Procedure** on page 394.

   4. Drag the table or stored procedure to the canvas, and then click the sheet tab to start your analysis.

      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

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**Note:** Tableau Desktop does not support the Microsoft SQL Server TIME data type. Fields of this data type are not imported and do not appear in Tableau Desktop. If included in stored procedures, TIME data type fields will not appear in Tableau Desktop. For more information, see **Use a Stored Procedure** on page 394.

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**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the DNS tab.

**Resolve "Worksheet Unavailable" error message**

When you open a workbook, you may see a “Worksheet Unavailable” error message and then, when you click **Edit Connection**, you are prompted to provide your sign-in credentials. This error typically displays under one of two circumstances: you don't have access to a data
connection used in the workbook, or your credentials are invalid, for example, your password has expired.

To resolve, verify that your sign-in credentials are correct. If they are, contact the Tableau administrator to ask about access to the data connection.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases
- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source
- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows
- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field
- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some
cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select Copy.

Connect to live data or use an extract

- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click Add at the top of the data source page, to add data source filters.

Microsoft SQL Server data source example

Here is an example of a Microsoft SQL Server data source using Tableau Desktop on a Windows computer:
MonetDB

This topic describes how to connect Tableau to a MonetDB database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- User name and password

Use this connector with Tableau Desktop on a Windows computer.
Make the connection and set up the data source

1. On the start page, under Connect, click MonetDB, and then do the following:
   1. Enter the name of the server that hosts the database and the name of the database that you want to connect to.
   2. Enter the user name and password, and then click Sign In.

   If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, select a schema.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag a table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.
Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select **Hide**.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

Split columns

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select **Create calculated field**.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select **Copy**.

Connect to live data or use an extract

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click **Add** at the top of the data source page, to add data source filters.

**MonetDB data source example**

Here is an example of a MonetDB data source:
MySQL

This topic describes how to connect Tableau to a MySQL database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- User name and password
- Are you connecting to an SSL server?

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **MySQL**, and then do the following:
   1. Enter the name of the server that hosts the database.
   2. Enter the user name and password, and then click **Sign In**.

   Select the **Require SSL** check box when connecting to an SSL server.
If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:

   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

   2. From the Database drop-down list, select a database or use the text box to search for a database by name.

   3. Under Table, select a table or use the text box to search for a table by name.

   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click Add next to Connections. For more information, see Join Your Data on page 349.

- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**

- In the grid, click Update Now to preview the first 1,000 rows of your data.

- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.

- To have changes automatically reflect in the grid, click Automatically Update.

**Manage metadata**
Click the metadata grid button ☰ to perform routine management tasks.

**Sort fields and rows**
- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**
Click the column drop-down arrow and select Hide.

**Rename a field**
- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

**Split columns**
If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

**Create a new calculation based on an existing field in the data source**
Click the column drop-down arrow and select Create calculated field.

**Copy values**
Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**
Select the values, right-click, and then select Copy.

**Connect to live data or use an extract**
- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**
Click Add at the top of the data source page, to add data source filters .

**MySQL data source example**
Here is an example of a MySQL data source using Tableau Desktop on a Windows computer:
**OData**

This topic describes how to connect Tableau to an OData data source. Tableau connects to OData V2, and does not support browsing OData service documents.

**Note:** Use the OData connector to connect to your Windows Azure Marketplace data. Workbooks created in earlier versions of Tableau that use the Windows Azure Marketplace DataMarket connector will work as expected.

Before you begin, gather this connection information:

- Server URL for the data you want to connect to
- Sign-in credentials, if required
  - For Windows Azure Marketplace: Account key
  - User name and password
Make the connection and set up the data source

1. On the start page, under Connect, click OData, and then do the following:
   1. Enter the server URL for the data you are connecting to.
   2. If necessary, enter authentication information.
      You can authenticate using your Windows Azure Marketplace (DataMarket) account key, or a user name and password.
   3. Click Sign In.
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Click the sheet tab to start your analysis.
      After you click the sheet tab, Tableau imports the data by creating an extract. For more information about extracts, see Extract Your Data on page 409. Note that Tableau Desktop supports only extracts for OData. Unlike many extract connections, extracts from OData data sources cannot be refreshed. To get the updated data, you must reconnect to the data source.

OData data source example

Here is an example of an OData data source:
Oracle

This topic describes how to connect Tableau to an Oracle database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- (Optional) Oracle service name and port
- Authentication method: Integrated Authentication or user name and password
- (Optional) Initial SQL statement to run every time Tableau connects
Make the connection and set up the data source

1. On the start page, under Connect, click Oracle, and then do the following:
   1. Enter the server name.
   2. (Optional) Enter the Oracle service name and port number.
   3. Select how you want to sign in to the server. Specify whether to use Integrated Authentication or a specific user name and password.
   4. (Optional) Click Initial SQL to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run Initial SQL on page 343.
   5. Click Sign In.

   If Tableau can't make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Schema drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the schema. Note: Search is case-sensitive.
   3. Under Table, click the search icon or enter the table name and click the search icon, and then select the table. Note: Search is case-sensitive.

   Tableau Desktop also supports connecting to Oracle table functions, which appear under Stored Procedures in the left pane of the Data Source page.
   4. Drag a table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

Note: In order to use your net services definitions in Tableau, you must set either TNS_ADMIN or ORACLE_HOME as an environment variable. To set TNS_ADMIN as the environment variable use the full path of the directory that contains the tnsnames.ora file. To set ORACLE_HOME as an environment variable use the path to the main Oracle directory.
**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the **DNS** tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see [Join Your Data on page 349](#).
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, [Blend Your Data on page 363](#).

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.
Split columns
If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source
Click the column drop-down arrow and select Create calculated field.

Copy values
Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid
Select the values, right-click, and then select Copy.

Connect to live data or use an extract
- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source
Click Add at the top of the data source page, to add data source filters.

Oracle data source example
Here is an example of an Oracle data source using Tableau Desktop on a Windows computer:
Oracle Essbase

This topic describes how to connect Tableau to an Oracle Essbase database. Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- User name and password

Use this connector with Tableau Desktop on a Windows computer.

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **Oracle Essbase**, and then do the following:
   1. Enter the name of the server that hosts the database.
   2. Enter your user name and password to sign in to the server, and then click **Sign In**.
If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Select an application.
   3. Select a database from your application.
   4. Click the sheet tab to start your analysis.

**Set an Accounts Dimension**

In some case, the accounts dimension for your data source can appear in the Dimensions area of the Data pane. This might occur if there is an error in the cube and another field is identified as the accounts dimension or there is no accounts dimension set at all. The accounts dimension defines the fields that are included as measures. To correct this error, right-click the field and then select **Set as Accounts Dimension** from the context menu.
Oracle Essbase data source example

Here is an example of an Oracle Essbase data source:
Pivotal Greenplum Database

This topic describes how to connect Tableau to a Pivotal Greenplum Database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- User name and password
- (Optional) Initial SQL statement to run every time Tableau connects

Make the connection and set up the data source

1. On the start page, under Connect, click Pivotal Greenplum Database, and then do the following:
1. Enter the name of the server that hosts the database and the name of the database you want to connect to.

2. Enter the user name and password.

3. (Optional) Click **Initial SQL** to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run **Initial SQL** on page 343.

4. Click **Sign In**.

   If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:

   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

   2. Select and drag a table to the canvas, and then click the sheet tab to start your analysis.

     Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the **DNS** tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see Join Your Data on page 349.

- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**
- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see *Split a Field into Multiple Fields* on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.
Add data source filters to restrict the visibility and use of the fields in the data source

Click **Add** at the top of the data source page, to add data source filters.

**Pivotal Greenplum Database data source example**

Here is an example of a Pivotal Greenplum Database data source using Tableau Desktop on a Windows computer.

![Image of Pivotal Greenplum Database settings](image)

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**PostgreSQL**

This topic describes how to connect Tableau to a PostgreSQL database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- Authentication method: Integrated Authentication or user name and password
- Are you connecting to an SSL server?

**Note:** If you're using a Mac, and it is not attached to the domain correctly, the Mac won't know that Kerberos is being used in the domain, and the Authentication drop-down list won't be available.

### Make the connection and set up the data source

1. On the start page, under **Connect**, click **PostgreSQL**, and then do the following:
   1. Enter the name of the server that hosts the database that you want to connect to.
   2. Enter the name of the database.
   3. Select how you want to sign in to the server. Specify whether to use **Integrated Authentication** or **User Name and Password**. If the server is password protected, and you are not in a Kerberos environment, you must enter the user name and password.
   4. Click **Sign In**.

   Select the **Require SSL** check box when connecting to an SSL server.

   If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Under **Table**, select a table or use the text box to search for a table by name.
   3. Drag the table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

### Sign in on a Mac

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to **System Preferences > Network > Advanced**, and then open the **DNS** tab.
(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values
Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**
Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**
- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**
Click **Add** at the top of the data source page, to add data source filters.

**PostgreSQL data source example**
Here is an example of a PostgreSQL data source using Tableau Desktop on a Windows computer.
Presto

This topic describes how to connect Tableau to a Presto database and set up the data source. Tableau connects to Presto 141t from Teradata.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- User name

Make the connection and set up the data source

1. On the start page, under Connect, click Presto, and then do the following:
   1. Enter the name of the server you want to connect to.
   2. Enter the database name.
   3. Enter the user name to sign in to the database.
4. Click **Sign In**.
   If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Schema** drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the schema.
   3. In the **Table** text box, click the search icon or enter the table name and click the search icon, and then select the table.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.

   Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.example.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, add the domain to the list of Search Domains for the Mac computer. To update the list of Search Domains, go to **System Preferences** > **Network** > **Advanced**; then open the DNS tab. If you do this, then you need only provide the server name when connecting.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click **Add** next to **Connections**. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select **Data** > **New Data Source** to add a new data source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update**
Now again to see your changes.

- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

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Click **Add** at the top of the data source page, to add data source filters.

**Presto data source example**

Here is an example of a Presto data source using Tableau Desktop on a Windows computer:

![Presto Data Source Example](image)

**Progress OpenEdge**

This topic describes how to connect Tableau to a Progress OpenEdge database and set up the data source.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to
- Database name
- User name and password

Use this connector with Tableau Desktop on a Windows computer.
Make the connection and set up the data source

1. On the start page, under Connect, click Progress OpenEdge, and then do the following:
   1. Enter the name of the server that hosts the database you want to connect to.
   2. Enter the name of the database.
   3. Enter the user name and password, and then click Sign In.

      If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Under Table, select a table or use the text box to search for a table by name.
   3. Drag the table to the canvas, and then click the sheet tab to start your analysis.

      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.
Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select Create calculated field.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select Copy.

Connect to live data or use an extract

- If your data supports it, select Live or Extract under Connection at the top of the data source page.
- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click Add at the top of the data source page, to add data source filters.

Progress OpenEdge data source example

Here is an example of a Progress OpenEdge data source:
QuickBooks Online

This topic describes how to connect Tableau to QuickBooks Online data and set up the data source. It also describes an example of how to create a workbook with multiple user accounts and how to refresh the data in the workbook. Finally, you can review troubleshooting suggestions for QuickBooks Online errors.

**IMPORTANT**: For the latest information about this connector, see the current version of the [QuickBooks Online](https://www.intuit.com/quickbooks) Help topic.

Before you begin, gather this connection information:

- Your email address or user ID and password for your QuickBooks Online account

**Note**: To connect Tableau to QuickBooks Online data, you must be a Company Administrator on the QuickBooks Online company. Only one administrator per company can connect Tableau to QuickBooks Online.
Make the connection and set up a data source

1. On the start page, under **Connect**, click **QuickBooks Online**, and then do the following:
   1. Enter your email address or user ID and password for your QuickBooks Online account.
   2. Click **Sign In**.
      
      QuickBooks Online periodically prompts for two-step verification. If this happens, follow the prompts to get a code to confirm your Intuit account.
   3. If more than one company is associated with your account, select the company you want to connect to.
   4. Click **Authorize** to authorize Intuit to securely share your data with Tableau Desktop.
      
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Under **Sheets**, select a sheet and drag it to the top of the canvas.
   3. Click the sheet tab to start your analysis.
      
      After you click the sheet tab, Tableau imports the data by creating an extract. Note that Tableau Desktop supports only extracts for QuickBooks Online. You can update the data by refreshing the extract. For more information, see **Extract Your Data** on page 409.
      
      Creating extracts may take some time depending on the amount of data that is included.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data
View the data in the Tableau data source

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select **Hide**.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

Split columns

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select **Create calculated field**.

Copy values

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

Copy values in the metadata grid

Select the values, right-click, and then select **Copy**.

Connect to live data or use an extract

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source. For more information see, **Blend Your Data** on page 363.
source page.

- If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click Add at the top of the data source page, to add data source filters.

**Create a workbook that connects to multiple user accounts**

You may want to create a workbook that connects to multiple QuickBooks Online user accounts. When you do this, pay close attention to which account you are signed in to when you refresh the extract for each account.

Here is an example of the general process you follow to create and then refresh the data for a workbook that connects to user account A and user account B.

**Create the workbook**

1. Follow the steps in "Make a connection and set up a data source" section to connect to user account A.

2. Click the Tableau icon to open the Connect pane and repeat the steps to connect to user account B.

   Note that you are already signed in to user account A, but you want to sign in to user account B. To do this, on the "Authorize Intuit to securely share..." screen, in the upper-right corner, click "Not you?" to sign in with a different user account.

3. Create your view and then save this example as a packaged workbook (.twbx).

**Refresh the data in the workbook**

Open the workbook and sign in to each account.

1. When you sign in to user account A, be sure to select the correct company.

2. Refresh the extract.

3. When you sign in to user account B, remember that you are already signed in to user account A, so click the "Not you?" link to sign in with a different user account. Be sure to select the correct company.

4. Refresh the extract.

**Note:** Tableau refreshes the extract with data from the account you're signed in with and the company you select, so be sure that you've made the correct choices. If the company name is a dimension in the data, you can check it to confirm that the data is what you expect.
Troubleshoot QuickBooks Online errors

You might see one of the following errors when you try to connect Tableau to your QuickBooks Online data.

**Sorry, only administrators can buy apps…**

QuickBooks Online requires that each user who connects an app to QuickBooks Online be a Company Administrator. The following Intuit error appears if you are not an administrator on the company account:

```
Sorry, only administrators of <email address>'s Company can buy apps in the company. Please contact administrator in the company or else choose another company.
```

To resolve this issue, ask your company account owner to make you a Company Administrator on the account.

**Error Code: app_already_purchased**

Only one Company Administrator is allowed to connect per application, for example to Tableau Desktop. If someone in your company has already connected Tableau to your QuickBooks Online account, the following Intuit error appears:

```
Oops! An error has occurred. Please close this window and try again.

Error Code: app_already_purchased

Message: The application has already been subscribed to by another user for this company. Please contact <email address> to make changes to this subscription.
```

To resolve this issue, you need to ask that Company Administrator to give up the application privileges for Tableau Desktop and provide them to you. If that’s not possible, for example, because the administrator actively uses Tableau, another option is for the administrator to publish the data source to Tableau Server or Tableau Online, so that anyone with permission can access the data.

**Changing a Connection Opens the My Apps Page**

If you need to access another QuickBooks Online company, after you sign in (and possibly go through the two-step authentication process), Intuit might show the My Apps page, rather than the “select the company to connect to” page. To resolve this issue, follow these steps:

1. Close the My Apps page.
2. On the Tableau **Connect** pane, select QuickBooks Online.
3. If more than one company is associated with your account, select the company you
would like to connect to.

4. Click **Authorize** to open the Tableau data source page.

**QuickBooks Online data source example**

Here is an example of a QuickBooks Online data source using Tableau Desktop on a Windows computer:
Salesforce

This topic describes how to connect Tableau to Salesforce.com data and set up a data source.

Before you begin, gather this connection information:

- Salesforce user name and password

Use this connector with Tableau Desktop on a Windows computer.

Make the connection and set up the data source

1. On the start page, under Connect, click Salesforce, and then do the following:
   1. Enter your user name and password for Salesforce.com.
   2. Click Log In.
   3. In the Allow Access dialog box, click Allow.

      If the connection is unsuccessful, verify that the authentication information is correct. If the connection continues to fail, your computer is having trouble locating the server or you may not have permission to access the data. Contact your network administrator or Salesforce administrator.

2. On the data source page, do the following:

   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Select a standard connection or create your own custom connection.

      Under Standard Connection, you can select from a list of predefined queries, which represent commonly used objects, and drag it to the canvas. Or, under Table, you can select a single table, which includes any custom objects your company has created, and drag it to the canvas.

   3. Click the sheet tab to start your analysis.

After you click the sheet tab, Tableau imports the data by creating an extract. Note that Tableau Desktop supports only extracts for Salesforce. You can update the data by refreshing the extract. For more information, see Extract Your Data on page 409.

The initial extract may take some time depending on the amount of data that is included. After the initial extract, you can incrementally update objects by refreshing the extract.

Using Joins in Salesforce

When you set up the data source on the data source page, when you drag a table to the canvas, the list of tables you can select from to join is filtered. You can create joins on any string fields and on fields that are constrained references between tables. (Only left and inner joins
are supported.) You can also add joins later. For more information, see **Join Your Data** on page 349.

**Salesforce data source example**

Here is an example of a Salesforce data source:
After you log in and click **Allow** in step 1.3 above, Tableau imports the data by creating an extract. You can update the data by refreshing the extract. For more information, see **Extract Your Data** on page 409.

**Note:** The initial extract may take some time depending on the amount of data that is included. After the initial extract, you can incrementally update objects by refreshing the extract.

**Updated Salesforce API**

Beginning in Tableau 9.0, Salesforce extracts are created with a newer Salesforce API, version 30.0. When you attempt to do a full or incremental refresh on an extract created prior to Tableau 9.0 (which was created with an older version of the API), Tableau prompts you to either upgrade the extract to use the newer Salesforce API v, or continue to use the older Salesforce API. For more information on the benefits and considerations of upgrading, see **Upgrade to Salesforce API 30.0** in the Tableau Knowledge Base.

**Troubleshooting Salesforce Connections**

Tableau leverages the various force.com APIs to connect to Salesforce.com, Force.com, and Database.com data. These services have some restrictions on the type of data and the amount of data that you can access at a given time. If you are having trouble connecting, the following list of common restrictions may help you find a solution.

**Company Account and User Profile Configuration**

In order for Tableau to connect to Salesforce data, all of the following must be enabled on both your company’s account and your user profile:

- SOAP API for signing in
- REST API for getting meta data
- BULK API for downloading objects
- REST API for downloading objects that the BULK API does not support
- Replication SOAP APIs for retrieving changes in the data

In order to optimize for performance and ensure the APIs are available for all of their customers, Salesforce.com balances the load by limiting the number of concurrent API requests as well as limiting the total number of API requests overall. An error occurs if these limits are reached while connected using Tableau. See the Salesforce.com developer documentation to learn more about these limits.

Some editions of Salesforce may not allow API access at all. Contact your Salesforce administrator to verify that your account has access to the above list of APIs.
Errors During Extract

When you connect to Salesforce using Tableau, the data is automatically extracted into a Tableau Data Extract file. In some cases, certain fields cannot be extracted because of character limits. Specifically, text fields that are greater than 4096 characters and calculated fields will not be included in the extract. If you have calculated fields in your data, you will need to recreate them in Tableau after creating the extract.

In addition, the Force.com API restricts queries to 10,000 total characters.

Splunk

This topic describes how to connect Tableau to Splunk data and set up a data source.

Before you begin, gather this connection information:

- Server URL, including the name of the database, if there are multiple databases
- User name and password

Use this connector with Tableau Desktop on a Windows computer.

Make the connection and set up the data source

1. On the start page, under **Connect**, click **Splunk**, and then do the following:
   
   1. Enter the server URL. You should use HTTPS to connect to Splunk data.
      
      If your server contains multiple databases, enter the name of a specific database on the server.
      
      **Note:** Database names are case sensitive.

      2. Enter your user name and password, and then click **Sign In**.
      
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:

   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

   2. **Saved Search**, enter a saved search name in the text box or select a saved search from the list, and drag it to the box at the top of the data source page.

   3. Click the sheet tab to start your analysis.
Splunk data source example

Here is an example of a Splunk data source:

SAP HANA

This topic describes how to connect Tableau to an SAP HANA database, pass an option to the Java virtual machine (JVM), install trusted SSL certificates, and select variables and input parameters.

Before you begin, gather this connection information:

- Name of server that hosts the database you want to connect to
- Authentication method:
  - Windows: Windows Authentication or user name and password
  - Mac: Kerberos or user name and password
- Are you connecting to an SSL server?
- (Optional) Initial SQL statement to run every time Tableau connects

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **SAP HANA**, and then do the following:
   1. Enter the name of the server that hosts the database you want to connect to.
   2. Specify how you want to sign in to the server:
      - **On Windows**
        Select **Use Windows Authentication** if your environment supports single sign-on (SSO). For more information, see [Quick Start: SAP HANA Single Sign-On on page 1488](#). **Note:** Tableau Desktop requires SAP HANA driver version 1.00.85 and later to support SSO for SAP HANA on Windows.
        Or, select **Use a specific username and password**. If the server is password protected and you are not in a Kerberos environment, you must enter the user name and password.
      - **On Mac**
        Select **Kerberos** or select **Use a specific username and password**.
   3. (Optional) Click **Initial SQL** to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see [Run Initial SQL on page 343](#).
   4. Click **Sign In**.
      Select the **Require SSL** check box when connecting to an SSL server.
      If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Schema** drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the schema.
   3. In the **Table** text box, click the search icon or enter the table name and click the search icon, and then select the table.
   4. Drag the table to the canvas, and then click the sheet tab to start your analysis.
By default, column labels are displayed instead of column names.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Note:** When you create a self-join with an analytic view, if one of the tables contains variables, make sure that the table with variables is on the left. Otherwise, the join may not return the expected results.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.example.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, add the domain to the list of Search Domains for the Mac computer. To update the list of Search Domains, go to **System Preferences > Network > Advanced**; then open the DNS tab. If you do this, then you need only provide the server name when connecting.

**Pass an option to the JVM on a Mac**

To connect Tableau Desktop on a Mac to SAP HANA, you must have Java installed on your Mac. For more information, see SAP HANA on the Drivers and Activation page.

If you’re familiar with how to pass a system property to the Java virtual machine (JVM), and you are using an Oracle JVM, you can use the environment variable `_JAVA_OPTIONS` to override the default options.

The `_JAVA_OPTIONS` variable takes a string, which is equivalent to command-line JVM arguments. The following example sets the maximum heap size to 256 MB, and specifies the path to the Kerberos configuration file:

```bash
export _JAVA_OPTIONS="-Xmx256m -Dsun.security.krb5.conf=/etc/krb5.conf"
```

Tableau starts the JVM with the following default options:

- `-Xmx512m`
  
  Sets the maximum heap size to 512 MB

- `sun.security.jgss.native=true`
  
  Forces the JVM to delegate Kerberos authentication to the operating system library

If the default options don’t work, you can use one of the following options to configure Kerberos authentication:

```bash
sun.security.krb5.conf
```
java.security.krb5.realm
java.security.krb5.kdc5.conf
sun.security.jgss.native

Install trusted SSL certificates on a Mac

If you want to use SSL/TLS to encrypt communications between Tableau Desktop and your database, you may need to add certificates to the Java certificate trust store. This is required if your database uses self-signed certificates.

1. Start the Terminal application, and navigate to your Java Home directory, which is usually located at /Library/Internet Plug-Ins/JavaAppletPlugin.plugin/Contents/Home, unless you have installed the JDK or set the JAVA_HOME environment variable.

2. Run the following command. (You might need to use the sudo Terminal command, which is used by administrators to execute commands as a different user, such as root).

    bin/keytool -importcert -keystore cacerts -alias <certificate name> -file <path to certificate file>

You can now connect Tableau Desktop to your database using SSL/TLS.

For more information on installing trusted certificates, consult the documentation for your Java Runtime Environment.

Select variables and input parameters

If the table you use includes required or optional variables or parameters, the Variables and Input Parameters dialog box opens.
- Required variables and parameters display their current value or *Required.*
- Optional variables and parameters display their current value or are blank.
- Prompt for the variable when the workbook is opened by selecting the check box under Prompt.

Select a variable or parameter and type or select a value for it. Repeat for all required values and any optional values that you want to include, and then click OK.

For more information, see Work with SAP BW Variables and SAP HANA Variables and Input Parameters in the Tableau Knowledge Base.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.

To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data**
source

Click **Add** at the top of the data source page, to add data source filters.

**SAP HANA data source example**

Here is an example of an SAP HANA data source using Tableau Desktop on a Windows computer.

---

**SAP NetWeaver Business Warehouse**

This topic describes how to connect Tableau to an SAP NetWeaver Business Warehouse (BW) data source.

Before you begin, gather this connection information:
- Connection name
- User name and password
- (Optional) Client for BW system
- (Optional) Language

Use this connector with Tableau Desktop on a Windows computer.

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **SAP NetWeaver Business Warehouse**, and then do the following:
   
   1. Select a connection from the drop-down list.
      
      A connection appears in the drop-down list if a system entry exists for it. You can create a new system entry using the SAP Logon utility, or contact your database administrator.
   
   2. Enter the user name and password to sign in to the server. Optionally, enter the **Client ID** for the BW system and the **Language**.
   
   3. Click **Sign In**.
      
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   
   2. Select a catalog or InfoProvider.
   
   3. Select a cube or query.
   
   4. Click the sheet tab to start your analysis.

**Select Variables and Input Parameters**

If the table you use includes required or optional variables or parameters, the Variables and Input Parameters dialog box opens.
- Required variables and parameters display their current value or *Required.*
- Optional variables and parameters display their current value or are blank.
- Prompt for the variable when the workbook is opened by selecting the check box under Prompt.

Select a variable or parameter and type or select a value for it. Repeat for all required values and any optional values that you want to include, and then click OK.

For more information, see Work with SAP BW Variables and SAP HANA Variables and Input Parameters in the Tableau Knowledge Base.

**Select the Alias for a Dimension**

When you connect to SAP NetWeaver Business Warehouse (SAP BW) databases, you have the option to select which alias to use for dimensions. SAP BW offers a number of different options including long name, short name, medium name, and key. Sometimes the alias used by default is not very useful. You can right-click the dimension and change it to another option such as Short Name, which changes the labels to something more meaningful.
SAP BW data source example

Here is an example of an SAP BW data source:
For more information about connecting to SAP NetWeaver Business Warehouse databases, see Connecting to SAP BW in the Tableau Knowledge Base.

For information about using SAP BW extracts and their limitations, see SAP BW Extract Limitations in the Tableau Knowledge Base.

**SAP Sybase ASE**

This topic describes how to connect Tableau to an SAP Sybase ASE database and set up the data source. Tableau connects to Sybase ASE version 15.2 and later.

Before you begin, gather this connection information:

- Name of the server you want to connect to and port number
- User name and password
- (Optional) Initial SQL statement to run every time Tableau connects
Use this connector with Tableau Desktop on a Windows computer.

**Make the connection and set up the data source**

1. On the start page, under **Connect**, click **SAP Sybase ASE**, and then do the following:
   1. Enter the name of the server you want to connect to, and specify the port to use.
   2. Enter the user name and password.
   3. (Optional) Click **Initial SQL** to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see **Run Initial SQL** on page 343.
4. Click **Sign In**.

   If Tableau can’t make the connection, verify that your credentials are correct. If you still can’t connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Database** drop-down list, select a database or use the text box to search for a database by name.
   3. From the **Schema** drop-down list, select a schema or use the text box to search for a schema by name.
   4. Under **Table**, select a table or use the text box to search for a table by name.

      You can also specify a stored procedure in the database. To access stored procedures, the database must be appropriately configured with a linked server, which could be a remote server or a pointer to the database itself (known as loopback). For more information, see **Use a Stored Procedure** on page 394.
   5. Drag a table or stored procedure to the canvas, and then click the sheet tab to start your analysis.

      Use custom SQL to connect to a specific query rather than the entire data source. For more information, see **Connect to a Custom SQL Query** on page 389.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**
- Click **Add** next to **Connections**. For more information, see **Join Your Data** on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, **Blend Your Data** on page 363.

**View the data in the Tableau data source**
- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**
- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**
- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.
Connect to live data or use an extract

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

Add data source filters to restrict the visibility and use of the fields in the data source

Click **Add** at the top of the data source page, to add data source filters.

**SAP Sybase ASE data source example**

Here is an example of an SAP Sybase ASE data source:
SAP Sybase IQ

This topic describes how to connect Tableau to a SAP Sybase IQ database and set up the data source.

Before you begin, gather this connection information:

- Name of the host that hosts the database you want to connect to
- Server name
- Authentication method: Windows Authentication or user name and password

Use this connector with Tableau Desktop on a Windows computer.

Make the connection and set up the data source

1. On the start page, under Connect, click SAP Sybase IQ, and then do the following:
   1. Enter the host name that hosts the database that you want to connect to.
   2. Enter the server name.
   3. Select how you want to sign in to the server. Specify whether to use Windows Authentication or a specific user name and password. If the server is password protected, you must enter the user name and password.
   4. Click Sign In.

      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the Database drop-down list, select a database or use the text box to search for a database by name.
   3. Under Table, select a table or use the text box to search for a table by name.
   4. Drag a table to the top area of the data source page, and then click the sheet tab to start your analysis.

      Use custom SQL to connect to a specific query rather than the entire data source.
      For more information, see Connect to a Custom SQL Query on page 389.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:
Get more data from different databases

- Click **Add** next to **Connections**. For more information, see [Join Your Data](#) on page 349.
- If a connection you want is not listed, select **Data > New Data Source** to add a new data source. For more information see, [Blend Your Data](#) on page 363.

View the data in the Tableau data source

- In the grid, click **Update Now** to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click **Update Now** again to see your changes.
- To have changes automatically reflect in the grid, click **Automatically Update**.

Manage metadata

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the **Sort fields** drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select **Hide**.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select **Reset Name**.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see [Split a Field into Multiple Fields](#) on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**
Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**SAP Sybase IQ data source example**

Here is an example of an SAP Sybase IQ data source:
Snowflake

This topic describes how to connect Tableau to a Snowflake data warehouse and set up the data source.

Before you begin, gather this connection information:

- Name of the server name that you want to connect to
- User name and password
- (Optional) Initial SQL statement to run every time Tableau connects

Make the connection and set up the data source

1. On the start page, under **Connect**, click **Snowflake**, and then do the following:
   1. Enter the name of the server that you want to connect to.
   2. Enter your user name and password, and then click **Sign In**.
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.
   3. (Optional) Click **Initial SQL** to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see Run Initial SQL on page 343.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Warehouse** drop-down list, select the warehouse or use the text box to search for a warehouse by name.
   3. From the **Database** drop-down list, select a database or use the text box to search for a database by name.
   4. From the **Schema** drop-down list, select a schema or use the text box to search for a schema by name.
   5. Under **Table**, select a table or use the text box to search for a table by name.
   6. Drag a table to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.
**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

**(Optional) Review and manage the data source**

You can make the following changes before you start your analysis:

**Get more data from different databases**

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

**View the data in the Tableau data source**

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

**Manage metadata**

Click the metadata grid button to perform routine management tasks.

**Sort fields and rows**

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

**Hide a field**

Click the column drop-down arrow and select Hide.

**Rename a field**

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.
**Split columns**

If your data supports split, click the column drop-down arrow, and then select **Split**. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see **Split a Field into Multiple Fields** on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**Snowflake data source example**

Here is an example of a Snowflake data source using Tableau Desktop on a Windows computer.
Spark SQL

This topic describes how to connect Tableau to a Spark SQL database and set up the data source. Tableau can connect to Spark version 1.2.1 and later.

**Note:** On Windows, you can use the Spark SQL connector to connect to a Spark cluster on Azure HDInsight. To do this, install the Spark on Azure HDInsight drivers.

Before you begin, gather this connection information:

- Name of the server that hosts the database you want to connect to and port number
- Authentication method:
  - No Authentication
  - User Name
  - User Name and Password
  - User Name and Password (SSL)
- Microsoft Azure HDInsight Emulator
- Microsoft Azure HDInsight Service
- HTTP
- HTTPS
- Sign-in credentials. Your choices depend on the authentication method you choose, and can include the following:
  - User name
  - Password
  - HTTP Path
- (Optional) Initial SQL statement to run every time Tableau connects

Make the connection and set up the data source

1. On the start page, under **Connect**, click **Spark SQL**, and then do the following:
   1. Enter the name of the server that hosts the database and the port number to use.
   2. Connect to the database using SparkThriftServer. Note that the legacy SharkServer and SharkServer2 connections are provided for your use, but are not supported by Tableau.
   3. (Optional) Click **Initial SQL** to specify a SQL command to run at the beginning of every connection, such as when you open the workbook, refresh an extract, sign in to Tableau Server, or publish to Tableau Server. For more information, see **Run Initial SQL** on page 343.
   4. Click **Sign In**.
      
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. From the **Schema** drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the schema.
   3. In the **Table** text box, click the search icon or enter the table name and click the search icon, drag the table to the canvas, and then click the sheet tab to start your analysis.
Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

Sign in on a Mac

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.

Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the column drop-down arrow and select Hide.

Rename a field
• Double-click the field name.

• To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

**Split columns**

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.

**Create a new calculation based on an existing field in the data source**

Click the column drop-down arrow and select Create calculated field.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select Copy.

**Connect to live data or use an extract**

• If your data supports it, select Live or Extract under Connection at the top of the data source page.

• If you choose to create an extract, click the Edit link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click Add at the top of the data source page, to add data source filters.

**Spark SQL data source example**

Here is an example of a Spark SQL data source using Tableau Desktop on a Windows computer.
Teradata

This topic describes how to connect Tableau to a Teradata database or a Teradata Unity server and set up the data source.

Before you begin, gather this connection information:

- For Teradata database: Name of the server you want to connect to
- For Teradata Unity server: URL of the server you want to connect to
- Authentication method: Teradata Database, LDAP, or Integrated Authentication
- Depending on the environment, the user name and password

Make the connection and set up the data source

1. On the start page, under Connect, click Teradata, and then do the following:
   1. Enter the name of the server that hosts the database you want to connect to.

   Note: You can connect to a Teradata Unity server by entering the appropriate URL in the Server text box.
2. Select how you want to sign in to the server. Specify whether to use the built-in Teradata Database authentication, LDAP, or Integrated Authentication.

If the server is password protected, and you are not in a Kerberos environment, you must select Teradata Database or LDAP and enter the user name and password.

3. (Optional) Click Query Banding and Initial SQL.

Query banding enables you to pass parameters into the Teradata environment. For more information, see Advanced Teradata Options on page 1347. Additionally, you can specify a SQL command that will be run once upon connection. For more information, see Run Initial SQL on page 343.

4. Click Sign In.

If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.

2. On the data source page, do the following:

1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.

2. From the Database drop-down list, click the search icon or enter the schema name in the text box and click the search icon, and then select the database.

3. In the Table text box, click the search icon or enter the table name and click the search icon, and then select the table.

You can also specify a stored procedure in the database. For more information and for a list of constraints specific to Teradata databases, see Use a Stored Procedure on page 394.

4. Drag the table or stored procedure to the canvas, and then click the sheet tab to start your analysis.

Use custom SQL to connect to a specific query rather than the entire data source. For more information, see Connect to a Custom SQL Query on page 389.

**Sign in on a Mac**

If you use Tableau Desktop on a Mac, when you enter the server name to connect, use a fully qualified domain name, such as mydb.test.ourdomain.lan, instead of a relative domain name, such as mydb or mydb.test.
Alternatively, you can add the domain to the list of Search Domains for the Mac computer so that when you connect, you need to provide only the server name. To update the list of Search Domains, go to System Preferences > Network > Advanced, and then open the DNS tab.

(Optional) Review and manage the data source

You can make the following changes before you start your analysis:

Get more data from different databases

- Click Add next to Connections. For more information, see Join Your Data on page 349.
- If a connection you want is not listed, select Data > New Data Source to add a new data source. For more information see, Blend Your Data on page 363.

View the data in the Tableau data source

- In the grid, click Update Now to preview the first 1,000 rows of your data.
- If you add tables, remove tables, or make changes to the join conditions, click Update Now again to see your changes.
- To have changes automatically reflect in the grid, click Automatically Update.

Manage metadata

Click the metadata grid button to perform routine management tasks.

Sort fields and rows

- Select how you want to sort the columns in the grid or metadata grid from the Sort fields drop-down list. You can sort the columns by data source or table order.
- In the grid view, sort the row values by clicking the sort button next to the column name.

Hide a field

Click the field drop-down arrow and select Hide.

Rename a field

- Double-click the field name.
- To revert back to the original name of the field, select a column or multiple columns, click the column drop-down arrow, and then select Reset Name.

Split columns

If your data supports split, click the column drop-down arrow, and then select Split. In some cases, you need to check for Split on the Data pane in the worksheet. For more information, see Split a Field into Multiple Fields on page 403.
Create a new calculation based on an existing field in the data source

Click the column drop-down arrow and select **Create calculated field**.

**Copy values**

Select the values in the grid and then press Ctrl+C (Command-C on a Mac).

**Copy values in the metadata grid**

Select the values, right-click, and then select **Copy**.

**Connect to live data or use an extract**

- If your data supports it, select **Live** or **Extract** under **Connection** at the top of the data source page.
- If you choose to create an extract, click the **Edit** link that appears to set up filters that define a subset of the data to include in the extract.

**Add data source filters to restrict the visibility and use of the fields in the data source**

Click **Add** at the top of the data source page, to add data source filters.

**Teradata data source example**

Here is an example of a Teradata data source using Tableau Desktop on a Windows computer.
Advanced Teradata Options

When connecting to Teradata databases you can optionally set up query bands and initial sql. These advanced options are used to increase performance and take advantage of the built in security rules of the database.

Query Bands

When connecting to a Teradata database, you can optionally define query band statements that run during connection. Query banding allows you to pass parameters into the Teradata environment. Use these to set up a workbook to filter the data based on security rules that exist in the database. For example, you can pass in the Tableau Server user name for the current user so when the view is loaded it only shows the data specific to that user. Query bands can also be used to improve performance. When connecting to Teradata, you can define a map between the name of the attributes passed into the query band and the corresponding values from Tableau.

To set up query banding:
1. On the data source page, select **Data > Query Banding and Initial SQL**.
2. In the subsequent dialog box, specify name/value pairs in the top text box labeled Query Banding. You can use the **Insert** drop-down menu to add Tableau values. The Tableau values are described in the table below.

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>&lt;TableauMode&gt;</code></td>
<td>The mode Tableau is operating in when generating queries. This value will either be “Connect” when retrieving metadata or “Analytical” when retrieving actual data.</td>
<td>Connect or Analytical</td>
</tr>
<tr>
<td><code>&lt;LoginUser&gt;</code></td>
<td>The user name of the person signed in to the database.</td>
<td>jsmith</td>
</tr>
<tr>
<td><code>&lt;ServerUser&gt;</code></td>
<td>The signed-in Server user. Does not include domain name.</td>
<td>jsmith</td>
</tr>
</tbody>
</table>

**Note:**
ProxyUser returns the same value as ServerUser. However, ProxyUser sets up impersonation and stores the Tableau Server user in the query band.
<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>parameter. If you are using query banding for security purposes, you should use ProxyUser instead. This will ensure that query results are not shared between different users. ServerUser should only be used for auditing purposes.</td>
<td></td>
</tr>
<tr>
<td>&lt;ServerUserFull&gt;</td>
<td>The signed-in server user including the domain name (if the server is using Active Directory).</td>
<td>domain.lan\jsmith</td>
</tr>
</tbody>
</table>

**Note:**
ProxyUser Full returns the same value as ServerUser
<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>rFull.</td>
<td>However, ProxyUser Full sets up impersonation and stores the Tableau Server user in the query band parameter. If you are using query banding for security purposes, you should use ProxyUser Full instead. This will ensure that query results are not shared between different users. ServerUse rFull should only be used for auditing purposes.</td>
<td></td>
</tr>
<tr>
<td>&lt;ProxyUser&gt;</td>
<td>Used when setting up impersonation on the server. Provides the authentication credentials for the server.</td>
<td>jsmith</td>
</tr>
<tr>
<td>Value</td>
<td>Description</td>
<td>Example</td>
</tr>
<tr>
<td>-------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------</td>
</tr>
<tr>
<td>username</td>
<td>username of the current server user.</td>
<td></td>
</tr>
<tr>
<td>&lt;ProxyUserFull&gt;</td>
<td>Used when setting up impersonation on the server. Provides the username and</td>
<td>domain.lan\jsmith</td>
</tr>
<tr>
<td></td>
<td>domain name of the current server user.</td>
<td></td>
</tr>
<tr>
<td>&lt;TableauApp&gt;</td>
<td>The name of the Tableau application.</td>
<td>Tableau Desktop Professional or Tableau Server</td>
</tr>
<tr>
<td>&lt;TableauVersion&gt;</td>
<td>The version of the Tableau application.</td>
<td>6100.11.0428.0300</td>
</tr>
<tr>
<td>&lt;WorkbookName&gt;</td>
<td>The name of the workbook.</td>
<td>Financial-Analysis</td>
</tr>
</tbody>
</table>

An example query band statement is shown below. This example passes the user name for the current server user.

```plaintext
Applic-ationName-=<TableauApp>Version=<TableauVersion>ProxyUser=<ProxyUser>TableauMode=<TableauMode>
```

Tableau checks the statement for errors as you type. When it is valid a green check mark displays at the bottom of the text box.
Initial SQL

When connecting to Teradata databases, you can optionally specify a SQL command that will be run once upon connection. See Run Initial SQL on page 343 to learn more about adding these commands to your connection.

**Note:** If Tableau detects that the Initial SQL payload cannot be delivered in one query, it attempts to split the query into separate statements, where each statement must end with a semicolon followed by a newline character, with no additional characters (such as an extra space) in between. This requirement is important because if a semicolon exists within the interior of a statement, for example within a string literal, it may not be safe to split the statement at that point. If the Initial SQL code that you specify in Tableau returns an error, and the same Initial SQL is deemed valid by the Teradata databases, it may be that Tableau has split the query incorrectly. If this happens, try reformatting the SQL code in Tableau manually.

Teradata OLAP Connector

This topic describes how to establish a Teradata OLAP connection.
Before you begin, gather this connection information:

- Connection name
- User name and password

Use this connector with Tableau Desktop on a Windows computer.

When you connect to Teradata OLAP data, you select from a list of connections, each representing a system data source name (DSN). A connection appears in the drop-down list if a system DSN exists for that connection. You can use the Windows ODBC Data Source Administrator utility to create a system DSN, or contact your database administrator.

Make the connection and set up the data source

1. On the start page, under Connect, click Teradata OLAP Connector, and then do the following:
   1. Select a connection from the drop-down list.
   2. Enter your user name and password to log on to the server.
      If Tableau can't make the connection, verify that your credentials are correct. If you still can't connect, your computer is having trouble locating the server. Contact your network administrator or database administrator.
   3. Click Sign In.

2. On the data source page, do the following:
   1. (Optional) Click the default data source name at the top of the page, and then enter a unique data source name for use in Tableau. For example, use a data source naming convention that helps other users of the data source figure out which data source to connect to.
   2. Select a catalog.
   3. Select a cube from the catalog.
   4. Click the sheet tab to start your analysis.

Named sets from a Teradata OLAP data source are displayed in the Sets area of the Data pane in Tableau. You can interact with these named sets in the same way you interact with other custom sets in Tableau. For more information, see Sets on page 473. You can view underlying data for Teradata OLAP data sources, provided the database administrator has enabled this functionality. For more information, see View Data on page 529.

Teradata OLAP connection example

Here is an example of a Teradata OLAP connection:
Web Data Connector

This topic describes web data connectors, what to do before you use a connector, and how to connect Tableau to a web data connector.

You can use a web data connector to connect to data that is accessible over HTTP and that doesn't already have a connector. A web data connector is an HTML file that includes JavaScript code. You can create your own web data connector or use one that has been created by someone else. The web data connector must be hosted on a web server running locally on your computer, on a third-party web server, or on Tableau Server.

Test and vet the web data connector

You should use a web data connector that you trust. If you are unfamiliar with the web data connector, you or your Tableau Server administrator should test and vet the web data
connector before you use it. For more information, see Testing and Vetting Web Data Connectors in the Tableau Server documentation.

**When to use an imported web data connector**

When you use a web data connector, Tableau creates an extract of the data that the connector accesses. You can refresh the extract in Tableau Desktop.

When you publish the data source or workbook to Tableau Server, you cannot refresh the extract on Tableau Server unless the web data connector was imported to Tableau Server before you used it. For more information, see Web Data Connectors in Tableau Server in the Tableau Server Help.

The import process results in a URL where the web data connector is available on Tableau Server. The server administrator should give this URL to you and to anyone else who wants to use the connector in a workbook.

If you open a workbook on Tableau Server that was created using a web data connector, but the connector has not been imported to Tableau Server, and you want to be able to refresh the extract on Tableau Server, follow the process for testing, vetting, and importing the connector. Then, in your workbook, edit the connection and change the URL of the connector to the URL provided by Tableau Server. You can then refresh your data on Tableau Server.

When you publish to Tableau Online, as a security measure, Tableau Online can't connect to or refresh an extract created by a web data connector. To refresh a web data connector extract, you use the sync client. For more information, see Schedule Refreshes Using the Sync Client in the Tableau Online Help.

**Connect to the data source**

1. On the start page, under Connect, click **Web Data Connector**.
2. Enter the URL of the web data connector that you want to connect to, and then press Enter.
   
   **Note:** If you enter a URL to a website, rather than to a web data connector, an error message will appear.

3. If the connector displays a webpage, enter any information that you’re prompted for, and then submit the page.
4. Wait while the connector retrieves your data and imports it into Tableau as an extract.
5. Click the sheet tab to start your analysis.
Optional settings

After you connect, you can make the following configuration changes to the data source before you start your analysis.

- **Sort fields and rows** – From the **Sort fields** drop-down list, select how you want to sort the columns in the grid or metadata grid. Sort the row values by clicking the sort button next to the column name.

- **Rename or hide columns** – Click the column header drop-down arrow and select the option you want.

- **Split columns** – Depending on how the data is structured, you can split the columns in your data into new fields. For more information, see **Split a Field into Multiple Fields** on page 403.

- **Create calculations** – Create a new calculation based on an existing field in the data source.

- **Copy values** – Copy values in the grid by selecting the values and then pressing Ctrl+C. Alternatively, to copy values in the metadata grid, select the values, right-click, and then select **Copy**.

- **Add new or edit other data sources** – Click the drop-down arrow next to the data source.

**Web data connector data source example**

An example of a web data connector data source is shown below. The first time you connect to a web data connector, the connection page outlines how to connect to the web data connector.

After you connect to a web data connector, on the connection page, you can do the following:

- View a history of all the web data connectors that you’ve connected to, or clear the history, in the drop-down list in the address bar.

- View your five most recently used connectors under Recent Connectors.

- Click links at the bottom on the window to learn more about web data connectors:
  - **What's this?** links to an overview of this feature.
  - **Use a connector** links to this topic.
  - **Build a connector** links to the Web Data Connector SDK, which provides tools and documentation for building a web data connector.
Other Databases (ODBC)

You can see the file and database types that are supported by Tableau Desktop listed on the start page, under Connect. For the various files and database types you see listed, Tableau has implemented customized techniques and capabilities so that you can get the most from your data.
Note: This data source option is supported only for Tableau Desktop on Windows computers.

If your file or database type is not listed, you may be able to use the general ODBC standard for connecting Tableau Desktop to your data. To connect to your data using the ODBC driver, do the following:

1. On the start page, under Connect, click Other Databases (ODBC).
2. Enter the information required to make the connection.

Note: If table or schema names are not listed, click the search icon or enter the name in the text box and click the search icon, and then select the name.

For more information, see Tableau and ODBC in the Tableau Knowledge Base.

Important: When you use an ODBC driver to connect to an unsupported database, the outcome may vary and compatibility with Tableau Desktop features is not guaranteed.

Functions, Operators, & Data Types

This section explains how to use and combine the various data types supported by Tableau. In addition, this section discusses how to format and use the building blocks of formulas in Tableau. These parts include literal expressions, functions, and operators.

All of these features are important to understand when you create custom fields such as calculations.

Data Types

Tableau supports string, date/datetime, number, and boolean data types. These data types are automatically handled in the proper fashion. However, if you create calculated fields of your own, you need to be aware of how to use and combine the different data types in formulas. For example, you cannot add a string to a number. Also, many functions that are available to you when you define a calculation only work when they are applied to specific data types. For example, the DATEPART() function can accept only a date/datetime data type as an argument. So, you can write DATEPART('year',#April 15,2004#) and expect a valid result: 2004. You cannot write DATEPART('year','Tom Sawyer') and expect a valid result. In fact, this example returns an error because "Tom Sawyer" is a string, not a date/datetime.

Although Tableau will attempt to fully validate all calculations, some data type errors cannot be found until the query is run against the database. These issues appear as error dialogs at the time of the query rather than in the calculation dialog box.
The data types supported by Tableau are described below. Refer to Type Conversion on page 1378 to learn about converting from one data type to another.

**STRING**
A sequence of zero or more characters. For example, "Wisconsin", "ID-44400", and "Tom Sawyer" are all strings. Strings are recognized by single or double quotes. The quote character itself can be included in a string by repeating it. For example, 'O''Hanrahan'.

**DATE/DATETIME**
A date or a datetime. For example "January 23, 1972" or "January 23, 1972 12:32:00 AM". If you would like a date written in long-hand style to be interpreted as a a date/datetime, place the # sign on either side of it. For instance, "January 23, 1972" is treated as a string data type but #January 23, 1972# is treated as a date/datetime data type.

**NUMBER**
Numerical values in Tableau can be either integers or floating-point numbers.

With floating-point numbers, results of some aggregations may not always be exactly as expected. For example, you may find that the SUM function returns a value such as -1.42e-14 for a column of numbers that you know should sum to exactly 0. This happens because the Institute of Electrical and Electronics Engineers (IEEE) 754 floating-point standard requires that numbers be stored in binary format, which means that numbers are sometimes rounded at extremely fine levels of precision. You can eliminate this potential distraction by using the ROUND function (see Number Functions on page 1361 or by formatting the number to show fewer decimal places.

Operations that test floating point values for equality can behave unpredictably for the same reason. Such comparisons can occur when using level of detail expressions as dimensions, in categorical filtering, creating ad-hoc groups, creating IN/OUT sets, and with data blending.

Note: The largest signed 64-bit integer is 9,223,372,036,854,775,807. When connecting to a new data source, any column with data type set to Number (Whole), can accommodate values up to this limit; for larger values, Tableau will use floating point.

**BOOLEAN**
A field that contains the values TRUE or FALSE. An unknown value arises when the result of a comparison is unknown. For example, the expression 7 > Null yields unknown. Unknown booleans are automatically converted to Null.
Formatting Literals

When you are using functions you will sometimes want to use literal expressions to represent numbers, strings, dates, and more. A literal expression signifies a constant value that is represented “as is.” For example, you may have a function where your input is a date. Rather than just type “May 1, 2005”, which would be interpreted a a string, you would type #May 1, 2005#, which is equivalent to using a date function to convert the argument from a string to a date (refer to Date Functions on page 1374). You can use numeric, string, date, boolean, and Null literals. The way to format each of these literals is described below.

Numeric Literals

A numeric literal is written exactly like you usually write numbers. If you want to input the number one as a numeric literal you would type 1. Subsequently, if you want to input the number 3.1415 as a numeric literal you would type 3.1415.

String Literals

A string literal can be written either using single quotations or double quotations. If your string has a single or double quotation within it, simply type the symbol twice. For example, if you wanted to input the string “cat” as a string literal you could type ‘cat’ or “cat”. Additionally, if you want to type the string “She’s my friend.” as a string literal you could type ‘She’’s my friend.’ or “She’s my friend.”

Date Literals

Date literals are signified by the pound symbol (#). If you wanted to input the date “August 22, 2005” as a literal date you would type #August 22, 2005#.

Boolean Literals

Boolean literals are written as either true or false. If you wanted to input “true” as a boolean literal you would type true.

Null Literals

Null literals are written simply as Null. If you wanted to input “Null” as a Null literal you would type Null.

Functions

The calculation functions are grouped into categories. These are the same categories used in the calculation editor. The aggregate functions such as sum, average, and so on are described in Aggregations on page 322.

For information on calculations, see Calculated Fields on page 746.
Number Functions

ABS(number)
Returns the absolute value of the given number.

Examples
ABS(-7) = 7
ABS([Budget Variance])
The second example returns the absolute value for all the numbers contained in the Budget Variance field.

ACOS(number)
Returns the arc cosine of the given number. The result is in radians.

Example
ACOS(-1) = 3.14159265358979

ASIN(number)
Returns the arc sine of a given number. The result is in radians.

Example
ASIN(1) = 1.5707963267949

ATAN(number)
Returns the arc tangent of a given number. The result is in radians.

Example
ATAN(180) = 1.5652408283942

ATAN2(y number, x number)
Returns the arc tangent of two given numbers (x and y). The result is in radians.

Example
ATAN2(2, 1) = 1.10714871779409

CEILING(number)
Rounds a number to the nearest integer of equal or greater value.

Example
CEILING(3.1415) = 4

Availability by data source
<table>
<thead>
<tr>
<th>Data Source</th>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Access</td>
<td>Not supported</td>
</tr>
<tr>
<td>Microsoft Excel</td>
<td>Supported</td>
</tr>
<tr>
<td>Text File</td>
<td>Supported</td>
</tr>
<tr>
<td>Statistical File</td>
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</tr>
<tr>
<td>Tableau Server</td>
<td>Supported</td>
</tr>
<tr>
<td>Actian Vectorwise</td>
<td>Not supported</td>
</tr>
<tr>
<td>Amazon Aurora</td>
<td>Not supported</td>
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<tr>
<td>Amazon EMR</td>
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<tr>
<td>Amazon Redshift</td>
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<tr>
<td>Aster Database</td>
<td>Not supported</td>
</tr>
<tr>
<td>Cloudera Hadoop</td>
<td>Supported</td>
</tr>
<tr>
<td>DataStax Enterprise</td>
<td>Supported</td>
</tr>
<tr>
<td>EXASolution</td>
<td>Not supported</td>
</tr>
<tr>
<td>Firebird</td>
<td>Not supported</td>
</tr>
<tr>
<td>Google Analytics</td>
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<tr>
<td>Google BigQuery</td>
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<tr>
<td>Hortonworks Hadoop Hive</td>
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<tr>
<td>HP Vertica</td>
<td>Not supported</td>
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<tr>
<td>IBM BigInsights</td>
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<tr>
<td>IBM DB2</td>
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<tr>
<td>IBM Netezza</td>
<td>Not supported</td>
</tr>
<tr>
<td>Database/Tool</td>
<td>Support</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>MapR Hadoop Hive</td>
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</tr>
<tr>
<td>MarkLogic</td>
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</tr>
<tr>
<td>Microsoft Analysis Services</td>
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<tr>
<td>Microsoft PowerPivot</td>
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<td>Oracle Essbase</td>
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<td>Salesforce</td>
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<tr>
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<tr>
<td>Splunk</td>
<td>Not supported</td>
</tr>
<tr>
<td>Teradata</td>
<td>Not supported</td>
</tr>
<tr>
<td>Teradata OLAP Connector</td>
<td>Not supported</td>
</tr>
</tbody>
</table>

**COS(number)**

Returns the cosine of an angle. Specify the angle in radians.
Example
\[ \cos\left(\frac{\pi}{4}\right) = 0.707106781186548 \]

\textbf{COT(number)}

Returns the cotangent of an angle. Specify the angle in radians.

Example
\[ \cot\left(\frac{\pi}{4}\right) = 1 \]

\textbf{DEGREES(number)}

Converts a given number in radians to degrees.

Example
\[ \text{DEGREES}\left(\frac{\pi}{4}\right) = 45.0 \]

\textbf{DIV(integer1, integer2)}

Returns the integer part of a division operation, in which integer1 is divided by integer2.

Example
\[ \text{DIV}(11,2) = 5 \]

\textbf{EXP(number)}

Returns \( e \) raised to the power of the given number.

Examples
\[ \exp(2) = 7.389 \]
\[ \exp(-[\text{Growth Rate}]\times[\text{Time}]) \]

\textbf{FLOOR(number)}

Rounds a number to the nearest integer of equal or lesser value.

Example
\[ \text{FLOOR}(3.1415) = 3 \]

\textbf{Availability by data source}

<table>
<thead>
<tr>
<th>Data Source</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Access</td>
<td>Not supported</td>
</tr>
<tr>
<td>Microsoft Excel</td>
<td>Supported</td>
</tr>
<tr>
<td>Software</td>
<td>Support Status</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------</td>
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<tr>
<td>Text File</td>
<td>Supported</td>
</tr>
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</tbody>
</table>

**HEXBINX(number, number)**

Maps an x, y coordinate to the x-coordinate of the nearest hexagonal bin. The bins have side length 1, so the inputs may need to be scaled appropriately.

**HEXBINX** and **HEXBINY** are binning and plotting functions for hexagonal bins. Hexagonal bins are an efficient and elegant option for visualizing data in an x/y plane such as a map. Because the bins are hexagonal, each bin closely approximates a circle and minimizes variation in the distance from the data point to the center of the bin. This makes the clustering both more accurate and informative.
Example
HEXBINX([Longitude], [Latitude])

HEXBINY(number, number)
Maps an x, y coordinate to the y-coordinate of the nearest hexagonal bin. The bins have side length 1, so the inputs may need to be scaled appropriately.

Example
HEXBINY([Longitude], [Latitude])

LN(number)
Returns the natural logarithm of a number. Returns Null if number is less than or equal to 0.

LOG(number [, base])
Returns the logarithm of a number for the given base. If the base value is omitted, base 10 is used.

MAX(number, number)
Returns the maximum of the two arguments, which must be of the same type. Returns Null if either argument is Null. MAX can also be applied to a single field in an aggregate calculation.

Examples
MAX(4,7)
MAX(Sales,Profit)
MAX([First Name],[Last Name])

MIN(number, number)
Returns the minimum of the two arguments, which must be of the same type. Returns Null if either argument is Null. MIN can also be applied to a single field in an aggregate calculation.

Examples
MIN(4,7)
MIN(Sales,Profit)
MIN([First Name],[Last Name])

PI()
Returns the numeric constant pi: 3.14159.

POWER(number, power)
Raises the number to the specified power.
Examples

\[ \text{POWER}(5, 2) = 5^2 = 25 \]
\[ \text{POWER}(\text{Temperature}, 2) \]

You can also use the ^ symbol:
\[ 5^2 = \text{POWER}(5, 2) = 25 \]

Radians (number)

Converts the given number from degrees to radians.

Example

\[ \text{RADIANS}(180) = 3.14159 \]

ROUND(number, [decimals])

Rounds numbers to a specified number of digits. The decimals argument specifies how many decimal points of precision to include in the final result. If decimals is omitted, number is rounded to the nearest integer.

Example

This example rounds every Sales value to an integer:

\[ \text{ROUND}(\text{Sales}) \]

Some databases, such as SQL Server, allow specification of a negative length, where -1 rounds number to 10's, -2 rounds to 100's, and so on. This is not true of all databases. For example, it is not true of Excel or Access.

SIGN(number)

Returns the sign of a number: The possible return values are -1 if the number is negative, 0 if the number is zero, or 1 if the number is positive.

Example

If the average of the profit field is negative, then
\[ \text{SIGN}(\text{AVG(Profit)}) = -1 \]

SIN(number)

Returns the sine of an angle. Specify the angle in radians.

Example

\[ \text{SIN}(0) = 1.0 \]
\[ \text{SIN}(\pi / 4) = 0.707106781186548 \]
**SQRT(number)**
Returns the square root of a number.

**Example**
SQRT(25) = 5

**SQUARE(number)**
Returns the square of a number.

**Example**
SQUARE(5) = 25

**TAN(number)**
Returns the tangent of an angle. Specify the angle in radians.

**Example**
TAN(PI( )/4) = 1.0

**ZN(expression)**
Returns the expression if it is not null, otherwise returns zero. Use this function to use zero values instead of null values.

**Example**
ZN([Profit]) = [Profit]

**String Functions**

**ASCII(string)**
Return the ASCII code for the first character of string.

**Example**
ASCII('A') = 65

**CHAR(number)**
Returns the character encoded by the ASCII code number.

**Example**
CHAR(65) = 'A'

**Contains(string, substring)**
Returns true if the given string contains the specified substring.
Example

CONTAINS("Calculation", "alcu") = true

ENDSWITH(string, substring)

Returns true if the given string ends with the specified substring. Trailing white spaces are ignored.

Example

ENDSWITH("Tableau", "leau") = true

FIND(string, substring, [start])

Returns the index position of substring in string, or 0 if the substring isn't found. If the optional argument start is added, the function ignores any instances of substring that appear before the index position start. The first character in the string is position 1.

Examples

FIND("Calculation", "alcu") = 2
FIND("Calculation", "Computer") = 0
FIND("Calculation", "a", 3) = 7
FIND("Calculation", "a", 2) = 2
FIND("Calculation", "a", 8) = 0

FINDNTH(string, substring, occurrence)

Returns the position of the nth occurrence of substring within the specified string, where n is defined by the occurrence argument.

Example

FINDNTH("Calculation", "a", 2) = 7

LEFT(string, number)

Returns the left-most number of characters in the string.

Example

LEFT("Matador", 4) = "Mata"

LEN(string)

Returns the length of the string.

Example

LEN("Matador") = 7
LOWER(string)
Returns string, with all characters lowercase.

Example
LOWER("ProductVersion") = "productversion"

LTRIM(string)
Returns the string with any leading spaces removed.

Example
LTRIM(" Matador ") = "Matador 

MAX(a, b)
Returns the maximum of a and b (which must be of the same type). This function is usually used to compare numbers, but also works on strings. With strings, MAX finds the value that is highest in the sort sequence defined by the database for that column. It returns Null if either argument is Null.

Example
MAX ("Apple","Banana") = "Banana"

MID(string, start, [length])
Returns the string starting at index position start. The first character in the string is position 1. If the optional argument length is added, the returned string includes only that number of characters.

Examples
MID("Calculation", 2) = "alculation"
MID("Calculation", 2, 5) ="alcul"

MIN(a, b)
Returns the minimum of a and b (which must be of the same type). This function is usually used to compare numbers, but also works on strings. With strings, MIN finds the value that is lowest in the sort sequence. It returns Null if either argument is Null.

Example
MIN ("Apple","Banana") = "Apple"

REPLACE(string, substring, replacement)
Searches string for substring and replaces it with replacement. If substring is not found, the string is not changed.
Example
REPLACE("Version8.5", "8.5", "9.0") = "Version9.0"

RIGHT(string, number)
Returns the right-most number of characters in string.

Example
RIGHT("Calculation", 4) = "tion"

RTRIM(string)
Returns string with any trailing spaces removed.

Example
RTRIM(" Calculation ") = " Calculation"

SPACE(number)
Returns a string that is composed of the specified number of repeated spaces.

Example
SPACE(1) = " "

SPLIT(string, delimiter, token number)
Returns a substring from a string, using a delimiter character to divide the string into a sequence of tokens.

The string is interpreted as an alternating sequence of delimiters and tokens. So for the string abc-defgh-i-jkl, where the delimiter character is '-', the tokens are abc, defgh, i, and jkl. Think of these as tokens 1 through 4. SPLIT returns the token corresponding to the token number. When the token number is positive, tokens are counted starting from the left end of the string; when the token number is negative, tokens are counted starting from the right.

Examples
SPLIT (‘a-b-c-d’, ‘-’, 2) = ‘b’
SPLIT (‘a|b|c|d’, ‘|’, -2) = ‘c’

Some data sources impose limits on splitting string. The following table shows which data sources support negative token numbers (splitting from the right) and whether there is a limit on the number of splits allow per data source. A SPLIT function that specifies a negative token number and would be legal with other data sources will return this error with these data sources: “Splitting from right is not support by the data source.”
<table>
<thead>
<tr>
<th>Data Source</th>
<th>Left/Right Constraints</th>
<th>Maximum Number of Splits</th>
<th>Version Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tableau Data Extract</td>
<td>Both</td>
<td>Infinite</td>
<td></td>
</tr>
<tr>
<td>Microsoft Excel</td>
<td>Both</td>
<td>Infinite</td>
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<td>Infinite</td>
<td></td>
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<tr>
<td>OData</td>
<td>Both</td>
<td>Infinite</td>
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<td>Google Analytics</td>
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<td>Infinite</td>
<td></td>
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<td>Infinite</td>
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</tr>
<tr>
<td>MySQL</td>
<td>Both</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>PostgreSQL</td>
<td>Left only prior to version 9.0; both for version 9.0 and above</td>
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<td></td>
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<tr>
<td>Teradata</td>
<td>Left only</td>
<td>10</td>
<td>Version 14 and later</td>
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<tr>
<td>Hortonworks Hadoop Hive</td>
<td>Left only</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>System</td>
<td>Compatibility</td>
<td>Version</td>
<td>Notes</td>
</tr>
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<td>---------------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Cloudera Hadoop</td>
<td>Left only</td>
<td>10</td>
<td>Impala supported starting in version 2.3.0.</td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td>Both</td>
<td>10</td>
<td>2008 and later</td>
</tr>
</tbody>
</table>

**STARTSWITH(string, substring)**

Returns true if `string` starts with `substring`. Leading white spaces are ignored.

**Example**

```plaintext```
STARTSWITH("Joker", "Jo") = true
```

**TRIM(string)**

Returns the string with leading and trailing spaces removed. For example, `TRIM(" Calculation ") = "Calculation"

**UPPER(string)**

Returns string, with all characters uppercase.

**Example**

```plaintext```
UPPER("Calculation") = "CALCULATION"
```

**Date Functions**

Tableau provides a variety of date functions. Many of the examples use the # symbol with date expressions. See [Formatting Literals](#) on page 1360 for an explanation of this symbol. Additionally, many date functions use `date_part`, which is a constant string argument. The valid `date_part` values that you can use are:

<table>
<thead>
<tr>
<th><code>date_part</code></th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>'year'</td>
<td>Four-digit year</td>
</tr>
<tr>
<td>'quarter'</td>
<td>1-4</td>
</tr>
<tr>
<td>'month'</td>
<td>1-12 or &quot;January&quot;, &quot;February&quot;, and so on</td>
</tr>
<tr>
<td>'dayofyear'</td>
<td>Day of the year; Jan 1 is 1, Feb 1 is 32, and so on</td>
</tr>
<tr>
<td>'day'</td>
<td>1-31</td>
</tr>
<tr>
<td>'weekday'</td>
<td>1-7 or &quot;Sunday&quot;, &quot;Monday&quot;, and so on</td>
</tr>
<tr>
<td>date_part</td>
<td>Values</td>
</tr>
<tr>
<td>-----------</td>
<td>--------</td>
</tr>
<tr>
<td>'week'</td>
<td>1-52</td>
</tr>
<tr>
<td>'hour'</td>
<td>0-23</td>
</tr>
<tr>
<td>'minute'</td>
<td>0-59</td>
</tr>
<tr>
<td>'second'</td>
<td>0-60</td>
</tr>
</tbody>
</table>

**Note:** Date functions do not take account of the configured fiscal year start. See *Fiscal Dates* on page 581.

**DATEADD(date_part, interval, date)**

Returns the specified date with the specified number interval added to the specified date_part of that date.

**Example**

DATEADD('month', 3, #2004-04-15#) = 2004-07-15 12:00:00 AM

This expression adds three months to the date #2004-04-15#.

**DATEDIFF(date_part, date1, date2, [start_of_week])**

Returns the difference between date1 and date2 expressed in units of date_part. The start_of_week parameter is optional. If it is omitted, the start of week is determined by the data source. See *Date Properties for a Data Source* on page 572.

**Example**

DATEDIFF('week', #2013-09-22#, #2013-09-24#, 'monday') = 1
DATEDIFF('week', #2013-09-22#, #2013-09-24#, 'sunday') = 0

The first expression returns 1 because when start_of_week is 'monday', then 22 September (a Sunday) and 24 September (a Tuesday) are in different weeks. The second expression returns 0 because when start_of_week is 'sunday' then 22 September (a Sunday) and 24 September (a Tuesday) are in the same week.

**DATENAME(date_part, date, [start_of_week])**

Returns date_part of date as a string. The start_of_week parameter is optional. If it is omitted, the start of week is determined by the data source. See *Date Properties for a Data Source* on page 572.

**Examples**

DATENAME('year', #2004-04-15#) = "2004"
DATENAME('month', #2004-04-15#) = "April"

**DATEPART**<br>
Returns date_part of date as an integer.<br>The `start_of_week` parameter is optional. If it is omitted, the start of week is determined by the data source. See **Date Properties for a Data Source** on page 572.

**Note:** When the `date_part` is weekday, the `start_of_week` parameter is ignored. This is because Tableau relies on a fixed weekday ordering to apply offsets.

**Examples**

```
DATEPART('year', #2004-04-15#) = 2004
DATEPART('month', #2004-04-15#) = 4
```

**DATETRUNC**<br>Truncates the specified date to the accuracy specified by the `date_part`. This function returns a new date. For example, when you truncate a date that is in the middle of the month at the month level, this function returns the first day of the month. The `start_of_week` parameter is optional. If it is omitted, the start of week is determined by the data source. See **Date Properties for a Data Source** on page 572.

**Examples**

```
DATETRUNC('quarter', #2004-08-15#) = 2004-07-01 12:00:00 AM
DATETRUNC('month', #2004-04-15#) = 2004-04-01 12:00:00 AM
```

**DAY**<br>Returns the day of the given date as an integer.

**Example**

```
DAY(#2004-04-12#) = 12
```

**ISDATE**<br>Returns true if a given string is a valid date.

**Example**

```
ISDATE("April 15, 2004") = true
```

**MAKEDATE**<br>Returns a date value constructed from the specified year, month, and date.<br>Available for Tableau Data Extracts. Check for availability in other data sources.
Example

MAKEDATE(2004, 4, 15) = #April 15, 2004#

**MAKEDATETIME(date, time)**

Returns a datetime that combines a date and a time. The date can be a date, datetime, or a string type. The time must be a datetime. This function is available only for MySQL connections.

Examples

MAKEDATETIME("1899-12-30", #07:59:00#) = #12/30/1899 7:59:00 AM#

MAKEDATETIME([Date], [Time]) = #1/1/2001 6:00:00 AM#

**MAKETIME(hour, minute, second)**

Returns a date value constructed from the specified hour, minute, and second.

Available for Tableau Data Extracts. Check for availability in other data sources.

Example

MAKETIME(14, 52, 40) = #14:52:40#

**MAX(expression) or MAX(expr1, expr2)**

Usually applied to numbers but also works on dates. Returns the maximum of a and b (a and b must be of the same type). Returns Null if either argument is Null.

Examples

MAX(#2004-01-01#, #2004-03-01#) = 2004-03-01 12:00:00 AM

MAX([[ShipDate1], [ShipDate2]])

**MIN(expression) or MIN(expr1, expr2)**

Usually applied to numbers but also works on dates. Returns the minimum of a and b (a and b must be of the same type). Returns Null if either argument is Null.

Examples

MIN(#2004-01-01#, #2004-03-01#) = 2004-01-01 12:00:00 AM

MIN([[ShipDate1], [ShipDate2]])

**MONTH(date)**

Returns the month of the given date as an integer.

Example

MONTH(#2004-04-15#) = 4
NOW()
Returns the current date and time.
The return varies depending on the nature of the connection:

- For a live, unpublished connection, NOW returns the data source server time.
- For a live, published connection, NOW returns the data source server time.
- For an unpublished extract, NOW returns the local system time.
- For a published extract, NOW returns the local time of the Tableau Server Data Engine. When there are multiple worker machines indifferent time zones, this can produce inconsistent results.

Example
NOW() = 2004-04-15 1:08:21 PM

TODAY()
Returns the current date.

Example
TODAY() = 2004-04-15

YEAR(date)
Returns the year of the given date as an integer.

Example
YEAR(#2004-15#) = 2004

Type Conversion
The result of any expression in a calculation can be converted to a specific data type. The conversion functions are STR(), DATE(), DATETIME(), INT(), and FLOAT(). For example, if you want to cast a floating point number like 3.14 as an integer, you could write INT(3.14). The result would be 3, which is an integer. The casting functions are described below.

A boolean can be cast to an integer, float, or string. It cannot be cast to a date. True is 1, 1.0, or “1”, while False is 0, 0.0 or “0”. Unknown maps to Null.

DATE(expression)
Returns a date given a number, string, or date expression.

Examples
DATE([Employee Start Date])
DATE("April 15, 2004") = #April 15, 2004#
DATE("4/15/2004")
DATE(#2006-06-15 14:52#) = #2006-06-15#

Quotation marks are required in the second and third examples.

DATETIME(expression)
Returns a datetime given a number, string, or date expression.

Example
DATETIME("April 15, 2005 07:59:00") = April 15, 2005 07:59:00

DATEPARSE(format, string)
Converts a string to a datetime in the specified format. Support for some locale-specific formats is determined by the computer’s system settings. Letters that appear in the data and do not need to be parsed should be surrounded by single quotes (‘’). For formats that do not have delimiters between values (e.g., MMddyy), verify that they are parsed as expected. The format must be a constant string, not a field value. This function returns Null if the data does not match the format.

This function is available for non-legacy Microsoft Excel and text file connections, MySQL, Oracle, PostgreSQL, and Tableau data extract data sources. Some formats may not be available for all data sources.

Examples
DATEPARSE ("dd.MMMM.yyyy", "15.April.2004") = #April 15, 2004#
DATEPARSE ("h'h' m'm' s's'", "10h 5m 3s") = #10:05:03#

For more examples, see Understanding the DATEPARSE Function.

FLOAT(expression)
Casts its argument as a floating point number.

Examples
FLOAT(3) = 3.000
FLOAT([Age]) converts every value in the Age field to a floating point number.

INT(expression)
Casts its argument as an integer. For expressions, this function truncates results to the closest integer toward zero.

Examples
INT(8.0/3.0) = 2
When a string is converted to an integer it is first converted to a float and then rounded.

**STR** (expression)
Casts its argument as a string.

**Example**

`STR([Age])` takes all of the values in the measure called `Age` and converts them to strings.

**Logical Functions**

**CASE** expression **WHEN** value1 **THEN** return1 **WHEN** value2 **THEN** return2... **ELSE** default return **END**

Use the **CASE** function to perform logical tests and return appropriate values. **CASE** is often easier to use than **IIF** or **IF THEN ELSE**. The **CASE** function evaluates **expression**, compares it to a sequence of values, `value1, value2, etc.,` and returns a result. When a value that matches **expression** is encountered, **CASE** returns the corresponding return value. If no match is found, the default return expression is used. If there is no default return and no values match, then Null is returned.

Typically, you use an **IF** function to perform a sequence of arbitrary tests, and you use a **CASE** function to search for a match to an expression. But a **CASE** function can always be rewritten as an **IF** function, although the **CASE** function will generally be more concise.

Many times you can use a group to get the same results as a complicated case function.

**Examples**

```sql
CASE [Region] WHEN "West" THEN 1 WHEN "East" THEN 2 ELSE 3 END
CASE LEFT(DATENAME('weekday',[Order Date]),3) WHEN "Sun" THEN 0 WHEN "Mon" THEN 1 WHEN "Tue" THEN 2 WHEN "Wed" THEN 3 WHEN "Thu" THEN 4 WHEN "Fri" THEN 5 WHEN "Sat" THEN 6 END
```

**IIF** *(test, then, else, [unknown])*  

Use the **IIF** function to perform logical tests and return appropriate values. The first argument, **test**, must be a boolean: either a boolean field in the data source, or the result of a logical expression using operators (or a logical comparison of AND, OR, or NOT). If **test** evaluates to **TRUE**, then **IIF** returns the **then** value. If **test** evaluates to **FALSE**, then **IIF** returns the **else** value.

A boolean comparison may also yield the value **UNKNOWN** (neither **TRUE** nor **FALSE**), usually due to the presence of Null values in **test**. The final argument to **IIF** is returned in the event of an **UNKNOWN** result for the comparison. If this argument is left out, Null is returned.
Examples

IIF(7>5, "Seven is greater than five", "Seven is less than five")
IIF([Cost]>[Budget Cost], "Over Budget", "Under Budget")
IIF([Budget Sales]!=0, [Sales]/[Budget Sales], 0)
IIF(Sales>=[Budget Sales], "Over Cost Budget and Over Sales Budget", "Over Cost Budget and Under Sales Budget","Under Cost Budget")

IF test THEN value END / IF test THEN value ELSE else END

Use the IF THEN ELSE function to perform logical tests and return appropriate values. The IF THEN ELSE function evaluates a sequence of test conditions and returns the value for the first condition that is true. If no condition is true, the ELSE value is returned. Each test must be a boolean: either a boolean field in the data source or the result of a logical expression. The final ELSE is optional, but if it is not provided and there is no true test expression, then the function returns Null. All of the value expressions must be of the same type.

Examples

IF [Cost]>[Budget Cost] THEN "Over Budget" ELSE "Under Budget" END
IF [Budget Sales]!=0 THEN [Sales]/[Budget Sales] END

IF test1 THEN value1 ELSEIF test2 THEN value2 ELSE else END

Use this version of the IF function to perform logical tests recursively. There is no built-in limit to the number of ELSEIF values you can use with an IF function, though individual databases may impose a limit on IF function complexity. While an IF function can be rewritten as a series of nested IIF statements, there are differences in how the expressions will be evaluated. In particular, an IIF statement distinguishes TRUE, FALSE and UNKNOWN, whereas an IF statement only worries about TRUE and not true (which includes both FALSE and UNKNOWN).

Example

IF [Region]="West" THEN 1 ELSEIF [Region]="East" THEN 2 ELSE 3 END

IFNULL(expression1, expression2)

The IFNULL function returns the first expression if the result is not null, and returns the second expression if it is null.

Example

IFNULL([Profit], 0) = [Profit]

ISDATE(string)

The ISDATE function returns TRUE if the string argument can be converted to a date and
FALSE if it cannot.

Examples

ISDATE("January 1, 2003") = TRUE
ISDATE("Jan 1 2003") = TRUE
ISDATE("1/1/03") = TRUE
ISDATE("Janxx 1 2003") = FALSE

ISNULL(expression)

The ISNULL function returns TRUE if the expression is Null and FALSE if it is not.

Example

The following example uses ISNULL in combination with IIF to replace null values with 0's.
IIF(ISNULL([Sales]), 0, [Sales] )

MIN(expression) or MIN(expression1,expression2)

The MIN function returns the minimum of an expression across all records or the minimum of two expressions for each record.

Use cases

Use logical functions to create specific views from a data source without changing the source itself. For example, combine different members of a dimension, or filter a segment out of a view. Below are a few basic examples, using the IF statement with different types of logical operator. For more information about logical operators, see Operators on page 1415.

Learn how to use logical functions to group members of a field, compare values, exclude values, and create virtual bins:

**Group members of a field**

In an OR statement, only one of the conditions in the statement needs to be true for the entire calculation to evaluate to true.

In this example, an OR operator is used to create a new region called East Coast, made up of members of the East and South regions:

IF [Region] = “East” OR [Region] = “South” THEN “East Coast” ELSE [Region] END
Using this calculation, your view will update to look like this:

**Logical statements**

Logical statements that use the **AND** operator are useful when more than one field needs to be involved. In an AND statement, all conditions must evaluate to true for the overall calculation to be true.

The following calculation finds furniture sales for the Central region:

Use this calculation in a view to easily show how furniture sales in the Central region compare to total sales.

Exclude values

The calculation in this example uses the **not equal to** operator (<>). This operator is often used to exclude values or filter a member of a dimension out of a view.

The following formula calculates the total sales for all regions except East:

IF Region <> “East” THEN [Sales] END

Using this calculation, your view will update to look like this:
Create virtual bins

The greater than or equal to operator (>=) can be used to create virtual bins to categorize data in different ways. This type of calculation is very useful and is similar to how KPIs (Key Performance Indicators) are evaluated. In this calculation, the >= operator is used to group sales into large, medium, and small orders based on the dollar amount.

IF [Sales] >= 5000 THEN "Large Order"
ELSEIF [Sales] >= 1000 THEN "Medium Order"
ELSE "Small Order" END

Using this calculation, your view will update to look like this:
Aggregate Functions

**Aggregations and floating-point arithmetic:** The results of some aggregations may not always be exactly as expected. For example, you may find that the Sum function returns a value such as \( -1.42 \times 10^{-14} \) for a column of numbers that you know should sum to exactly 0. This happens because the Institute of Electrical and Electronics Engineers (IEEE) 754 floating-point standard requires that numbers be stored in binary format, which means that numbers are sometimes rounded at extremely fine levels of precision. You can eliminate this potential distraction by using the ROUND function (see **Number Functions on page 1361**) or by formatting the number to show fewer decimal places.

**ATTR(expression)**

Returns the value of the expression if it has a single value for all rows. Otherwise returns an asterisk. Null values are ignored.

**AVG(expression)**

Returns the average of all the values in the expression. AVG can be used with numeric fields only. Null values are ignored.

**COUNT(expression)**

Returns the number of items in a group. Null values are not counted.

**COUNTD(expression)**

Returns the number of distinct items in a group. Null values are not counted. This function is not available in the following cases: workbooks created before Tableau Desktop 8.2 that use Microsoft Excel or text file data sources, workbooks that use the legacy connection, and workbooks that use Microsoft Access data sources. Extract your data into an extract file to use this function. See **Extract Your Data on page 409**.
MAX(expression)
Returns the maximum of an expression across all records. If the expression is a string value, this function returns the last value where last is defined by alphabetical order.

MEDIAN(expression)
Returns the median of an expression across all records. Median can only be used with numeric fields. Null values are ignored. This function is not available for workbooks created before Tableau Desktop 8.2 or that use legacy connections. It is also not available for connections using any of the following data sources:
- Access
- Amazon Redshift
- Cloudera Hadoop
- HP Vertica
- IBM DB2
- IBM Netezza
- Microsoft Excel
- Microsoft SQL Server
- MySQL
- Teradata
- Text files

For other data source types, you can extract your data into an extract file to use this function. See Extract Your Data on page 409.

MIN(expression)
Returns the minimum of an expression across all records. If the expression is a string value, this function returns the first value where first is defined by alphabetical order.

PERCENTILE(expression, number)
Returns the percentile value from the given expression corresponding to the specified number. The number must be between 0 and 1 (inclusive)—for example, 0.66, and must be a numeric constant.

This function is available for the following data sources:
- Non-legacy Microsoft Excel and Text File connections.
- Extracts and extract-only data source types (for example, Google Analytics, OData, or Salesforce).
- Sybase IQ 15.1 and later data sources.
- Oracle 10 and later data sources.
- Cloudera Hive and Hortonworks Hadoop Hive data sources.
- EXASolution 4.2 and later data sources.
For other data source types, you can extract your data into an extract file to use this function. See Extract Your Data on page 409.

**STDEV(expression)**

Returns the statistical standard deviation of all values in the given expression based on a sample of the population.

**STDEVP(expression)**

Returns the statistical standard deviation of all values in the given expression based on a biased population.

**SUM(expression)**

Returns the sum of all values in the expression. SUM can be used with numeric fields only. Null values are ignored.

**VAR(expression)**

Returns the statistical variance of all values in the given expression based on a sample of the population.

**VARP(expression)**

Returns the statistical variance of all values in the given expression on the entire population.

**Pass-Through Functions (RAWSQL)**

These RAWSQL pass-through functions can be used to send SQL expressions directly to the database, without first being interpreted by Tableau. If you have custom database functions that Tableau doesn’t know about, you can use these pass-through functions to call these custom functions.

Your database usually will not understand the field names that are shown in Tableau. Because Tableau does not interpret the SQL expressions you include in the pass-through functions, using the Tableau field names in your expression may cause errors. You can use a substitution syntax to insert the correct field name or expression for a Tableau calculation into pass-through SQL. For example, if you had a function that computed the median of a set of values, you could call that function on the Tableau column [Sales] like this:

```
RAWSQLAGG_REAL("MEDIAN(%1)", [Sales])
```

Because Tableau does not interpret the expression, you must define the aggregation. You can use the RAWSQLAGG functions described below when you are using aggregated expressions.

RAWSQL pass-through functions will not work with published data sources.
These functions may return different results starting in Tableau Desktop 8.2 than they did in earlier versions of Tableau Desktop. This is because Tableau now uses ODBC for pass-through functions instead of OLE DB. ODBC truncates when returning real values as integer; OLE DB rounds when returning real values as integer.

**RAWSQL Functions**

The following RAWSQL functions are available in Tableau.

**RAWSQL_BOOL(“sql_expr”, [arg1], …[argN])**

Returns a Boolean result from a given SQL expression. The SQL expression is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values.

In the example, %1 is equal to [Sales] and %2 is equal to [Profit].

**RAWSQL_BOOL(“IIF( %1 > %2, True, False)”, [Sales], [Profit])**

**RAWSQL_DATE(“sql_expr”, [arg1], …[argN])**

Returns a Date result from a given SQL expression. The SQL expression is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Order Date].

**Example**

RAWSQL_DATE(“%1”, [Order Date])

**RAWSQL_DATETIME(“sql_expr”, [arg1], …[argN])**

Returns a Date and Time result from a given SQL expression. The SQL expression is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Delivery Date].

**Example:** RAWSQL_DATETIME(“MIN(%1)”, [Delivery Date])

**RAWSQL_INT(“sql_expr”, [arg1], …[argN])**

Returns an integer result from a given SQL expression. The SQL expression is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Sales].

**Example**

RAWSQL_INT(“500 + %1”, [Sales])

**RAWSQL_REAL(“sql_expr”, [arg1], …[argN])**

Returns a numeric result from a given SQL expression that is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Sales]
Example
RAWSQL_REAL("-123.98 * %1", [Sales])

RAWSQL_STR("sql_expr", [arg1], …[argN])

Returns a string from a given SQL expression that is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Customer Name].

Example
RAWSQL_STR("%1", [Customer Name])

RAWSQLAGG_BOOL("sql_expr", [arg1], …[argN])

Returns a Boolean result from a given aggregate SQL expression. The SQL expression is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values.

In the example, %1 is equal to [Sales] and %2 is equal to [Profit].

Example: RAWSQLAGG_BOOL("SUM( %1) >SUM( %2)", [Sales], [Profit])

RAWSQLAGG_DATE("sql_expr", [arg1], …[argN])

Returns a Date result from a given aggregate SQL expression. The SQL expression is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Order Date].

Example
RAWSQLAGG_DATE("MAX(%1)", [Order Date])

RAWSQLAGG_DATETIME("sql_expr", [arg1], …[argN])

Returns a Date and Time result from a given aggregate SQL expression. The SQL expression is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Delivery Date].

Example
RAWSQLAGG_DATETIME("MIN(%1)", [Delivery Date])

RAWSQLAGG_INT("sql_expr", [arg1], …[argN])

Returns an integer result from a given aggregate SQL expression. The SQL expression is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Sales].

Example
RAWSQLAGG_INT("500 + SUM(%1)", [Sales])
RAWSQLAGG_REAL("sql_expr", [arg1] ...[argN])

Returns a numeric result from a given aggregate SQL expression that is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Sales]

Example

RAWSQLAGG_REAL("SUM( %1)", [Sales])

RAWSQLAGG_STR("sql_expr", [arg1] ...[argN])

Returns a string from a given aggregate SQL expression that is passed directly to the underlying database. Use %n in the SQL expression as a substitution syntax for database values. In this example, %1 is equal to [Discount].

Example

RAWSQLAGG_STR("AVG( %1)", [Discount])

User Functions

Use these user functions to create user filters based on user lists in your data source. For example, assume you have a view that shows the sales performance for each employee. When you publish that view, you may want to only allow employees to see their own sales numbers. You can use the function CURRENTUSER to create a field that returns True if the username of the person signed in to the server is the same as the employee name in the view. Then when you filter the view using this calculated field, only the data for the user who is currently signed in is shown.

FULLNAME( )

Returns the full name for the current user. This is the Tableau Server or Tableau Online full name when the user is signed in; otherwise the local or network full name for the Tableau Desktop user.

Example

[Manager]=FULLNAME( )

If manager Dave Hallsten is signed in, this example returns True only if the Manager field in the view contained Dave Hallsten. When used as a filter, this calculated field can be used to create a user filter that only shows data that is relevant to the person signed in to the server.

ISFULLNAME(string)

Returns true if the current user's full name matches the specified full name, or false if it does not match. This function uses the Tableau Server or Online full name when the user is signed in; otherwise it uses the local or network full name for the Tableau Desktop user.
Example

ISFULLNAME(“Dave Hallsten”)
This example returns true if Dave Hallsten is the current user, otherwise it returns false.

ISMEMBEROF(string)
Returns true if the person currently using Tableau is a member of a group that matches the given string. If the person currently using Tableau is signed in, the group membership is determined by groups on Tableau Server or Tableau Online. If the person is not signed in, this function returns false.
Example

IF ISMEMBEROF(“Sales”) THEN “Sales” ELSE “Other” END

ISUSERNAME(string)
Returns true if the current user's username matches the specified username, or false if it does not match. This function uses the Tableau Server or Online username when the user is signed in; otherwise it uses the local or network username for the Tableau Desktop user.
Example

ISUSERNAME(“dhallsten”)
This example returns true if dhallsten is the current user; otherwise it returns false.

USERDOMAIN()
Returns the domain for the current user when the user is signed on to Tableau Server. Returns the Windows domain if the Tableau Desktop user is on a domain. Otherwise this function returns a null string.
Example

[Manager]=USERNAME() AND [Domain]=USERDOMAIN()

USERNAME()
Returns the username for the current user. This is the Tableau Server or Tableau Online username when the user is signed in; otherwise it is the local or network username for the Tableau Desktop user.
Example

[Manager]=USERNAME()
If the manager dhallsten was signed in, this function would only return True when the Manager field in the view is dhallsten. When used as a filter this calculated field can be used to create a user filter that only shows data that is relevant to the person signed in to the server.
Table Calculation Functions

Use table calculation functions to customize table calculations. Table Calculations are computations that are applied to the values in the entire table and are often dependent on the table structure itself. See Customize Table Calculations on page 822 for information about creating and customizing table calculations.

FIRST( )

Returns the number of rows from the current row to the first row in the partition. For example, the view below shows quarterly sales. When FIRST() is computed within the Date partition, the offset of the first row from the second row is -1.

Example

When the current row index is 3, FIRST() = -2.

INDEX( )

Returns the index of the current row in the partition, without any sorting with regard to value. The first row index starts at 1. For example, the table below shows quarterly sales. When INDEX() is computed within the Date partition, the index of each row is 1, 2, 3, 4..., etc.

Example

For the third row in the partition, INDEX() = 3.
LAST()  
Returns the number of rows from the current row to the last row in the partition. For example, the table below shows quarterly sales. When LAST() is computed within the Date partition, the offset of the last row from the second row is 5.

```
<table>
<thead>
<tr>
<th>Year of Order Date</th>
<th>Quarter of Order Date</th>
<th>Central</th>
<th>East</th>
<th>South</th>
<th>West</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>Q1</td>
<td>$160,877</td>
<td>$231,411</td>
<td>$139,934</td>
<td>$185,961</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>$197,213</td>
<td>$204,914</td>
<td>$337,813</td>
<td>$213,807</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>$302,678</td>
<td>$166,201</td>
<td>$283,808</td>
<td>$208,812</td>
</tr>
<tr>
<td></td>
<td>Q4</td>
<td>$297,208</td>
<td>$228,983</td>
<td>$214,945</td>
<td>$230,291</td>
</tr>
<tr>
<td>2010</td>
<td>Q1</td>
<td>$180,609</td>
<td>$180,123</td>
<td>$273,943</td>
<td>$251,145</td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>$106,765</td>
<td>$224,882</td>
<td>$251,391</td>
<td>$195,978</td>
</tr>
<tr>
<td></td>
<td>Q3</td>
<td>$156,613</td>
<td>$50,303</td>
<td>$194,661</td>
<td>$102,731</td>
</tr>
</tbody>
</table>
```

Example  
When the current row index is 3 of 7, LAST() = 4.

LOOKUP(expression, [offset])  
Returns the value of the expression in a target row, specified as a relative offset from the current row. Use FIRST() + n and LAST() - n as part of your offset definition for a target relative to the first/last rows in the partition. If offset is omitted, the row to compare to can be set on the field menu. This function returns NULL if the target row cannot be determined.

The view below shows quarterly sales. When LOOKUP SUM(Sales), 2) is computed within the Date partition, each row shows the sales value from 2 quarters into the future.
LOOKUP(SUM([Profit]), FIRST()+2) computes the SUM(Profit) in the third row of the partition.

PREVIOUS_VALUE(expression)

Returns the value of this calculation in the previous row. Returns the given expression if the current row is the first row of the partition.

Example

SUM([Profit]) * PREVIOUS_VALUE(1) computes the running product of SUM(Profit).

RANK(expression, ['asc' | 'desc'])

Returns the standard competition rank for the current row in the partition. Identical values are assigned an identical rank. Use the optional 'asc' | 'desc' argument to specify ascending or descending order. The default is descending.

With this function, the set of values (6, 9, 9, 14) would be ranked (4, 2, 2, 1).

Nulls are ignored in ranking functions. They are not numbered and they do not count against the total number of records in percentile rank calculations.
For information on different ranking options, see **Table Calculation Type: Rank** on page 805.

**Example**

The following image shows the effect of the various ranking functions (RANK, RANK_DENSE, RANK_MODIFIED, RANK_PERCENTILE, and RANK_UNIQUE) on a set of values. The data set contains information on 14 students (StudentA through StudentN); the Age column shows the current age of each student (all students are between 17 and 20 years of age). The remaining columns show the effect of each rank function on the set of age values, always assuming the default order (ascending or descending) for the function.

<table>
<thead>
<tr>
<th>Student</th>
<th>Age</th>
<th>RANK&lt;sub&gt;0&lt;/sub&gt;</th>
<th>RANK&lt;sub&gt;DENSE&lt;/sub&gt;</th>
<th>RANK&lt;sub&gt;MODIFIED&lt;/sub&gt;</th>
<th>RANK&lt;sub&gt;PERCENTILE&lt;/sub&gt;</th>
<th>RANK&lt;sub&gt;UNIQUE&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>StudentA</td>
<td>19</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>StudentB</td>
<td>19</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>StudentC</td>
<td>19</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>StudentD</td>
<td>19</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>StudentE</td>
<td>17</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>StudentF</td>
<td>17</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>StudentG</td>
<td>17</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>StudentH</td>
<td>17</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>StudentI</td>
<td>17</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>StudentJ</td>
<td>17</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>StudentK</td>
<td>17</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>StudentL</td>
<td>17</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>StudentM</td>
<td>17</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>StudentN</td>
<td>17</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

**RANK_DENSE(expression, ['asc' | 'desc'])**

Returns the dense rank for the current row in the partition. Identical values are assigned an identical rank, but no gaps are inserted into the number sequence. Use the optional 'asc' | 'desc' argument to specify ascending or descending order. The default is descending.

With this function, the set of values (6, 9, 9, 14) would be ranked (3, 2, 2, 1).

Nulls are ignored in ranking functions. They are not numbered and they do not count against the total number of records in percentile rank calculations.

For information on different ranking options, see **Table Calculation Type: Rank** on page 805.

**RANK_MODIFIED(expression, ['asc' | 'desc'])**

Returns the modified competition rank for the current row in the partition. Identical values are assigned an identical rank. Use the optional 'asc' | 'desc' argument to specify ascending or descending order. The default is descending.

With this function, the set of values (6, 9, 9, 14) would be ranked (4, 3, 3, 1).

Nulls are ignored in ranking functions. They are not numbered and they do not count against the total number of records in percentile rank calculations.

For information on different ranking options, see **Table Calculation Type: Rank** on page 805.
**RANK_PERCENTILE(expression, ['asc' | 'desc'])**

Returns the percentile rank for the current row in the partition. Use the optional 'asc' | 'desc' argument to specify ascending or descending order. The default is ascending.

With this function, the set of values (6, 9, 9, 14) would be ranked (0.25, 0.75, 0.75, 1.00).

Nulls are ignored in ranking functions. They are not numbered and they do not count against the total number of records in percentile rank calculations.

For information on different ranking options, see Table Calculation Type: Rank on page 805.

**RANK_UNIQUE(expression, ['asc' | 'desc'])**

Returns the unique rank for the current row in the partition. Identical values are assigned different ranks. Use the optional 'asc' | 'desc' argument to specify ascending or descending order. The default is descending.

With this function, the set of values (6, 9, 9, 14) would be ranked (4, 2, 3, 1).

Nulls are ignored in ranking functions. They are not numbered and they do not count against the total number of records in percentile rank calculations.

For information on different ranking options, see Table Calculation Type: Rank on page 805.

**RUNNING_AVG(expression)**

Returns the running average of the given expression, from the first row in the partition to the current row.

The view below shows quarterly sales. When `RUNNING_AVG(SUM([Sales])` is computed within the Date partition, the result is a running average of the sales values for each quarter.
Example

RUNNING_AVG(SUM([Profit])) computes the running average of SUM(Profit).

RUNNING_COUNT(expression)

Returns the running count of the given expression, from the first row in the partition to the current row.

Example

RUNNING_COUNT(SUM([Profit])) computes the running count of SUM(Profit).

RUNNING_MAX(expression)

Returns the running maximum of the given expression, from the first row in the partition to the current row.
Example

RUNNING_MAX(SUM([Profit])) computes the running maximum of SUM(Profit).

RUNNING_MIN(expression)

Returns the running minimum of the given expression, from the first row in the partition to the current row.

Example

RUNNING_MIN(SUM([Profit])) computes the running minimum of SUM(Profit).
**RUNNING_SUM(expression)**

Returns the running sum of the given expression, from the first row in the partition to the current row.

Example

`RUNNING_SUM(SUM([Profit]))` computes the running sum of `SUM(Profit)`

**SIZE()**

Returns the number of rows in the partition. For example, the view below shows quarterly sales. Within the Date partition, there are seven rows so the `SIZE()` of the Date partition is 7.

Example

`SIZE() = 5` when the current partition contains five rows.

**SCRIPT_BOOL**

Returns a Boolean result from the specified expression. The expression is passed directly to a running external service instance. In R expressions, use `.argn` (with a leading period) to reference parameters (.arg1, .arg2, etc.).
Examples

In this R example, .arg1 is equal to SUM([Profit]):

```R
SCRIPT_BOOL("is.finite(.arg1)", SUM([Profit]))
```

The next example returns True for store IDs in Washington state, and False otherwise. This example could be the definition for a calculated field titled IsStoreInWA.

```R
SCRIPT_BOOL('grepl(".*_WA", .arg1, perl=TRUE)',ATTR([Store ID]))
```

**SCRIPT_INT**

Returns an integer result from the specified expression. The expression is passed directly to a running external service instance. In R expressions, use .argn (with a leading period) to reference parameters (.arg1, .arg2, etc.)

Examples

In this R example, .arg1 is equal to SUM([Profit]):

```R
SCRIPT_INT("is.finite(.arg1)", SUM([Profit]))
```

In the next example, k-means clustering is used to create three clusters:

```R
SCRIPT_INT('result <- kmeans(data.frame(.arg1,.arg2,.arg3,.arg4),3);result$cluster;', SUM([Petal length]), SUM([Petal width]),SUM ([Sepal length]),SUM([Sepal width]))
```

**SCRIPT_REAL**

Returns a real result from the specified expression. The expression is passed directly to a running external service instance. In R expressions, use .argn (with a leading period) to reference parameters (.arg1, .arg2, etc.)

Examples

In this R example, .arg1 is equal to SUM([Profit]):

```R
SCRIPT_REAL("is.finite(.arg1)", SUM([Profit]))
```

The next example converts temperature values from Celsius to Fahrenheit.

```R
SCRIPT_REAL('library(udunits2);ud.convert(.arg1, "celsius", "degree_fahrenheit"'),AVG([Temperature]))
```

**SCRIPT_STR**

Returns a string result from the specified expression. The expression is passed directly to a running external service instance. In R expressions, use .argn (with a leading period) to reference parameters (.arg1, .arg2, etc.)
Examples

In this R example, .arg1 is equal to SUM([Profit]):

```
SCRIPT_STR("is.finite(.arg1)", SUM([Profit]))
```

The next example extracts a state abbreviation from a more complicated string (in the original form 13XSL_CA, A13_WA):

```
SCRIPT_STR('gsub(".*_", "", .arg1)',ATTR([Store ID]))
```

**TOTAL(expression)**

Returns the total for the given expression in a table calculation partition.

Example

Assume you are starting with this view:

You open the calculation editor and create a new field which you name **Totality**:
You then drop Totality on Text, to replace SUM(Sales). Your view changes such that it sums values based on the default Compute Using value:

This raises the question, What is the default Compute Using value? If you right-click (Control-click on a Mac) Totality in the Data pane and choose Edit, there is now an additional bit of information available:
The default **Compute Using** value is **Table (Across)**. The result is that **Totality** is summing the values across each row of your table. Thus, the value that you see across each row is the sum of the values from the original version of the table.

The values in the 2011/Q1 row in the original table were $8601, $6579, $44262, and $15006. The values in the table after **Totality** replaces **SUM(Sales)** are all $74,448, which is the sum of the four original values.

Notice the triangle next to Totality after you drop it on Text:

This indicates that this field is using a table calculation. You can right-click the field and choose **Edit Table Calculation** to redirect your function to a different **Compute Using** value. For example, you could set it to **Table (Down)**. In that case, your table would look like this:
WINDOW_AVG(expression, [start, end])

Returns the average of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

For example, the view below shows quarterly sales. A window average within the Date partition returns the average sales across all dates.

Example

WINDOW_AVG(SUM([Sales]), FIRST(), LAST()) computes the average of SUM(Profit) from the second row to the current row.
WINDOW_COUNT(expression, [start, end])

Returns the count of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

Example

WINDOW_COUNT(SUM([Profit]), FIRST()+1, 0) computes the count of \( \text{SUM(Profit)} \) from the second row to the current row.

WINDOW_MEDIAN(expression, [start, end])

Returns the median of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

For example, the view below shows quarterly profit. A window median within the Date partition returns the median profit across all dates.

WINDOW_MEDIAN(SUM([Profit]), FIRST(), LAST())

Example

WINDOW_MEDIAN(SUM([Profit]), FIRST()+1, 0) computes the median of \( \text{SUM(Profit)} \) from the second row to the current row.

WINDOW_MAX(expression, [start, end])

Returns the maximum of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

For example, the view below shows quarterly sales. A window maximum within the Date partition returns the maximum sales across all dates.
Example

WINDOW_MAX(SUM([Profit]), FIRST()+1, 0) computes the maximum of SUM(Profit) from the second row to the current row.

WINDOW_MIN(expression, [start, end])

Returns the minimum of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

For example, the view below shows quarterly sales. A window minimum within the Date partition returns the minimum sales across all dates.
Example

WINDOW_MIN(SUM([Profit]), FIRST()+1, 0) computes the minimum of SUM(Profit) from the second row to the current row.

WINDOW_PERCENTILE(expression, number, [start, end])

Returns the value corresponding to the specified percentile within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

Example

WINDOW_PERCENTILE(SUM([Profit]), 0.75, -2, 0) returns the 75th percentile for SUM(Profit) from the two previous rows to the current row.

WINDOW_STDEV(expression, [start, end])

Returns the sample standard deviation of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

Example

WINDOW_STDEV(SUM([Profit]), FIRST()+1, 0) computes the standard deviation of SUM(Profit) from the second row to the current row.

WINDOW_STDEVP(expression, [start, end])

Returns the biased standard deviation of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

Example

WINDOW_STDEVP(SUM([Profit]), FIRST()+1, 0) computes the standard deviation of SUM(Profit) from the second row to the current row.

WINDOW_SUM(expression, [start, end])

Returns the sum of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()-n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

For example, the view below shows quarterly sales. A window sum computed within the Date partition returns the summation of sales across all quarters.
Example

\[
\text{WINDOW\_SUM}(\text{SUM}([\text{Profit}]), \text{FIRST}()+1, 0)
\]
computes the sum of SUM(Profit) from the second row to the current row.

**WINDOW\_VAR(expression, [start, end])**

Returns the sample variance of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

Example

\[
\text{WINDOW\_VAR}((\text{SUM}([\text{Profit}]), \text{FIRST}()+1, 0)
\]
computes the variance of SUM(Profit) from the second row to the current row.

**WINDOW\_VARP(expression, [start, end])**

Returns the biased variance of the expression within the window. The window is defined by means of offsets from the current row. Use FIRST()+n and LAST()n for offsets from the first or last row in the partition. If the start and end are omitted, the entire partition is used.

Example

\[
\text{WINDOW\_VARP}(\text{SUM}([\text{Profit}]), \text{FIRST}()+1, 0)
\]
computes the variance of SUM(Profit) from the second row to the current row.

**Additional Functions**

**REGEXP\_REPLACE(string, pattern, replacement)**

Returns a copy of the given string where the regular expression pattern is replaced by the replacement string. This function is available for Text File, Hadoop Hive, Google BigQuery, PostgreSQL, Tableau Data Extract, Microsoft Excel, Salesforce, HP Vertica, Pivotal Greenplum, Teradata (version 14.1 and above), and Oracle data sources.
For Tableau data extracts, the pattern and the replacement must be constants.

For information on regular expression syntax, see your data source’s documentation. For Tableau extracts, regular expression syntax conforms to the standards of the ICU (International Components for Unicode), an open source project of mature C/C++ and Java libraries for Unicode support, software internationalization, and software globalization. See the Regular Expressions page in the online ICU User Guide.

Example

REGEXP_REPLACE('abc 123', '\s', '-') = 'abc-123'

REGEXP_MATCH(string, pattern)
Returns true if a substring of the specified string matches the regular expression pattern. This function is available for Text File, Google BigQuery, PostgreSQL, Tableau Data Extract, Microsoft Excel, Salesforce, HP Vertica, Pivotal Greenplum, Teradata (version 14.1 and above), Impala 2.3.0 (through Cloudera Hadoop data sources), and Oracle data sources.

For Tableau data extracts, the pattern must be a constant.

For information on regular expression syntax, see your data source’s documentation. For Tableau extracts, regular expression syntax conforms to the standards of the ICU (International Components for Unicode), an open source project of mature C/C++ and Java libraries for Unicode support, software internationalization, and software globalization. See the Regular Expressions page in the online ICU User Guide.

Example

REGEXP_MATCH('-(\[1234\],[The.\sMarket]\)-','\s*\(\w.*\(\w*\)\(\w*\)\)')=true

REGEXP_EXTRACT(string, pattern)
Returns the portion of the string that matches the regular expression pattern. This function is available for Text File, Hadoop Hive, Google BigQuery, PostgreSQL, Tableau Data Extract, Microsoft Excel, Salesforce, HP Vertica, Pivotal Greenplum, Teradata (version 14.1 and above), and Oracle data sources.

For Tableau data extracts, the pattern must be a constant.

For information on regular expression syntax, see your data source’s documentation. For Tableau extracts, regular expression syntax conforms to the standards of the ICU (International Components for Unicode), an open source project of mature C/C++ and Java libraries for Unicode support, software internationalization, and software globalization. See the Regular Expressions page in the online ICU User Guide.

Example

REGEXP_EXTRACT('abc 123', '[a-z]+\s+(\d+)') = '123'
REGEXP_EXTRACT_NTH(string, pattern, index)

Returns the portion of the string that matches the regular expression pattern. The substring is matched to the nth capturing group, where n is the given index. If index is 0, the entire string is returned. This function is available for Text File, PostgreSQL, Tableau Data Extract, Microsoft Excel, Salesforce, HP Vertica, Pivotal Greenplum, Teradata (version 14.1 and above), and Oracle data sources.

For Tableau data extracts, the pattern must be a constant.

For information on regular expression syntax, see your data source’s documentation. For Tableau extracts, regular expression syntax conforms to the standards of the ICU (International Components for Unicode), an open source project of mature C/C++ and Java libraries for Unicode support, software internationalization, and software globalization. See the Regular Expressions page in the online ICU User Guide.

Example

REGEXP_EXTRACT_NTH('abc 123', '([a-z]+)\s+(\d+)', 2) = '123'

Hadoop Hive Specific Functions

GET_JSON_OBJECT(JSON string, JSON path)

Returns the JSON object within the JSON string based on the JSON path.

PARSE_URL(string, url_part)

Returns a component of the given URL string where the component is defined by url_part. Valid url_part values include: 'HOST', 'PATH', 'QUERY', 'REF', 'PROTOCOL', 'AUTHORITY', 'FILE' and 'USERINFO'.

Example

PARSE_URL('http://www.tableau.com', 'HOST') = 'www.tableau.com'

PARSE_URL_QUERY(string, key)

Returns the value of the specified query parameter in the given URL string. The query parameter is defined by the key.

Example

PARSE_URL_QUERY('http://www.tableau.com?page=1&cat=4', 'page') = '1'
XPath_Boolean(XML string, XPath expression string)
Returns true if the XPath expression matches a node or evaluates to true.

Example
XPath_Boolean('<values><value id="0">1</value><value id="1">5</value>', 'values/value [@id=1] = 5') = true

XPath_Double(XML string, XPath expression string)
Returns the floating-point value of the XPath expression.

Example
XPath_Double('<values><value>1.0</value><value>5.5</value></values>', 'sum(value/*)') = 6.5

XPath_Float(XML string, XPath expression string)
Returns the floating-point value of the XPath expression.

Example
XPath_Float('<values><value>1.0</value><value>5.5</value></values>', 'sum(value/*)') = 6.5

XPath_Int(XML string, XPath expression string)
Returns the numerical value of the XPath expression, or zero if the XPath expression cannot evaluate to a number.

Example
XPath_Int('<values><value>1</value><value>5</value></values>', 'sum(value/*)') = 6

XPath_Long(XML string, XPath expression string)
Returns the numerical value of the XPath expression, or zero if the XPath expression cannot evaluate to a number.

Example
XPath_Long('<values><value>1</value><value>5</value></values>', 'sum(value/*)') = 6
**XPATH_SHORT**(XML string, XPath expression string)

Returns the numerical value of the XPath expression, or zero if the XPath expression cannot evaluate to a number.

**Example**

XPATH_SHORT('<values><value>1</value><value>5</value></values>','sum(value/*)') = 6

**XPATH_STRING**(XML string, XPath expression string)

Returns the text of the first matching node.

**Example**

XPATH_STRING('<sites><url domain="org">http://www.w3.org</url><url domain="com">http://www.tableau.com</url></sites>','sites/url[@domain="com"]') = 'http://www.tableau.com'

**Google BigQuery Specific Functions**

**DOMAIN**(string_url)

Given a URL string, returns the domain as a string.

**Example**

DOMAIN('http://www.google.com:80/index.html') = 'google.com'

**GROUP_CONCAT**(expression)

Concatenates values from each record into a single comma-delimited string. This function acts like a `SUM()` for strings.

**Example**

GROUP_CONCAT(Region) = "Central,East,West"

**HOST**(string_url)

Given a URL string, returns the host name as a string.

**Example**


**LOG2**(number)

Returns the logarithm base 2 of a number.
Example
LOG2(16) = '4.00'

LTRIM_THIS(string, string)
Returns the first string with any leading occurrence of the second string removed.

Example
LTRIM_THIS([-Sales-],'-') = 'Sales-

RTRIM_THIS(string, string)
Returns the first string with any trailing occurrence of the second string removed.

Example
RTRIM_THIS([-Market-],'') = '[-Market'

TIMESTAMP_TO_USEC(expression)
Converts a TIMESTAMP data type to a UNIX timestamp in microseconds.

Example
TIMESTAMP_TO_USEC(#2012-10-01 01:02:03#)=1349053323000000

USEC_TO_TIMESTAMP(expression)
Converts a UNIX timestamp in microseconds to a TIMESTAMP data type.

Example
USEC_TO_TIMESTAMP(1349053323000000) = #2012-10-01 01:02:03#

TLD(string_url)
Given a URL string, returns the top level domain plus any country domain in the URL.

Example
TLD('http://www.google.com:80/index.html') = '.com'

TLD('http://www.google.co.uk:80/index.html') = '.co.uk'
Operators
To create calculated fields and formulas, you need to understand the operators supported by Tableau. This section discusses the basic operators that are available and the order (precedence) of operations.

+ (addition)
This means addition when applied to numbers and concatenation when applied to strings. When applied to dates, it can be used to add a number of days to a date. For example,

7 + 3
Profit + Sales
'abc' + 'def' = 'abcdef'
#April 15, 2004# + 15 = #April 30, 2004#

– (subtraction)
This means subtraction when applied to numbers and negation if applied to an expression. When applied to dates, it can be used to subtract a number of days from a date. Hence it can also be used to calculate the difference in days between two dates. For example,

7 - 3
Profit - Sales
-(7+3) = -10
#April 16, 2004# - 15 = #April 1, 2004#
#April 15, 2004# - #April 8, 2004# = 7

* (multiplication)
This means numeric multiplication. For example, 5 * 4 = 20.

/ (division)
This means numeric division. For example, 20 / 4 = 5.

% (modulo)
This calculates a numeric remainder. For example, 5% 4 = 1.

=, =, >, <, >=, <=, !=, <> (comparisons)
These are the basic comparison operators that can be used in expressions. Their meanings are as follows: = = or =(equal to), > (greater than), < (less than), >= (greater than or equal to), <= (less than or equal to), != and <> (not equal to).
Each operator compares two numbers, dates, or strings and returns a boolean (TRUE or FALSE). Booleans themselves, however, cannot be compared using these operators. For example, TRUE=TRUE is not a valid expression. To compare booleans in this way, use the logical operators AND and OR. For example, TRUE AND TRUE is a valid expression.

^ (power)
This symbol is equivalent to the POWER function. It raises a number to the specified power. For example:

\[ 6^3 = 216 \]

AND
This is a logical operator. An expression or a boolean must appear on either side of it. For example,

\[ \text{IIF(Profit =100 AND Sales =1000, "High", "Low")} \]

If both expressions are TRUE (i.e., not FALSE and not UNKNOWN), then the result is TRUE. If either expression is UNKNOWN, then the result is UNKNOWN. In all other cases, the result is FALSE.

If you create a calculation in which the result of an AND comparison is displayed on a worksheet, Tableau displays TRUE and FALSE. If you would like to change this, use the Format area in the format dialog.

OR
This is a logical operator. An expression or a boolean must appear on either side of it. For example,

\[ \text{IIF(Profit =100 OR Sales =1000, "High", "Low")} \]

If either expression is TRUE, then the result is TRUE. If both expressions are FALSE, then the result is FALSE. If both expressions are UNKNOWN, then the result is UNKNOWN.

If you create a calculation in which the result of an OR comparison is displayed on a worksheet, Tableau displays TRUE and FALSE. If you would like to change this, use the Format area in the format dialog. The OR operator employs "short circuit evaluation." This means that if the first expression is evaluated to be TRUE, then the second expression is not evaluated at all. This can be helpful if the second expression results in an error when the first expression is TRUE, because the second expression in this case is never evaluated.

NOT
This is a logical operator. It can be used to negate another boolean or an expression. For example,

\[ \text{IIF(NOT(Sales = Profit),"Not Equal","Equal")} \]
**Precedence**

All operators are evaluated in a specific order. For example, \(2^1+2\) is equal to 4 and not equal to 6. The reason is that the * operator is always evaluated before the + operator.

The following table shows the order in which operators are evaluated. The first line has the highest precedence. Operators on the same line have the same precedence. If two operators have the same precedence they are evaluated from left to right in the formula.

<table>
<thead>
<tr>
<th>Precedence</th>
<th>Operator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>– (negate)</td>
</tr>
<tr>
<td>2</td>
<td>^ (power)</td>
</tr>
<tr>
<td>3</td>
<td>*, /, %</td>
</tr>
<tr>
<td>4</td>
<td>+, –</td>
</tr>
<tr>
<td>5</td>
<td>==, &gt;, &lt;, &gt;=, &lt;=, !=</td>
</tr>
<tr>
<td>6</td>
<td>NOT</td>
</tr>
<tr>
<td>7</td>
<td>AND</td>
</tr>
<tr>
<td>8</td>
<td>OR</td>
</tr>
</tbody>
</table>

Parentheses can be used as needed. Operators that appear within parentheses are evaluated before those outside of parentheses, starting from the innermost parentheses and moving outward. For example, \((1+(2\cdot2+1)\cdot(3\cdot6/3)) = 31\).

**Keyboard Shortcuts**

**General Keyboard Shortcuts**

Tableau keyboard shortcuts are listed below.

<table>
<thead>
<tr>
<th>Description</th>
<th>Keyboard Shortcut</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Windows</strong></td>
</tr>
<tr>
<td>Select all data</td>
<td>Ctrl+A</td>
</tr>
<tr>
<td>Use Rectangular Selection tool</td>
<td>A</td>
</tr>
<tr>
<td>Smaller cell size</td>
<td>Ctrl+B</td>
</tr>
<tr>
<td>Action</td>
<td>Windows Key Combination</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Bigger cell size</td>
<td>Ctrl+Shift+B</td>
</tr>
<tr>
<td>Copy selected data</td>
<td>Ctrl+C</td>
</tr>
<tr>
<td>Place selected field on Columns shelf</td>
<td>Alt+Shift+C</td>
</tr>
<tr>
<td>Connect to data source</td>
<td>Ctrl+D</td>
</tr>
<tr>
<td>Use Lasso Selection Tool</td>
<td>D</td>
</tr>
<tr>
<td>Describe sheet</td>
<td>Ctrl+E</td>
</tr>
<tr>
<td>Makes the find command in the Data pane active</td>
<td>Ctrl+F</td>
</tr>
<tr>
<td>Place selected field on Filters shelf</td>
<td>Alt+Shift+F</td>
</tr>
<tr>
<td>Enter/Exit Full Screen</td>
<td></td>
</tr>
<tr>
<td>Switch in and out of Presentation Mode</td>
<td>F7 , Ctrl+H</td>
</tr>
<tr>
<td>Place selected field on Size</td>
<td>Alt+Shift+I</td>
</tr>
<tr>
<td>Flip orientation of column labels at bottom of view</td>
<td>Ctrl+L</td>
</tr>
<tr>
<td>Place selected field on Detail</td>
<td>Alt+Shift+L</td>
</tr>
<tr>
<td>New worksheet</td>
<td>Ctrl+M</td>
</tr>
<tr>
<td>New workbook</td>
<td>Ctrl+N</td>
</tr>
<tr>
<td>Open file</td>
<td>Ctrl+O</td>
</tr>
<tr>
<td>Place selected field on Color</td>
<td>Alt+Shift+O</td>
</tr>
<tr>
<td>Print</td>
<td>Ctrl+P</td>
</tr>
<tr>
<td>Place selected field on Pages shelf</td>
<td>Alt+Shift+P</td>
</tr>
<tr>
<td>Place selected field on Rows shelf</td>
<td>Alt+Shift+R</td>
</tr>
<tr>
<td>Save file</td>
<td>Ctrl+S</td>
</tr>
<tr>
<td>Use Radial Selection Tool</td>
<td>S</td>
</tr>
<tr>
<td>Action</td>
<td>Keyboard Shortcuts</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Place selected field on Shape</td>
<td>Alt+Shift+S</td>
</tr>
<tr>
<td></td>
<td>Option-Shift-S</td>
</tr>
<tr>
<td>Place selected field on Text/Label</td>
<td>Alt+Shift+T</td>
</tr>
<tr>
<td></td>
<td>Option-Shift-T</td>
</tr>
<tr>
<td>Paste clipboard</td>
<td>Ctrl+V</td>
</tr>
<tr>
<td></td>
<td>Command-V</td>
</tr>
<tr>
<td>Swap rows and columns</td>
<td>Ctrl+W</td>
</tr>
<tr>
<td></td>
<td>Control-Command-W</td>
</tr>
<tr>
<td>Cut text selection (e.g., in captions,</td>
<td>Ctrl+X</td>
</tr>
<tr>
<td>titles, formulas, etc.)</td>
<td>Command-X</td>
</tr>
<tr>
<td>Place selected field on Rows shelf</td>
<td>Alt+Shift+X</td>
</tr>
<tr>
<td></td>
<td>Option-Shift-X</td>
</tr>
<tr>
<td>Redo</td>
<td>Ctrl+Y</td>
</tr>
<tr>
<td></td>
<td>Command-Shift-Z</td>
</tr>
<tr>
<td>Place selected field on Columns shelf</td>
<td>Alt+Shift+Y</td>
</tr>
<tr>
<td></td>
<td>Option-Shift-Y</td>
</tr>
<tr>
<td>Undo</td>
<td>Ctrl+Z</td>
</tr>
<tr>
<td></td>
<td>Command-Z</td>
</tr>
<tr>
<td>Clear the current worksheet</td>
<td>Alt+Shift+Backspace</td>
</tr>
<tr>
<td></td>
<td>Option-Shift-Delete</td>
</tr>
<tr>
<td>Make rows narrower</td>
<td>Ctrl+Left Arrow</td>
</tr>
<tr>
<td></td>
<td>Control-Command-Left Arrow</td>
</tr>
<tr>
<td>Make rows wider</td>
<td>Ctrl+Right Arrow</td>
</tr>
<tr>
<td></td>
<td>Control-Command-Right Arrow</td>
</tr>
<tr>
<td>Make columns shorter</td>
<td>Ctrl+Down Arrow</td>
</tr>
<tr>
<td></td>
<td>Control-Command-Down Arrow</td>
</tr>
<tr>
<td>Make columns taller</td>
<td>Ctrl+Up Arrow</td>
</tr>
<tr>
<td></td>
<td>Control-Command-Up Arrow</td>
</tr>
<tr>
<td>Show Me!</td>
<td>Ctrl+1, Ctrl+Shift+1</td>
</tr>
<tr>
<td></td>
<td>Command-1</td>
</tr>
<tr>
<td>Add the selected field to the sheet. Only</td>
<td>Enter</td>
</tr>
<tr>
<td>works with a single field</td>
<td>Return</td>
</tr>
<tr>
<td>Opens the Help</td>
<td>F1</td>
</tr>
<tr>
<td></td>
<td>Shift-Command-Question Mark</td>
</tr>
<tr>
<td>Deletes the selected sheet (on a dashboard)</td>
<td>Ctrl+F4</td>
</tr>
<tr>
<td>Closes the current workbook</td>
<td>Alt+F4</td>
</tr>
<tr>
<td></td>
<td>Command-W</td>
</tr>
<tr>
<td>Starts and stops forward playback</td>
<td>F4</td>
</tr>
</tbody>
</table>
### Navigation and Selection Shortcuts

In addition to the standard keyboard shortcuts there are several key combinations that can make navigating and selecting marks fast and easy.

<table>
<thead>
<tr>
<th>Description</th>
<th>Keyboard/Mouse Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Windows</strong></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Selects the mark</td>
<td>Click</td>
</tr>
<tr>
<td>Selects a group of marks</td>
<td>Drag</td>
</tr>
<tr>
<td>Adds individual marks to the selection</td>
<td>Ctrl+Click</td>
</tr>
<tr>
<td>Adds a group of marks to the selection</td>
<td>Ctrl+Drag</td>
</tr>
</tbody>
</table>
### Pans around the view

<table>
<thead>
<tr>
<th>Description</th>
<th>Shift+Drag</th>
<th>Shift-Drag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zooms in to a point in the view</td>
<td>Double-click, Ctrl+Shift+Click</td>
<td>Double-click, Shift-Command-Click</td>
</tr>
<tr>
<td>(requires zoom mode if not map)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooms out from a point on a map</td>
<td>Ctrl+Shift+Alt+Click</td>
<td>Shift-Option-Command-Click</td>
</tr>
<tr>
<td>(requires zoom mode if not map)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooms out</td>
<td>Shift+Double-click</td>
<td>Shift–Double-click</td>
</tr>
<tr>
<td>Zooms in to an area in the view</td>
<td>Ctrl+Shift+Drag</td>
<td>Shift-Command-Drag</td>
</tr>
<tr>
<td>(requires zoom mode if not map)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooms in and out on a map</td>
<td>Scroll</td>
<td>Scroll</td>
</tr>
<tr>
<td>Drags a row and scrolls through a long list</td>
<td>Click+Drag to bottom of pane+Hold</td>
<td>Click-Scroll, Command-Hold</td>
</tr>
<tr>
<td>simultaneously</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Field Selection Shortcuts

There are several key and mouse combinations that can make creating a view and selecting fields fast and easy.

<table>
<thead>
<tr>
<th>Description</th>
<th>Keyboard/Mouse Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Windows</td>
</tr>
<tr>
<td>Opens the Drop Field menu</td>
<td>Right-click+Drag to shelf</td>
</tr>
<tr>
<td>Copies a field in the view to be placed on another shelf or card</td>
<td>Ctrl+Drag</td>
</tr>
<tr>
<td>Adds a field to the view</td>
<td>Double-click</td>
</tr>
</tbody>
</table>

### Toolbar

Hide or display the Tableau toolbar by selecting **Window > Show Toolbar**.

The table below explains the functions of each toolbar button.
<table>
<thead>
<tr>
<th>Toolbar Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Tableau icon" /></td>
<td><strong>Tableau icon:</strong> navigates to the start page. For more information, see <a href="#">Start Page</a> on page 122.</td>
</tr>
<tr>
<td><img src="image" alt="Undo" /></td>
<td><strong>Undo:</strong> reverses the most recent action in the workbook. You can undo an unlimited number of times, back to the last time you opened the workbook, even after you have saved. For more information, see <a href="#">Undo and Redo</a> on page 526.</td>
</tr>
<tr>
<td><img src="image" alt="Redo" /></td>
<td><strong>Redo:</strong> repeats the last action you reversed with the Undo button. You can redo an unlimited number of times.</td>
</tr>
<tr>
<td><img src="image" alt="Save" /></td>
<td><strong>Save:</strong> saves the changes made to the</td>
</tr>
<tr>
<td>Toolbar Button</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>workbook. For more information, see <strong>Saving Your Work</strong> on page 1143.</td>
</tr>
<tr>
<td><img src="image" alt="New Data Source" /></td>
<td><strong>New Data Source:</strong> opens the <strong>Connect</strong> pane, where you can create a new connection or open a saved connection. For more information, see <strong>Connect to Your Data</strong> on page 340.</td>
</tr>
<tr>
<td><img src="image" alt="Pause Auto Updates" /></td>
<td><strong>Pause Auto Updates:</strong> controls whether Tableau updates the view when changes are made. Use the drop-down menu to automatically update the entire sheet or just use filters. For more information,</td>
</tr>
<tr>
<td>Toolbar Button</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td><img src="image" alt="Turn off Automatic Updates button" /></td>
<td><strong>Run Update:</strong> runs a manual query of the data to update the view with changes when automatic updates are turned off. Use the drop-down menu to update the entire worksheet or just use filters.</td>
</tr>
<tr>
<td><img src="image" alt="New Worksheet button" /></td>
<td><strong>New Worksheet:</strong> creates a new blank worksheet. Use the drop-down menu to create a new worksheet, dashboard, or story. For more information, see <a href="page">Creating New Worksheets, Dashboards</a>.</td>
</tr>
</tbody>
</table>

see Turn off Automatic Updates to Boost Performance on page 1627.
<table>
<thead>
<tr>
<th>Toolbar Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Duplicate Sheet" /></td>
<td><strong>Duplicate Sheet:</strong> creates a new worksheet containing the same view as the current sheet. For more information, see <a href="#">Duplicating Sheets on page 235</a>.</td>
</tr>
<tr>
<td><img src="image" alt="Clear" /></td>
<td><strong>Clear:</strong> clears the current worksheet. Use the drop-down menu to clear specific parts of the view such as filters, formatting, sizing, and axis ranges.</td>
</tr>
<tr>
<td><img src="image" alt="Swap" /></td>
<td><strong>Swap:</strong> moves the fields on the <strong>Rows</strong> shelf to the <strong>Columns</strong> shelf and vice versa. The <strong>Hide Empty Rows</strong> and <strong>Hide Empty</strong></td>
</tr>
</tbody>
</table>

*and Stories on page 233.*
<table>
<thead>
<tr>
<th>Toolbar Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Columns</strong> settings are always swapped with this button.</td>
</tr>
<tr>
<td><img src="image" alt="Sort Ascend-ing" /></td>
<td><strong>Sort Ascending:</strong> applies a sort in ascending order of a selected field based on the measures in the view. For more information, see <a href="#">Sorting on page 444</a>.</td>
</tr>
<tr>
<td><img src="image" alt="Sort Descending" /></td>
<td><strong>Sort Descending:</strong> applies a sort in descending order of a selected field based on the measures in the view. For more information, see <a href="#">Sorting on page 444</a>.</td>
</tr>
<tr>
<td><img src="image" alt="Highlight" /></td>
<td><strong>Highlight:</strong> turns on highlighting for the selected sheet. Use the options on the drop-down</td>
</tr>
<tr>
<td>Toolbar Button</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>menu to define how values are highlighted. For more information, see [Highlight Toolbar Button](page 1030).</td>
<td></td>
</tr>
<tr>
<td>Group Members: creates a group by combining selected values. When multiple dimensions are selected, use the drop-down menu to specify whether to group on a specific dimension or across all dimensions. For more information, see [Groups](page 458).</td>
<td></td>
</tr>
<tr>
<td>Show Mark Labels: switches between showing and hiding mark labels for the</td>
<td></td>
</tr>
<tr>
<td>Toolbar Button</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>current sheet. For more information, see Mark Labels on page 504.</td>
<td></td>
</tr>
<tr>
<td>Fix Axes: switches between a locked axis that only shows a specific range and a dynamic axis that adjusts the range based on the minimum and maximum values in the view. For more information, see Edit Axes on page 964.</td>
<td></td>
</tr>
<tr>
<td>Fit specifies how the view should be sized within the window. Select Normal fit, Fit Width, Fit Height, or Entire View.</td>
<td></td>
</tr>
<tr>
<td>Show/Hide Cards: shows and hides specific cards in a worksheet.</td>
<td></td>
</tr>
<tr>
<td>Toolbar Button</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>Select each card that you want to hide or show on the drop-down menu.</td>
</tr>
<tr>
<td><img src="image" alt="Presentation Mode" /></td>
<td><strong>Presentation Mode</strong>: switches between showing and hiding everything except the view (i.e., shelves, toolbar, Data pane). For more information, see <a href="#">Reorganizing the Workspace on page 246</a>.</td>
</tr>
<tr>
<td><img src="image" alt="Show Me" /></td>
<td><strong>Show Me</strong>: helps you choose a view type by highlighting view types that work best with the field types in your data. For more information, see <a href="#">Show Me on page 551</a>.</td>
</tr>
</tbody>
</table>
Pass Expressions to R

R is an open source software programming language and a software environment for statistical computing and graphics. In Tableau Desktop, you can use a set of four functions to pass R expressions to an Rserve server and obtain a result. The functions are

SCRIPT_BOOL
SCRIPT_INT
SCRIPT_REAL
SCRIPT_STR

See Table Calculation Functions on page 1393 for details and examples.

Before you can use any of the SCRIPT functions, you must establish a connection to an Rserve server, which is a server that allows applications to access R functionality. See Rserve for details. And for more information about using R with Tableau, see the blog post Tableau 8.1 and R.

Tableau has been tested with R versions 3.1 and 3.2, and with Rserver version 0.6-8.

Configure an Rserve Connection

To configure an Rserve connection, follow these steps:

1. On the Help menu in Tableau Desktop choose Settings and Performance > Manage Exernal Service connection to open the External Service Connection dialog box:

   ![External Service Connection dialog box]

2. Enter or select a server name using a domain or an IP address. The drop-down list includes localhost and the server you most recently connected to.

3. Specify a port. Port 6311 is the default port for Rserve servers.
4. If the server requires credentials, specify a Username and Password.

5. Click **Test Connection**.

6. Click **OK**.

If no connection can be established, an error message is displayed. Click **Show Details** in the message to see any diagnostic information returned by the server.

---

**Share a Workbook That Requires an Rserve Connection**

You may need to send a workbook that contains R functionality to other users, who may be using different copies of Tableau Desktop on other computers. Or, users may download a workbook from Tableau Server that contains R functionality. Before users will be able to use the R functionality in workbooks they have received or downloaded to Tableau Desktop, they must configure Rserve connections on their computers.

---

**Publish a Workbook That Requires an Rserve Connection**

Before you publish a workbook that relies on an Rserve connection to Tableau Server, you should configure Tableau Server to have its own Rserve connection. You do this by configuring settings with `tabadmin set`. The settings are equivalent to the values you set in the Rserve Connection dialog box. They are:

- `vizqlserver.rserve.host`
- `vizqlserver.rserve.port`
- `vizqlserver.rserve.username`
- `vizqlserver.rserve.password`

**Note:** The settings `vizqlserver.rserve.username` and `vizqlserver.rserve.password` should be omitted if Tableau Desktop connects to RServe without a username and password.

For information on how to use the above `tabadmin set` options to configure Tableau Server, see [Change Tableau Server’s Configuration from the Command Line](https://www.tableau.com/support/change-tableau-server’s-configuration-from-the-command-line.html).

Tableau cannot verify that workbooks that use R will render properly on Tableau Server. There might be scenarios where a required statistical library is available on a user’s machine but not on the Rserve instance that Tableau Server is using.

For views that cannot be rendered in Tableau Server because of an R script error, you see a warning error when you publish the workbook:
This worksheet contains R scripts, which cannot be viewed on the target platform until the administrator configures an Rserve connection.

You cannot publish a workbook that contains R scripting to Tableau Online.

Because Tableau Server provides an authentication mechanism, it can be more secure to expose Rserve functionality to users through Tableau Server than in Tableau Desktop.

Troubleshooting R Connections

This topic describes errors you can receive when Tableau is connected to an Rserve server— or attempting to connect to an Rserve server. It also lists issues that you may encounter as you use R with Tableau.

Note: Tableau technical support cannot assist with writing, troubleshooting, or debugging R scripts.

Error Messages below

Other Issues on page 1436

Error Messages

<table>
<thead>
<tr>
<th>Error Message</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsupported type passed as an argument to SCRIPT function.</td>
<td>Tableau can only export the following Tableau data types to R:</td>
</tr>
<tr>
<td></td>
<td>• Number (Decimal)</td>
</tr>
<tr>
<td></td>
<td>• Number (Whole)</td>
</tr>
<tr>
<td></td>
<td>• Boolean</td>
</tr>
<tr>
<td></td>
<td>• String</td>
</tr>
<tr>
<td></td>
<td>• Date</td>
</tr>
<tr>
<td></td>
<td>• Date/Time</td>
</tr>
<tr>
<td>Unexpected number of results returned by SCRIPT function.</td>
<td>The R script result must be either a scalar or vector of length one that is replicated for</td>
</tr>
<tr>
<td></td>
<td>all rows, or a vector of length equal to the number of rows in the Tableau result table.</td>
</tr>
</tbody>
</table>

- 1432 -
<table>
<thead>
<tr>
<th>Function expected</th>
<th>Occurs when an invalid data type is received. Tableau can only import the following data types from R:</th>
</tr>
</thead>
</table>
| %2 values; %1 values were returned. | - RDouble  
- RInteger  
- RLogical  
- RCharacter |
| The result returned by the SCRIPT function is of an unexpected type. | This error is also reported if the result is null or if there was a script execution error for which Tableau could not collect an explanation from R. |
| This worksheet contains R scripts, which are not supported on the target platform. | This error is reported when you attempt to publish a worksheet containing an R script to a server that does not allow R scripts because `vizqlserver.script.disabled` is set to true. |
| This worksheet contains R scripts, which cannot be viewed on the target platform until the administrator configures an Rserve connection. | This error is reported when the server is configured to prevent Desktop from publishing worksheets with R scripts because `vizqlserver.script.disabled` is set to false. (The setting is named contrary to its meaning: true means Desktop can publish worksheets with R scripts, false means Desktop cannot publish worksheets with R scripts.)  
Setting `vizqlserver.script.disabled` to false will not prevent Tableau Online users from using `tabcmd` to publish workbooks with R scripts; however, the resulting views will generate this error when opened in a browser. |
<p>| An error occurred while communicating with the Rserve service. | Tableau runs all R scripts inside of the &quot;try&quot; R function. This error is displayed along with an R generated error message when the “try” function traps an R evaluation error. |
| This Rserve connection does not support authentication. |  |</p>
<table>
<thead>
<tr>
<th>Error Description</th>
<th>Suggested Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Try connecting without specifying a password.</td>
<td>Authentication failed. Please provide a valid Rserve username and password.</td>
</tr>
<tr>
<td>An unsupported authentication type is enabled in Rserve.</td>
<td>Either disable Rserve authentication or change to plaintext password authentication.</td>
</tr>
<tr>
<td>No Rserve connection configured. Specify a server name and try again.</td>
<td>See Pass Expressions to R on page 1430.</td>
</tr>
<tr>
<td>The calculation &quot;%1&quot; contains a disabled R script. Configure an Rserve connection to enable custom R scripts.</td>
<td>See Pass Expressions to R on page 1430.</td>
</tr>
<tr>
<td>The workbook you are attempting to publish contains custom R scripts. Custom R scripts are not allowed in public workbooks.</td>
<td>You cannot publish workbooks containing R scripts to Tableau Public.</td>
</tr>
<tr>
<td>Tableau Public does not support running R scripts. To take advantage of R integration, upgrade to Tableau Professional.</td>
<td>The &quot;Tableau Public&quot; in this error refers to Tableau Desktop Public.</td>
</tr>
<tr>
<td>Issue</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Tableau Reader cannot load custom R scripts.</td>
<td>You cannot view workbooks containing R scripts in Tableau Reader.</td>
</tr>
<tr>
<td>Rserve is busy or not responding.</td>
<td>Tableau has timed out a read pending on connection to Rserve — the timeout is 250ms.</td>
</tr>
<tr>
<td>Rserve is busy or not responding.</td>
<td>An IPC connection Read of the Rserve protocol header has thrown an exception.</td>
</tr>
<tr>
<td>Unrecognized Rserve signature.</td>
<td>The Rserve header signature must be &quot;Rsrv&quot;.</td>
</tr>
<tr>
<td>Unrecognized Rserve version.</td>
<td>The Rserve header version must be &quot;0103&quot;.</td>
</tr>
<tr>
<td>Unrecognized Rserve protocol.</td>
<td>The Rserve header protocol must be &quot;QAP1&quot;.</td>
</tr>
<tr>
<td>Authentication failure when connecting to R.</td>
<td>Tableau attempted and failed to authenticate with Rserve. Verify that you entered a valid password.</td>
</tr>
<tr>
<td>Incorrect number of bytes in parameter/body.</td>
<td></td>
</tr>
<tr>
<td>The length of data which Tableau read does not equal the length promised by the header.</td>
<td></td>
</tr>
<tr>
<td>Unrecognized response type.</td>
<td>The transport protocol type when reading a result was not SEXP as expected.</td>
</tr>
<tr>
<td>Excessively long &lt;type&gt;vector.</td>
<td>Unreasonably large number measuring the length of data sent to or from Rserve possibly indicating a corrupt protocol header.</td>
</tr>
</tbody>
</table>
Table 1: Tableau Issues

<table>
<thead>
<tr>
<th>Issue</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalid Rserve command.</td>
<td>Tableau may have improperly implemented the Rserve protocol.</td>
</tr>
<tr>
<td>Response from server was Error &quot;&lt;&lt; (uint32_t)status &lt;&lt; &quot;. See Rsrv.h for details.</td>
<td>Various error conditions are documented in the comments in Rsrv.h.</td>
</tr>
<tr>
<td>Excessively long header offset.</td>
<td>This may be due to a garbled header with an unreasonable offset to response data.</td>
</tr>
<tr>
<td>Rserve socket failed.</td>
<td>A login, script evaluation, read pending check, result read, or Tableau field to R script argument assignment threw a non-standard exception.</td>
</tr>
</tbody>
</table>

**Other Issues**

**SCRIPT Functions Run Even in Logical Statements That Evaluate as False**

A function that sends an expression to a running Rserve instance will be executed even when it is within a logical statement that would otherwise prevent it from being executed. This is true for logical functions such as IF, IIF, and CASE. For example:

```
IF 1==0 THEN

[[R script code]]

ELSE

"1 does not equal 0"

END
```

**Glossary**

**action**

An interaction that you can add to your views. There are three types of action: Filter, Highlight, and URL.
ad-hoc calculation
A calculation that you can create and update as you work with a field on a shelf in the view. Also known as type-in calculation or in-line calculation.

aggregation
A result of a mathematical operation applied to a measure. Predefined aggregations include summation and average. You can convert dimensions to measures by aggregating them as a count. For relational data sources, all measures must be either aggregated or disaggregated (unless they appear on the Filters shelf). Tableau aggregates measures, usually as a summation, when you place them on a shelf. For multidimensional (OLAP) data sources, aggregations are defined when the cube is created and cannot be modified in Tableau.

alias
An alternative name that you can assign to a field or to a dimension member.

Analytics pane
A pane on the left side of your workbook that provides quick and easy access to common analytic features in Tableau. From the Analytics pane, you can drag reference lines, box plots, trend lines forecasts, and other items into your view. Toggle between the Data pane and the Analytics pane by clicking one of the tabs at the top of the side bar.

bin
A user-defined grouping of measures in the data source.

blending data
The process of combining data from different data source types in a view. The first data source that you use in the view becomes the primary data source. The remaining data sources become the secondary.
**bookmark**
A .tbm file in the Bookmarks folder in the Tableau repository that contains a single worksheet. Much like web browser bookmarks, .tbm files are a convenient way to quickly display different analyses.

**calculated field**
A new field that you create by using a formula to modify the existing fields in your data source.

**caption**
A description of the current view on the active worksheet. For example, “Sum of Sales for each Market”. You can automatically generate captions or create your own custom captions. Show and hide the caption by selecting Worksheet > Show Caption.

**cell**
A basic element of any table that you create in Tableau. You can control cells to enhance your data view, which is useful for text tables and heat maps.

**color legend**
An area of the view that displays the colors associated with a measure or dimension member. The default legend is modified when you place a dimension or a measure on the Color property.

**Color property**
A property on the Marks card that enables you to encode data by assigning different colors to the marks in a view. The property accepts measures and dimensions. When you place a dimension on the Color property, Tableau separates the marks according to the members in the dimension, and assigns a unique color to each member. When you place a measure on the Color property, Tableau draws each mark with a different color using a continuous range. In both cases, a legend describes the color encoding.
Columns shelf
A shelf at the top of the workbook that you use to create the columns of a data table. The shelf accepts any number of dimensions and measures. When you place a dimension on the Columns shelf, Tableau creates headers for the members of that dimension. When you place a measure on the Columns shelf, Tableau creates quantitative axes for that measure. See also Rows shelf.

crosstab
A text table view. Use text tables to display the numbers associated with dimension members.

cube
A data source that is connected to a multidimensional database. Also known as multidimensional data source. For example, data sources that connect to Microsoft Analysis Services or Oracle Essbase are called cubes.

custom geocoding
A process of adding your own location data to extend the built-in geocoding.

dashboard
A combination of several views arranged on a single page. Use dashboards to compare and monitor a variety of data simultaneously.

Data Interpreter
A tool that parses your Excel or Google Sheets data source to help prepare your data for analysis.

Data pane
A pane on the left side of the workbook that displays the fields of the data sources to which Tableau is connected. The fields are divided into dimensions and measures. The Data pane also displays custom fields such as calculations, binned fields, and groups. You build views of your data by dragging fields from the Data pane onto the various shelves that are a part of every worksheet.
**data source**
The source of data outside or inside Tableau.

**Data Source page**
A page where you can set up your data source. The Data Source page generally consists of four main areas: left pane, join area, preview area, and metadata area.

**data view**
see: view

**Detail property**
A property on the Marks card that you can use to separate the marks in a view according to the level of detail (that is, members) of a dimension. The Detail property works only on aggregated data.

**dimension**
A field of categorical data. Dimensions typically hold discrete data such as hierarchies and members that cannot be aggregated. Examples of dimensions include dates, customer names, and customer segments. See also: measure.

**encoding**
A visual representation of your data. You can encode your data by color, shape, size, and path using the associated worksheet shelves.

**extract**
A saved subset of a data source that you can use to improve performance and analyze offline. You can create an extract by defining filters and limits that include the data you want in the extract.
field
A dimension or a measure in a database. For relational data sources, fields are the columns of a table. For cube (multidimensional) data sources, fields are the dimensions of a cube. Each dimension or column contains a unique attribute of the data, such as customer name, sales, or product type.

field label
A row or column heading that indicates the data field used to create the view. For example, a view that has rows for East, Central, and West might have a Region field label at the top of the column indicating that each row is a member of the Region field.

Filters shelf
A shelf on the left of the workbook that you can use to exclude data from a view by filtering it using measures and dimensions.

forecast
A calculation that predicts future trends based on current trends and data.

Format pane
A pane that contains formatting settings that control the entire worksheet, as well as individual fields in the view. When open, the Format pane appears on the left side of the workbook.

group
A field you can use to combine dimension members into higher level categories. For example, you could group a dimension that contains states into regions. Groups are marked with a paper clip icon in the Data pane.
header
A label for member names for each field that you place on Rows or Columns.

hexagonal binning
A technique for clustering data in a two-dimensional plane.

in-line calculation
see: ad-hoc calculation

join area
An area at the top of the Data Source page where you can drag tables or select queries or cubes to set up your data source. See also: Data Source page.

join condition
A relationship between fields in a join. You can define the relationship in the join area of the data source. See also: joining.

joining
A process of combining data from multiple tables in same-type data sources.

level of detail (LOD) expression
A syntax that supports aggregation at dimensionalities other than the view level. With level of detail expressions, you can attach one or more dimensions to any aggregate expression.
LOD
see: level of detail (LOD) expression

marks
A part of the view that visually represents one or more rows in a data source. A mark can be, for example, a bar, line, or square. You can control the type, color, and size of marks.

Marks card
A card to the left of the view where you can drag fields to control mark properties such as type, color, size, shape, label, tooltip, and detail.

measure
A field of quantitative data. Measures are fields that are dependent variables. They are typically quantitative fields or calculated fields like sales, temperature, or frequency. You can also create discrete measures in Tableau. See also: dimension.

metadata area
An area that can be accessed from the Data Source page by clicking the metadata button and that displays the fields in your data source as rows so that you can quickly examine the structure of your data source and perform routine management tasks, such as renaming fields or hiding multiple fields at once. When connected to cube data, the metadata displays by default. See also: Data Source page.

multidimensional data source
see: cube

packaged workbook
A single zip file with a .twbx extension that contains a workbook along with any supporting local file data sources and background images. Use this
format to package your work for sharing with others who don’t have access to the data.

**Pages shelf**
A shelf to the left of the view that you can use to split a view into a sequence of pages based on the members and values in a discrete or continuous field. Adding a field to the Pages shelf is like adding a field to the Rows shelf, except that a new page is created for each new row.

**pane**
An area in the table that is created by the intersection of rows and columns. Tables consist of one or more panes. The number of panes in a view depends on the number and type of fields placed on the Rows and Columns shelves.

**parameter**
A dynamic value that can replace a constant value in calculations, filters, and reference lines.

**pass-through function**
A function that sends SQL expressions directly to the database to access custom database functions.

**Path property**
A property on the Marks card that you can use to encode data by connecting marks using a particular drawing order. The property accepts measures and dimensions. Dimensions connect the marks according to the members in the dimension. If the dimension is a date, the drawing order is given by the date order. If the dimension contains words, the line is drawn based on the order of the words in the data source. Measures connect the marks according to the values of the measure. The measure can be aggregated or dis-aggregated. See also: path.

**pill**
A field in the view.
preview area
An area at the bottom of the Data Source page where you can review the fields and the first 10,000 rows of the data in the data source. You can also use preview area to make general modifications to your data source, such as hiding or renaming a field, or changing its data type. See also: Data Source page.

primary data source
The first data source that you use in a blended view. See also: blending data, secondary data source.

query
A set of formalized instructions that Tableau uses to communicate with databases. Common query languages include SQL and MDX. Every time you build a view of your data, Tableau translates your actions into queries and retrieves the requested information from the data source. If you are building a dense data view, you can turn queries off until all the fields you want are placed on shelves.

relational data source
A data source that is connected to a relational database.

relational database
A database that presents information in tables with rows and columns. Examples of relational databases that Tableau supports are Excel workbooks, Access databases, comma-delimited text files, MySQL database, and Tableau Data Extract files.

Repository
A collection of workbooks, bookmarks, data sources, and logs. By default, the Tableau Repository is located on the drive where Tableau is installed, in the My Documents\My Tableau Repository folder.
**Rows shelf**
A shelf at the top of the workbook that you can use to create the rows of a data table. The shelf accepts any number of dimensions and measures. When you place a dimension on the Rows shelf, Tableau creates headers for the members of that dimension. When you place a measure on the Rows shelf, Tableau creates quantitative axes for that measure.

**secondary data source**
A second or subsequent data source that you use in a blended view. See also: blending data, primary data source.

**set**
A custom field that defines a subset of data based on some conditions. A set can be based on a computed condition or on a specific data point in the view. Sets appear at the bottom of the Data pane in the Sets area.

**Shape legend**
A legend that displays the shapes associated with dimension members. The legend appears on worksheets that have a dimension placed on the Shape shelf.

**Shape shelf**
A shelf to the left of the view that you can use to encode data by assigning different shapes to the marks in the view. The Shape shelf accepts dimensions only. When you place a dimension on the shelf, Tableau separates the marks according to the members of the dimension, and a legend describes the encoding. You cannot place a measure on the shelf because measures do not contain members.

**sheet**
A view (also known as worksheet), dashboard, or story. Sheets appear as tabs at the bottom of the workbook.
shelves
Named areas to the left and top of the view. You build views by placing fields onto the shelves. Some shelves are available only when you select certain mark types. For example, the Shape shelf is available only when you select the Shape mark type.

Size shelf
A shelf to the left of the view that allows you can use to encode data by assigning different sizes to the marks in the view. The Size shelf accepts measures and dimensions. When you place a dimension on the shelf, Tableau separates the marks according to the members in the dimension, and assigns a unique size to each member. When you place a measure on the shelf, Tableau assigns a different size to each mark using a continuous range.

small multiples
A view that contains small multiple charts of the same type.

story
A sheet that contains a sequence of views or dashboards that work together to convey information.

story point
An individual view in a story.

table
A visual presentation of a data view. Tables consist of panes, headers, and cells.

table calculation
A computation that uses data from multiple rows in the database and that is applied to the values in the table.
**Text shelf**
A shelf to the left of the view that you can use to view the numbers associated with a view, and to encode data by assigning text labels to the marks. The shelf accepts measures and dimensions. The most common view using the Text shelf is a text table.

**tooltip**
Data details that appear when you hover over one or more marks in the view.

**type-in calculation**
see: ad-hoc calculation

**view**
A representation of your data in a Tableau worksheet or dashboard. You can create data views by placing fields on shelves.

**workbook**
A file with a .twb extension that contains one or more worksheets (and possibly also dashboards and stories).

**worksheet**
A sheet where you build views of your data by dragging fields onto shelves.

**Quick Starts**
Quick Starts are one-page articles that let you quickly review how a feature works and that provide links to more detailed information.

This topic lists the Quick Start categories for Tableau Desktop. You can find Quick Starts for other Tableau products here:

- Tableau Server
- Tableau Online
Quick Starts about Data Sources and Connections

The first step to analyzing data in Tableau is connecting to a data source. Quick Starts in this section help you get up and running with specific data sources, and also introduce working with extracts of your data as opposed to working with a live connection, explain ways to keep your data fresh, introduce working with your data in the grid on the Data Source page, and talk about ways to package and publish your data for others to see or work with.

Quick Start: Aggregated Extracts

You can optimize your extracts by only including the data you need. Specifically, you can exclude columns, create filters to limit the number of rows, aggregate data, and roll up dates.

1 Hide unused fields

Hidden fields are not included when you create an extract. By hiding unnecessary fields before you create an extract, you make the extract smaller and improve performance.

On the Data pane, click the drop-down arrow to the right of Dimensions and select **Hide All Unused Fields** from the context menu.

2 Define filters for the extract

Right-click the data source and select **Extract Data**.
In the dialog box, optionally define one or more filters to limit how much data gets extracted.

**Global filters are automatically added as filters on the extract.**

---

### 3 Aggregate data for visible dimensions

After defining any filters, select **Aggregate data for visible dimensions**. This aggregates the data using the default aggregation for measures.

If the extract contains Date fields, you can also select **Roll up dates to** to adjust date granularity and further minimizing the size of the extract.
4 Click Extract

When ready, click Extract and specify a location for the extract (TDE) file. The extract will only contain the visible fields and the data will be aggregated as you specified.

Refresh the extract at any time by selecting Data > Refresh All Extracts from the toolbar.

Quick Start: Automatically Update Workbook to Use Published Data Source

Publishing a data source is now as easy as clicking Publish data source on the Server menu. When you publish a data source, by default your workbook is updated to use the published data source.

Use the published data source (default)

When you publish a data source to Tableau Server or Tableau Online, the publishing process replaces the local version of the data source in your workbook with the published version. This new automated process replaces the manual four-step process you had to follow to update your workbook to use a published version of the data source, rather than the local version.

In addition to streamlining the publishing process, this new functionality also makes it easy for you to keep your workbook data refreshed. Simply schedule the extract for periodic refreshes, and your workbook will be automatically updated with the refreshed data.
Use the local data source

If you need to, you can continue to use the local data source, rather than a published data source. For example, you may want to use a local data source if the purpose of your workbook is to manage the data source.

- If the data source has not yet been published, when you publish the data source to Tableau Server or Tableau Online, clear the Update workbook to use the published data source check box.
- If the data source has been published and your workbook has been updated to use the published data source, click the Undo button to go back to the local data source. Note that this action does not remove the data source from the server.

Quick Start: Combine Tables Using Cross-Database Joins

When related data is stored in tables across different databases, you can use a cross-database join to combine the tables.

To create a cross-database, you must create a multi-connection Tableau data source. You do so by adding and then connecting to each of the different databases (including Excel and text files) before you join.

1 Connect to data

On the start page, under Connect, click a connector to connect to your data. This step automatically creates the first connection in the Tableau data source.
2 Add another connection

Add new connections only if the data comes from different databases. For example, add new connections to each database if you need to analyze tables from a text file and tables from Google Sheets.

In the left pane, under **Connections**, click the **Add** button to add a new connection to the Tableau data source.

A data source with more than one connection is referred to as a multi-connection data source.

**Note:** If the connector you want is not available from the **Connect** list, cross-database joins are not supported for the combination of sources that you want to join. This includes connections to cube data (e.g., Microsoft Analysis Services), extract-only data (e.g., Salesforce, Google Analytics, and OData), and Tableau Server data sources. Instead of joining tables, consider using data blending. For more information, see **Blend Your Data** on page 363.

3 Combine your data using a cross-database join

Drag tables from each connection to the canvas in order to create the cross-database join.

After you have joined the tables, you can update the data grid to show the new columns and rows in the multi-connection data source. Tableau colors the tables in the canvas and the columns in the data grid to show you which connection the data comes from.
By default, Tableau creates an inner join, but you can choose a left join.

You can fix broken joins

Before you join tables using a cross-database join, make sure that the data types of the join keys match. If the data types of the join keys don’t match, the join breaks, which is indicated by a red exclamation point. To fix a broken join, take one of the following steps:

- For text or Excel-based data, modify the data type of one of the text or Excel fields in the join key using the data type menu in the data grid.
- For most connections, you can use the Convert to custom SQL option to change the data type of one of the fields in the join key. The Convert to custom SQL option is available only when the data source contains only one connection. In this case, remove the second connection and then select Data > Convert to custom SQL.

4 Continue to prepare your multi-connection data source for analysis

After you’ve created a cross-database join, continue to prepare your multi-connection data source for analysis. You can rename and reset fields, create calculations, clean your Excel data with the Data Interpreter, change the data types of text and Excel-based fields, and so on. Keep the following points in mind:

Calculations and multi-connection data sources: Only a subset of calculations can be used in a multi-connection data source. You can use a specific calculation if it is 1.) supported by all the connections in the multi-connection data source and 2.) supported by Tableau extracts.

Pivot data from within a connection: To pivot data, you must use text columns or Excel columns from the same connection.

Union data within a connection: To union data, you must use text tables or Excel tables from the same connection.
Quick Start: Connect to Google Analytics

Google Analytics is a service that provides website owners data and detailed statistics about visitors to their website. As a website owner who subscribes to Google Analytics, you can use Tableau Desktop to connect directly to your Google Analytics data, analyze, and obtain rich insights about your website.

1 Sign in to Google

On the start page, under Connect, click Google Analytics. Then, sign in to Google Analytics with the email and password associated with your Google Analytics account. To complete the initial connection process, click Accept to let Tableau Desktop access your Google Analytics account.

2 Select a date range

Select from a list of preset date ranges to limit your data.
Google Analytics can provide complete data only up to the previous full day. For example, if you choose **Last 30 days**, data will be retrieved for the last 30-day period ending yesterday.

---

### 3 Select dimensions and measures

You can select up to seven dimensions and ten measures. When selecting measures, you can use a predefined measure group or customize your own group.
Some dimensions and measures cannot be used together. For more information, see Google Analytics Dimensions & Metrics Reference on the Google developer website.

4 Extract data

After completing the steps in the top area of the data source page, Tableau creates an extract of your data.

To update your extract you can perform a full or incremental extract refresh.

Quick Start: Connect to Salesforce

Salesforce.com is a web-based customer relationship management (CRM) application. You can use Tableau Desktop to directly connect to Salesforce.com so that you can analyze and answer questions about your accounts, contacts, opportunities, and more. In addition to Salesforce.com, you can use Tableau Desktop to connect to Force.com and Database.com.

1 Log in to Salesforce

On the start page, under Connect, click Salesforce. Enter the user name and password for your Salesforce account, and then click Log In. Then, in the Allow Access dialog box, click Allow.
2 Use built-in queries

Connect to your Salesforce data using one of the built-in queries under **Standard Connection**. These queries contain commonly used tables and joins.
Alternatively, you can create your own custom query.

3 Extract data

After you connect to Salesforce and complete the data source page by selecting or creating a query, click the sheet tab to start your analysis. When you click the sheet tab, Tableau creates an extract of your data. **Note:** Because of limitations in Salesforce, the extract process can take a very long time, depending on the query.
After the initial extract of your Salesforce data is created, we recommend that you publish the extract to Tableau Server and use the extract for any subsequent connections. To update your extract, you can perform a full or incremental extract refresh.

**Quick Start: Connect to Your Data**

In any analytics project, preparing your data for analysis is just as important as the analysis itself. Tableau makes it easy for you to connect to and bring your data into Tableau, combine, and quickly review the data before you begin analysis.

1 **Connect to your data**

On the start page, under **Connect**, click a file or database type (in this example, Microsoft SQL Server), and then enter the authentication information to connect.
2 Combine data (joins)

Select the file or database or schema. Then click and drag associated sheets, tables, or stored procedures to join sets. Otherwise, click the join icon to define the join type and clause. Choose from inner, left, right, and full outer. If you don’t want to join your data, click the sheet tab to start your analysis.
The data that you drag into the top area of the data source page will be the data source from which you will build your view. Tableau never changes the underlying data.

3 Review the data and change data types

Click **Update Now** to review the first 1,000 rows of the data source (or enter the number you want to see in the **Rows** text box). Every time you make changes to the joins, click **Update Now**. If you want changes in the joins to be automatically reflected in the grid, click **Automatically Update**. You can then make other modifications, such as changing the data type or renaming a column.

4 Connection options and data source filters

At the top of the data source page, select a live or extract connection to the data source. You can also edit your extract and add data source filters. Click the sheet tab to start your analysis.
Quick Start: Data Blending

If you need to analyze data from different databases, but the databases are not supported in a multi-connection data source, or the tables you need to analyze are at different levels of detail, use data blending. Data blending allows you to combine data from multiple data sources onto a single sheet. The Data pane includes a list of all the data sources you’re connected to. Relationships between the data sources are automatically created—or you can define custom relationships.

1 Connect to Multiple Data Sources

Select Data > Connect to Data and connect to your data. Then connect to another data set. The data sources are shown in a drop-down list at the top of the Data pane.
After you add a field to the view, the Data pane shows the secondary data source with a colored bar down the left side. If you don’t see such a bar, it means that Tableau has not yet determined which data source is the primary data source. As you start adding fields to the view the bar will appear.

2 Use Fields From Both Data Sources

When you drag a field from a secondary data source into the view, Tableau automatically creates relationships between the data sources (if it can). The related fields are marked with a Link icon in the Data pane.
In this view, the bars are created using the Sales values from the primary connection (Superstore Sales) while the reference lines show the Sales Plan values from the secondary connection (Sales Plan).

3 Create Custom Relationships

Relationships are automatically created based on field names. But you can define custom relationships by choosing Data > Edit Relationships.
4 Edit and Define Relationships

In the Relationships dialog box, select the primary data source in the drop-down at the top of the dialog box. Then select the secondary data source. Automatic relationships are shown, but you can select Custom and then click Add to link pairs of fields from the respective data sources.
Quick Start: Data Grid Enhancements
The following enhancements made to the grid on the Data Source page help you better see the data in your data source and prepare it for analysis.

A Sort columns and rows

Sort columns: Sort columns in the grid and metadata grid by selecting a sort option from the Sort fields drop-down list. Sort the columns by table or data source order.

Sort rows: Sort rows by clicking the sort button. Click the sort button once to sort rows in ascending order, click the sort button again to sort rows in descending order, and then click the sort button a final time to clear the sort.
A Modified sort state can occur when some tasks cause new columns to be added to the grid.

B Change or reset field names

**Rename column:** Double-click the name of the column to rename the field.

**Reset name:** If you’ve renamed a field, click the column drop-down menu, and then select **Reset Name** to revert back to the original name of the field. You can also select multiple columns and perform the same action.

Original name indicates the name specified in the underlying data. You can use the **Revert** command to reset field names that have changed as a result of naming improvements Tableau has automatically made.
Create new columns and see extract data

Create new calculations: Create new calculations, groups, or bins based on existing fields in the data source. Click the column drop-down arrow and select one of the respective options.

If you create an aggregate calculation, the values displayed in the grid are not meaningful until the calculation is used in context of the view’s level of detail.

See extract data: For the Web Data Connector, file- and relational-based data sources in Extract mode, you can see extract data in the grid, including extract only calculations like MEDIAN.

When in Extract mode, the row order of the values in the data source might be different than the row order of values in Live mode.

Copy values: Copy values in the grid by selecting the values and then pressing Ctrl+C (Command-C on a Mac). Alternatively, to copy values in the metadata grid, select the values, right-click, and then select Copy.

Quick Start: Hierarchies

When you connect to a data source, Tableau automatically separates date fields into hierarchies so you can easily break down the view by year, quarter, month, etc. You can also
create your own custom hierarchies. For example, if you have a set of fields named Region, State, and County, you can create a hierarchy from these fields so that you can quickly drill down between levels.

**Drag and drop fields in the Data pane**

Create hierarchies simply by dragging fields on top of other fields in the Data pane. After that you can reorder the levels of the hierarchy by dragging and dropping within the Data pane.

When you drag a member of the hierarchy to the view, you can use the plus and minus (+/-) buttons on the field on the shelf to drill through the levels.

**Note:** You can also create hierarchies by selecting multiple fields in the Data pane, right-clicking and selecting Create Hierarchy.

**Quick Start: Incremental Extract Updates**

When you import all or some of your data into Tableau’s data engine, you create a data extract. After you create the initial extract, you can set up an incremental refresh so that importing new data doesn’t require you to rebuild the entire extract. An incremental refresh can be defined by the values in a specified column. For example, if you’ve created an extract that has date values, you can define the incremental refresh to only add new rows if there are additions in the date column.

1. **Create an Extract**

Right-click the data source (or control-click on a Mac) and choose Extract Data to create the initial extract. You must do a full extract before you can set up an incremental refresh.
2 Configure the Incremental Refresh

After the data is imported, open the extract dialog box again and choose **Incremental refresh**. Select the column you want to use to identify new records from the drop-down. When finished, click **Extract**.
3 View Extract History

You can see a list of the updates that have been made since the initial extract by right-clicking the extract data source and choosing Extract > History.
4 Add Data from a File

If you regularly receive updates in a CSV or Excel file, you can add data to the extract directly from the local file by right-clicking the extract data source and choosing Extract > Append Data from File.
The local file must have the same columns as the original data source.

**Quick Start: Manage Incremental Extracts**

When you publish a workbook that has an incremental extract, you can associate it with up to two refresh tasks that Tableau Server will handle for you: An incremental refresh of the extract and a full refresh. After you publish the workbook, you or a Tableau Server administrator can modify any tasks that are associated with the workbook. You can also delete tasks or add more.

1 **Publish and Assign a Schedule**

In Tableau Desktop, after you create a workbook that uses an extract, go to **Server > Publish Workbook**, and click **Scheduling & Authentication**. Next, choose schedules for your refreshes and click OK.
After you publish in Tableau Desktop and choose your refresh schedules, Tableau Server handles the refresh tasks for you.

2 Select the Workbook

To modify a workbook’s scheduled task, sign in to Tableau Server and on the Workbooks page, select the workbook:
3 Access the Refresh Schedule

Click **Refresh Schedule**.

Select the check box for the refresh task you want to modify:
4 Edit, Delete, or Add More Tasks

Select the action you want to take—for example, **Change Schedule**—and make your selection. You can also delete the task, change its priority, or add more refresh tasks.

**Quick Start: Manage Metadata**

Use the metadata area to quickly examine and change the structure of the Tableau data source. You can use the metadata area to review the columns in your data and their data types, do routine management tasks such as renaming a column, hiding a column, changing the data type of a column, and changing the geographical role of the column.

**Note:** Metadata management tasks vary when working with a multi-dimensional data source.
1 Go to the metadata area

After you have set up your data source, click the metadata area button. If you are connected to a cube (multidimensional) data source, the metadata area is shown by default. For other data source types, such as Salesforce or Tableau data extracts (TDE), the default view will vary.

2 Review metadata

The columns of the data source are represented as rows in the metadata area. Each row shows the data type of the column, the column name in the Tableau data source, the name of the table in the underlying data from which the column comes, and the name of the column in the underlying data.
3 Manage metadata

Depending on the type of data you’re connected to, you can perform routine management tasks like hiding multiple columns at once or quickly renaming columns. For example, to hide multiple columns at once, press the CTRL or Command key, select the columns you want to hide, click the drop-down arrow next to a column name, and then select Hide. Changes that you make in the metadata area of the data source do not modify your underlying data.
Quick Start: Packaged Workbooks

Often, workbooks reference files that are stored on your local computer. These files might be Excel or Access files you used as data sources, Tableau extracts, or background image files. You can save copies of these local files along with your workbook in a single file called a packaged workbook. Packaged workbooks are easy to share with others.

1 Save As a Packaged Workbook

On the top menu in your workbook, click File > Save As and select Tableau Packaged Workbook as the type.

The file extension for packaged workbooks is .twbx.

2 Share Your Work with Others

A packaged workbook is a single file that contains a copy of all of the referenced local files, so you can easily share it using email, a shared file system, or by publishing to Tableau Server.

3 Opening Packaged Workbooks

To open a packaged workbook in Tableau Desktop, double-click the file on your computer, or drag and drop the file onto the running application.
4 Unpackaging Workbooks

You can access the packaged files at anytime by unpackaging the workbook. Right-click the packaged workbook file on your PC (or control-click on a Mac) and select Unpackage.

Unpackaging produces a workbook file (twb) along with a folder containing all of the referenced files.
Quick Start: Pivot Data from Columns to Rows

Sometimes, analyzing data that is stored in a crosstab format can be difficult in Tableau. When working with this type of data, you can pivot your data from crosstab format into columnar format.

For example, suppose you have the number of devices sold by quarter for three vendors in three separate fields. You can pivot your data so that the vendor is in one field and the number of devices sold is in another field.

1 Pivot the data

After you have set up the data source, in the grid, select two or more columns. Click the drop-down arrow next to the column name, and then select Pivot. New columns called "Pivot field names" and "Pivot field values" are created and added to the data source. The new columns replace the original columns that you selected to create the pivot.
Pivot is available only for non-legacy Microsoft Excel and text file data sources.

2 Add to the pivot

To add more data to the pivot, select another column, click the drop-down arrow next to the column name, and then select Add to Pivot. Make sure that the pivot columns and values look as expected before you begin your analysis.

To remove a pivot, click the drop-down arrow next to the name of a pivot column, and then select Remove Pivot.

Quick Start: Publish a Data Source to Tableau Online

You can publish data sources so that other Tableau Desktop users can connect to your data, and to have updates you make to the published data source flow to all workbooks that rely on it. This topic assumes you are familiar with setting up your data model and signing in to Tableau Online. For more information, see the related links at the bottom.

For help publishing data to Tableau Server, see Quick Start: Publish a Data Source to Tableau Server.
1 Sign in and initiate publishing

1. If you’re not already signed in to the site you want to publish to, select Server > Sign In, and sign in the way you normally to do Tableau Online.

2. Select Server > Publish Data Source. If your workbook is connected to multiple data sources, you can select the data source you want to publish.

3. In the Publish data source to Tableau Server dialog box, do the following:
   - Select the project you want to publish to and enter the data source name.
   - Add a description and tags that will help other users find your data source

2 Select the authentication type

The options available for accessing the data source depend on the type of data you publish. For descriptions of all of the authentication types, see Set Credentials for Accessing Your Published Data in the Tableau Desktop Help.

Information appears at the bottom of the dialog box to let you know whether you need to take further action, such as adding Tableau Online to your data provider’s authorized list.
3 Use the published data source

By default, when you publish, Tableau updates the workbook you're publishing from to use the published data source, and then closes the local data source. You can clear this check box if you want the workbook to continue to use the local data source.

For more information, see Quick Start: Automatically Update Workbook to Use Published Data Source.

4 Set up a refresh schedule

As you publish an extract of a data source that Tableau Online cannot reach directly, such as one that you maintain inside your organization's firewall, you are prompted to start the Tableau Online sync client and set up a scheduled refresh for that data source. Select the computer on which you want to run the sync client (My Computer is the computer you are publishing from).
Quick Start: Publish a Data Source to Tableau Server

You can publish data sources so that other Tableau Desktop users can connect to your data, and to have updates you make to the published data source flow to all workbooks that rely on it.

If you want to publish to Tableau Online, see **Quick Start: Publish a Data Source to Tableau Online** on page 1483.

1. Sign in to the server

If you're not already signed in to the server you want to publish to, select **Server > Sign In**, and enter your server name and user name and password.
2 Start the publishing process

1. Select **Server > Publish Data Source**.

   If your workbook is connected to multiple data sources, select the data source you want to publish from the submenu.

2. In the **Publish data source to Tableau Server** dialog box, do the following:
   - Select the project you want to publish to and enter the data source name.
   - Add a description and tags that will help other users find your data source.

3 Select the authentication type

The options available for accessing the published data source depend on the type of data you publish. The following image shows options for a SQL Server data source.
**4 Use the published data source**

By default, when you publish, Tableau updates the workbook you're publishing from to use the published data source and closes the local data source. You can clear this check box if you want the workbook to continue to use the local data source.

For more information, see **Quick Start: Automatically Update Workbook to Use Published Data Source** on page 1451.

**See also**

- Publish Data Sources and Workbooks
- Publish a Data Source

**Quick Start: SAP HANA Single Sign-On**

When SAP HANA is configured to support single sign-on (SSO), after you sign in to the SAP HANA server, you can access data, and publish data sources and workbooks to Tableau Server, without having to re-enter your user name and password. And, you can publish a data source or workbook so that other users with SSO can access the published data sources and workbooks without having to enter their user names and passwords.

**Important:** Your environment must be correctly configured to support SSO for SAP HANA:

- Tableau Desktop requires SAP HANA driver version 1.00.85 and later.
- Tableau Server must be configured to support SSO for SAP HANA. For information, see

1 Connect to SAP HANA using SSO

On the start page in Tableau Desktop, under Connect, select SAP HANA, specify a server name, select Use Windows Authentication, and then click Sign In.

![SAP HANA Connection](image)

2 Create a data source or a workbook

After you connect to SAP HANA data, you can set up a data source and publish it to Tableau Server for others to use. You can also create a view and publish the workbook to Tableau Server.
3 Publish to Tableau Server with SSO enabled

In an SSO environment, users don’t have to enter their credentials to access a data source or a workbook if you publish it to Tableau Server with the correct authentication mode.

Data Source

To enable SSO when you publish a data source to Tableau Server, follow these steps:

1. Select **Server > Publish Data Source**
2. Under Data Sources, click **Edit**.
3. In the Manage Data Sources dialog box, do the following:
   1. Select the **Publish Type: Embedded in workbook** or **Published separately**.
   2. Select **Viewer credentials** for **Authentication**.
4. Click **Publish**.
Workbook

To enable SSO when you publish a workbook to Tableau Server, follow these steps:

1. Select **Server > Publish Workbook**.
2. Under Data Sources, click **Edit**.
3. In the Manage Data Sources dialog box, do the following:
   1. Select the **Publish Type**: Embedded in workbook or Published separately.
   2. Select **Viewer credentials** for Authentication.
4. Click **Publish**.
Quick Start: Split a Field into Multiple Fields

Sometimes, it is easier to analyze a string fields if its values are separated into multiple fields. Use the Split and Custom Split commands to split string values from one field into multiple fields.

1 Split the field

After you have set up the data source, you can have Tableau automatically split the field based on a common separator or do a custom split of a field by specifying the common separator and the number of fields.

Note: The split and custom split commands are available for the following data sources types: Tableau data extracts, Microsoft Excel, Text, Salesforce, OData, Microsoft Azure Market Place,
Google Analytics, HP Vertica, Oracle, MySQL, PostgreSQL, Teradata, Amazon Redshift, Aster Data, Google Big Query, Cloudera Hadoop Hive, Hortonworks Hive, and Microsoft SQL Server.

**Split fields automatically**

In the grid, click the drop-down next to the column name. Select **Split**.

If Tableau cannot identify a common separator among the string values you are prompted to create a custom split.

**Use a custom split**

In the grid, click the drop-down arrow next to the column name of the column you want to split. Select **Custom Split**.
In the **Custom Split** dialog box, specify the following:

1. In the **Use the separator** box, enter the separator by which to separate the values in the field. The separator can be a character or a combination of characters or phrases.

2. Under **Split off**, select whether to split the string values for every instance (**All**) of the separator, the first (**First**) \( n \) instances of the separator, or the last \( n \) instances (**Last**) of the separator.

3. Enter the number of fields you want to generate from the split.
2 Review the results

New fields are created and added to the data source as calculated fields. If the new fields do not look as expected, you can undo the changes. After you verify that the split values look as expected, begin your analysis by clicking the sheet tab.

Note: You can also make modifications to the new split fields by editing the calculated fields from the Data pane in the sheet tab.

<table>
<thead>
<tr>
<th>Order ID</th>
<th>Calculation Order ID - Split 1</th>
<th>Calculation Order ID - Split 2</th>
<th>Calculation Order ID - Split 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA-2013-152156</td>
<td>CA 2013 152156</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA-2013-152156</td>
<td>CA 2013 152156</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA-2013-136568</td>
<td>CA 2013 136568</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US-2012-108966</td>
<td>US 2012 108966</td>
<td></td>
<td></td>
</tr>
<tr>
<td>US-2012-108966</td>
<td>US 2012 108966</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA-2011-115812</td>
<td>CA 2011 115812</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CA-2011-115812</td>
<td>CA 2011 115812</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Quick Start: Union Tables

When you create joins, you combine two or more tables of data by adding fields (columns). With unions, you can combine two or more tables of data by appending values (rows) from one table to another. You can union Microsoft Excel or text file-based tables that share the same fields. That is, to union two or more disparate tables, the related fields in each table must have matching field names and data types. For example, before you can union two single-field tables that contain customer names, both field names must be called "Customer Name" and both field data types must be string.

1 Connect to your Excel or text file data

On the start page, under Connect, click Excel or Text File to connect to your Excel or text file-based data.
2 Create a union

Double-click **New Union** to set up the union.
3 Union tables

Select individual tables from the left pane and drag it into the Union dialog box. To add multiple tables to a union at the same time, in the left pane, press **Shift** or **Ctrl**, select the tables you want to union, and then drag them below the first table. Click **Apply** or **OK** to complete the union.
4 Edit the union

Click the union drop-down arrow and then select **Edit union** to rename the union, add or remove individual tables in the union, or change the search criteria to include or exclude more tables in the union.
After you have unioned the tables, additional fields are added automatically generated to help identify where in the original data the values in the union are derived coming from. Review these values and the other values in the grid.

Continue to prepare your data source for analysis by joining other tables to the union table and making general modifications to the fields in the grid, such as pivot and split. When you are finished, click the sheet tab to start your analysis.

You can troubleshoot unions

If you notice some fields with null values, it could be because field names in the union table do not match. In this case, you can merge the non-matching fields by selecting two or more columns in the grid, clicking the column drop-down arrow, and then selecting **Merge mismatched fields**. When you use this option, a new field replaces the fields with the null values in to the Tableau data source. **Note**: You can also create a calculation to merge fields or combine fields by modifying the underlying Excel or text file data.
Quick Start: Use Data Interpreter to Prepare the Data Source for Analysis

Sometimes, the format of the data in your Microsoft Excel or Google Sheets data makes it difficult to analyze in Tableau. For example, your data might include sub-tables, hierarchical headers, extraneous headers and footers, or blank rows and columns. The Data Interpreter draws out sub-tables and removes some of that extraneous information to help prepare the data source for analysis.

1 Turn on the Data Interpreter

After you have connected to your data and set up the data source, if Tableau detects sub-tables, unique formatting, or some extraneous information, the Data Interpreter option becomes available. Select the Use Data Interpreter check box.

2 Review results

The Data Interpreter draws out sub-tables and removes the extraneous information from your Tableau data source and automatically updates the grid with its interpretation. You can also click the Review results link to see a copy of the data source. The data source copy contains annotation definitions and annotations that describe how your data was interpreted.
3 Begin your analysis

If you like the interpretations made by the Data Interpreter, you can begin your analysis by clicking the sheet tab. Alternatively, you can clear the **Use Data Interpreter** check box to use the original data source.

---

**Quick Start: Use Initial SQL Parameters**

You can pass parameters to your data source in an initial SQL statement. There are several reasons why this is useful:

- You can configure impersonation using the `TableauServerUser` or `TableauServerUserFull` parameters.
- If your data source supports it, you can set up row-level security (for example, for Oracle VPD or SAP Sybase ASE) to make sure that users see only the data that they are authorized to see.
- You can provide more details in logging, for example, the Tableau version or the workbook name.
Note: If you use the **TableauServerUser**, **TableauServerUserFull**, or **WorkbookName** parameter in an initial SQL statement, you will create a dedicated connection that can’t be shared. This will also restrict cache sharing, which can enhance security, but may also slow performance.

### Supported parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Example of returned value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TableauServerUser</strong></td>
<td>The user name of the current server user. Use when setting up impersonation on the server. Returns an empty string if the user is not signed in to Tableau Server.</td>
<td>asmith</td>
</tr>
<tr>
<td><strong>TableauServerUserFull</strong></td>
<td>The user name and domain of the current server user. Use when setting up impersonation on the server. Returns an empty string if the user is not signed in to Tableau Server.</td>
<td>domain.lanasmith</td>
</tr>
<tr>
<td><strong>TableauApp</strong></td>
<td>The name of the Tableau application.</td>
<td>Tableau Desktop Professional Tableau Server</td>
</tr>
<tr>
<td><strong>TableauVersion</strong></td>
<td>The version of the Tableau application.</td>
<td>9.3</td>
</tr>
<tr>
<td><strong>WorkbookName</strong></td>
<td>The name of the Tableau workbook. Use only in workbooks with an embedded data source.</td>
<td>Financial-Analysis</td>
</tr>
</tbody>
</table>

### Examples

The following examples show different ways you can use parameters.

- This example sets the security context on Microsoft SQL Server:

  ```sql
  EXECUTE AS USER = [TableauServerUser] WITH NO REVERT;
  ```

- This example can be used to help set up row-level security for Oracle VPD:

  ```sql
  begin
  DBMS_SESSION.SET_IDENTIFIER([TableauServerUser]);
  end;
  ```

- This example shows how, on a DataStax data source, you can use parameters to add
detail to logging or to set up a session variable to keep track of the data:

```sql
SET TABLEAUVERSION [TableauVersion];
```

**Note:** Oracle PL/SQL blocks require a trailing semicolon to terminate the block. Consult Oracle documentation for the proper syntax.

**Quick Start: Use Tableau Server Data Sources**

You may be able to use Tableau Server data sources that were created by an administrator or another workbook author. Because the data extract and any required database connection information or database drivers are stored within the data source on the server, using a Tableau Server data source is a fast way to quickly connect to data and start authoring. Tableau Server data sources can also contain a layer of workbook customizations such as calculations. Although you cannot alter customized fields that come with the data source, you can create additional customizations. You can also create a local copy of the data source, update or enhance it, and then republish it.

1 **Connect to Tableau Server**

On the start page in Tableau Desktop, under Connect, click Tableau Server, and then specify a server name and provide any necessary sign-in information.
You may need to provide a user name and a password, depending on how Tableau Server is authenticating users.

2 Select your Data Source

After you log in to Tableau Server, select a data source. It will load in the Data pane with a Tableau Server icon.
3 Create and Customize the View

Create one or more views in Tableau Desktop. You won’t be able to modify customizations that came with the data source, such as calculations, groups, and sets, but you can add new customizations of your own.
4 Publish a Modified Version of the Data Source

To create a data source that adds your customizations to the original, right-click the data source (or control-click on a Mac) and select Create Local Copy. A local, writable copy of the data source is created.
Quick Start: Query All Data from Google Analytics

When working with Google Analytics (GA) data, GA can restrict the amount of data that it returns from a query and provide sampled data instead. Performing analysis on sampled data can skew results and cause inaccurate inferences about the entire data set. In version 9.2, Tableau has made enhancements to GA queries to avoid returning sampled data by taking a single GA query, creating multiple queries from it, and then combining the results from the queries to bypass the query restrictions that cause sampling to occur.

1 Connect to GA data

From Tableau Desktop, on the start page and under Connect, click Google Analytics. Sign in to Google, select a date range, and then select the necessary dimensions and measures to create your query.
2 Compare queries

Tableau detects that your GA query might return sampled data, and, by default, returns all data instead.

If the GA query stays within the boundaries of the query restrictions, GA doesn't return sampled data and you do not see the above message.

The image below compares the same Google Analytics data set in version 9.1 and 9.2. The query in version 9.1 returns sampled data while the query in version 9.2 returns all data.
3 Troubleshoot issues with returning all data

If your query continues to return sampled data, consider the following:

- **Missing date dimension** – You must use the date dimension in your query to return all data.

- **Too much data** – Your query might contain too much data. Reduce the date range. **Note:** The minimum date range is one day.

- **Non-aggregatable dimensions and measures** – Some dimensions and measures cannot be separated into multiple queries. If you suspect a problematic dimension or measure in your query, hover over the All data button to see the tooltip that shows which dimensions or measures to remove from your query. For more information about these types of dimensions and measures, see Sampled Data from Google Analytics.

- **Legacy workbooks** – Workbooks created in Tableau Desktop 9.1 and earlier cannot return all data. Open the legacy workbook in Tableau Desktop 9.2, and save the workbook.

4 Return sampled data instead

In some cases when workbook performance is critical or there are specific dimensions and measures you want to use in your query that are not supported by Tableau’s default query process, use sampled data instead. To return sampled data, click the **Sample data** button.
Quick Starts about Visual Analysis

There are many features and techniques you can use as you explore your data in Tableau. Some of these are easiest to get through from the Analytics pane, and others become available after you’ve gotten a little deeper into your data.

The following Quick Starts highlight specific chart types, introduce specific tools, and explain ways to group and filter data.

Quick Start: Advanced Selection Tools

Tableau has a set of advanced selection tools that display in the view toolbar in the upper left corner of the view. Use the advanced selection tools to select multiple marks in the view.

1 Show the View Toolbar

By default, the view toolbar displays when you hover over a map view. To display the view toolbar in another view, right-click anywhere in the view and select Show View Toolbar.

The Show View Toolbar settings also apply to the view in Tableau Server and Tableau Online.

2 Open the Selection Tool Menu

Hover over the arrow on the view toolbar.
3 Pick a Selection Tool

Pick one of the following selection tools.

Lasso  Radial  Rectangular

Click and drag across the view to select marks.

Quick Start: Analytics Pane

The Analytics pane provides quick and easy access to common analytic objects in Tableau. You can drag reference lines, forecasts, trend lines, and other objects into your view from the Analytics pane, which appears on the left side of the workspace.

1 Analytics at Your Fingertips

Toggle between the Data pane and the Analytics pane by clicking one of the tabs at the top of the Side Bar:
2 Add an Analytics Object

To add an object from the Analytics pane, drag it into the view. When you drag an object from the Analytics pane, Tableau shows the possible destinations for that object in a drop target area in the upper left section of the view—drop the object within one of the red boxes.
The terms Table, Pane and Cell define the scope for the object.

3 Edit an Analytics Object

To edit an object you have added from the Analytics pane, click the object and choose **Edit**.

![Order Date Chart](image)

To edit a distribution band, you must click on the outer edge--clicking in the middle of the band has no effect.

**Quick Start: Area Charts**

An area chart is a line chart where the area between the line and the axis are shaded with a color. These charts are typically used to represent accumulated totals over time and are the conventional way to display stacked lines. Follow the steps below to create an area chart.

1 **Build a Stacked line chart**

Drag a dimension to the Columns shelf and a Measure to the Rows shelf. Then drag another dimension to **Color** on the Marks card.
This example shows the sum of total quantity by ship mode.

2 Select the Area mark type

The Automatic mark type will show this type of view as lines. On the Marks card, select Area to show the data as an area chart.
3 Adding formatting

You can add formatting to an area chart. For example, you can edit the color legend and turn on mark labels and borders.
4 Highlight the areas

You can also use highlight actions with area charts. For example, selecting a color in the legend or turning on the highlighter will highlight the entire area instead of just the line.
**Quick Start: Box Plots**

A box plot, also known as a box-and-whiskers plot, is a graphical display type well known to statisticians. Box plots provide quick insight into the distribution of data.

1 Use Show Me

Use Show Me to create a box plot.
2 Set Box Plot Options

To change the appearance of a box plot, select the box plot in the view, and then click **Edit**. Set the whisker distance, specify whether to show individual marks, and select the style of the box plot.

3 View Box Plot Statistics

To see statistics for a box plot, hover the cursor over it.
Box Plot Styles

Tableau offers a range of different styles to choose from when you format a box plot.

<table>
<thead>
<tr>
<th>Modern</th>
<th>Glass</th>
<th>Classic</th>
<th>Classic with Dual Fill</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Box Plot Style 1" /></td>
<td><img src="image2.png" alt="Box Plot Style 2" /></td>
<td><img src="image3.png" alt="Box Plot Style 3" /></td>
<td><img src="image4.png" alt="Box Plot Style 4" /></td>
</tr>
</tbody>
</table>

**Quick Start: Bullet Graphs**

A bullet graph is a variation of a bar graph developed to replace dashboard gauges and meters. A bullet graph is useful for comparing the performance of a primary measure to one or more other measures. Below is a single bullet graph showing how actual sales compared to estimated sales. Follow the steps below to learn how to create a bullet graph.

1. Select two measures to compare

   Hold down the Ctrl key (⌘ on the Mac) on your keyboard and select two measures in the Data pane.
2 Click Show Me on the toolbar

In Show Me, click the Bullet Graph view type.
Two types of reference lines are added: a line to indicate a target or goal, and a distribution to show ranges of performance.

3 Swap Reference Line Fields

Sometimes you might want to swap the reference lines fields. For example, the actual sales is shown as a reference distribution instead of a bar. To swap the two measures, right-click (control-click on the Mac) the axis and select **Swap Reference Line Fields**.
4 Refine by editing the reference lines

Right-click (control-click on the Mac) the axis in the view and select **Edit Reference Line**, and then select one of the reference lines to modify.
Add a measure to **Detail** to make it available as the target measure.

**Quick Start: Find Clusters in Data**
Cluster analysis partitions marks in the view into clusters, where the marks within each cluster are more similar to one another than they are to marks in other clusters.

1 **Add clusters to a view**

Drag **Cluster** from the **Analytics** pane into the view, and drop it on in the target area in the view:
Tableau adds **Clusters on Color**, and colors the marks in your view by cluster.

2 Configure clustering results

Let Tableau determine the optimal number of clusters, or specify exactly how many clusters you want, in the Clusters dialog box. You can also add or remove variables—the fields that determine the clusters. The default variables are the measures in the view when you create the clusters.
3 Assess the result

Does the view give you the insight you were aiming for? If not, you can continue to fine-tune the clusters by changing the number of clusters or adding or removing variables. To re-open the Clusters dialog box, click the Clusters field on the Marks card and choose Edit clusters.
4 See what the statistics say

It's not enough to know which marks are in what cluster. You also need to know what factors influenced the results. To get another perspective on clustering results, click the Clusters field on the Marks card and choose Describe clusters.

The table at the bottom of the Models tab in the Describe Clusters dialog box shows the average value for each variable in each cluster:

<table>
<thead>
<tr>
<th>Clusters</th>
<th>Number of Items</th>
<th>Avg. Life Expectancy Female</th>
<th>Avg. Life Expectancy Male</th>
<th>Avg. Population 65+</th>
<th>Avg. Population Urban</th>
<th>Tourism/PerCapita</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster 1</td>
<td>80</td>
<td>74.216</td>
<td>69.903</td>
<td>0.0048493</td>
<td>0.5325</td>
<td>159.312</td>
</tr>
<tr>
<td>Cluster 2</td>
<td>52</td>
<td>56.75</td>
<td>54.429</td>
<td>0.031889</td>
<td>0.21327</td>
<td>20.775</td>
</tr>
<tr>
<td>Cluster 3</td>
<td>29</td>
<td>79.164</td>
<td>71.706</td>
<td>0.15493</td>
<td>0.05312</td>
<td>120.82</td>
</tr>
<tr>
<td>Cluster 4</td>
<td>30</td>
<td>83.267</td>
<td>78.255</td>
<td>0.13405</td>
<td>0.07120</td>
<td>130.43</td>
</tr>
<tr>
<td>Not Clustered</td>
<td>26</td>
<td>Not available</td>
<td>Not available</td>
<td>Not available</td>
<td>Not available</td>
<td>Not available</td>
</tr>
</tbody>
</table>

Quick Start: Combination Charts

Combination charts are views that use multiple mark types in the same sheet. For example, you may show sum of profit as bars with a line across the bars showing sum of sales. You can also use combination charts to show multiple levels of detail in the same view. For example, you can have a line chart with individual lines showing average sales over time for each customer segment, then you can have another line that shows the combined average across all customer segments.

1 Customize marks

Click one of the measure names on the Marks card, and then select a mark type that is different than the other measure on the Marks card.
**2 Layer multiple panes**

Right-click a measure on the **Rows** or **Columns** shelf and select **Dual Axis**. The two mark types are now layered on top of each other.
Some marks can be hidden behind others. To move the marks forward or backward, right-click (control-click on a Mac) an axis in the view and select Move Marks to Back or Move Marks to Front.

3 Switch between panes

To switch between the layered panes, on the Marks card, select a measure name. For each pane you can change the mark type, colors, shapes, sizes, and other options.
4 Synchronize the axes

Right-click the secondary axis in the view and select **Synchronize Axis** to keep the two axes on the same scale.
Quick Start: Combine and Compare Sets

Sets are subsets of your data that meet certain conditions. A set can be based on a computed condition, such as a set that contains only customers with sales over a certain threshold. Computed sets update as your data changes. Alternatively, a set can be based on specific data points in your view. Follow the steps below to create a new set, add and remove data from sets, and combine sets.

1 Create a Set

There are many ways to create a set. To create a set with specific data points, select the marks in the view and then select Create Set on the tooltip. Alternatively, right-click (control-click on Mac) a dimension in the Data pane and select Create Set to create a computed set. Complete the Create Set dialog box.
The new set displays in the Sets area at the bottom of the Data pane.

2 Add and remove from Sets

If you created a set using specific data points, you can add more data to or subtract data from the set. After you select marks in the view, click the Sets drop-down menu on the tooltip and click Add to or Remove from to add or remove data from a particular set.

You can only add and remove from sets that share the same dimensions as the selected mark.

3 Compare In/Out values

Instead of looking at the individual members of a set, you can instead compare the members that are in the set to the ones that are not. To show in/out values in a set, right-click (control-click on Mac) a set in the view and select Show In/Out of Set.
4 Create combination sets

To combine multiple sets into a new combination set, right-click (control-click on Mac) two sets in the Data pane and select Create Combined Set. In the Create Set dialog box, specify how you want to combine the two sets.
Quick Start: Create Custom Territories on a Map

You can create custom territories on a map by grouping locations together. For example, if you have a map of total sales for each state in the United States, you can combine several or all of those states into a group to create a sales territory.

When you create territories, Tableau adds a separate geographic group field in the Data pane. Your existing geographic fields are not changed.

1 Select locations to group into a territory

On a map view, select several locations (marks) that you want to group into a custom territory.

2 Create the first group (your first territory)

On the tooltip that appears, click the Group icon, and then select the level of detail you want to group the locations by.
A new group field is added in the Data pane with a group icon next to it. The new field is also added to Color on the Marks card.

If you want to edit the locations in your territories at any time, right-click the group field in the Data pane and select **Edit group**.

3 **Continue grouping data to add additional territories**

Repeat steps 1 and 2 to create additional territories. Each territory is added as a group within the group field you created in step 2. You can create as many territories as you want.

**Note:** You might have to right-click the group field on the Marks card and select **Include Other** to continue grouping locations.
To edit the colors of your territories, click **Color** on the Marks card and select **Edit Colors**.

4 **Add the group field to the view**

From the Data pane, drag the newly created group field to **Detail** on the Marks card. Next, for the territory to appear properly, you must also remove the related geographic field(s) from the view.

For example, if you grouped states at the State, Country level, you must remove the State and Country fields from the view. The group field replaces these fields on Detail on the Marks card.

In the image below, notice that the State and Country fields are no longer on Detail on the Marks card because they have been replaced by the Country & State (group) field.
For this example, there are five groups within the Country & State (group) field, so five territories appear on the map. Aggregations, such as SUM(Sales), are computed at the level of the territory, rather than separately for each location within the territory. For example, in the image above, the orange territory includes the sum of sales for all states in that territory combined, 559,414 USD.

Create custom territories in the Group dialog box

You can also create custom territories by creating groups in the Data pane.

1. In the Data pane, right-click a geographic field (such as City or State) and select Create > Group.
2. In the Create Group dialog box, select the locations you want in your first territory and click Group. Each group you create represents a territory.
3. Repeat step 2 until you've created all of your territories, and then click OK.
   The new group field is added to the Data pane.
4. From the Data pane, drag the newly created group field to Detail on the Marks card.
   You can also drag the field to Color or Label on the Marks card to help differentiate between each territory.

Quick Start: Filled Maps

When mapping data in Tableau, a mark is shown for each location. The mark can be a shape such as a circle, square, pie, etc. Alternatively, you can fill the polygon for the geographic region
with a color based on a data value. For example, you can fill states with a color based on how profitable they are.

1 Build a Map View

Double-click a geographic field such as State, Area Code, Zip Code, etc.

The generated Latitude and Longitude fields are moved to the Rows and Columns shelves and the geographic field is moved to Detail on the Marks card.

2 Select the Filled Map Mark Type

The Automatic mark type will show this type of view as circles over a map. On the Marks card, click the Mark Type drop-down menu and select Filled Map to color the geographic areas.
3 Drag a Field to the Color Shelf

Define how the locations are colored by dragging another field to **Color** on the **Marks** card.
4 Worldwide Regions

Filled maps are available at the country and state/province level worldwide.

Quick Start: Filter Data Across Multiple Data Sources

You can filter data across multiple primary data sources in Tableau.

For example, suppose you have a worksheet that shows population size by each county in California, and that uses data source A. Suppose you also have a worksheet that shows the average education level by county in California that uses data source B. You can filter both of those worksheets by creating a county filter from data source A and applying it to data source B.

You can do this because the two worksheets use data sources that have data in common (county names).

Before you start: See the Cross data-source filtering FAQs forum post in the Tableau Community.

1 Create relationships between your data sources

To filter data across multiple primary data sources, you must first create a relationship between one or multiple fields. Sometimes Tableau does this automatically because your data sources have fields in common, as in the above example. This is called an automatic relationship.
If Tableau doesn’t automatically create relationships between your data sources based on a field they have in common, you can create the relationship between the two data sources manually.

To create a relationship between your two data sources:

1. Select Data > Edit Relationships.
2. In the Edit Relationships dialog box, select a data source to be the primary and a data source to be the secondary, click Custom, and then click Add.
3. In the Add/Edit Field Mapping dialog box, do the following, and then click OK:
   - Under Primary data source field, select a field.
   - Under Secondary data source field, select a field with similar data to the field you selected for the primary data source.

For example, in the image below, the field, County, in the primary data source is related to the field, County Name, in the secondary data source.

2 Add a field to the Filters shelf

From the Data pane, drag a dimension field to the Filters shelf. In the Filter dialog box that opens automatically, select the members you want to include or exclude from the view, and then click OK.

Note: If the Filter dialog box does not open automatically, right-click the field on the Filters shelf and select Edit filter.
3 Apply filter to views with related data sources

To apply the filter to all the worksheets in your workbook that use related data sources, right-click the field on the Filters shelf and select **Apply to worksheets > All using related data sources.**

Related data sources in this case are data sources in your workbook that have a relationship with the field on the Filters shelf. If you recall, a relationship is created by defining fields that your data sources have in common.

After you apply a filter to all related data sources, an icon appears next to the field on the **Filters** shelf to indicate that it is a cross data source filter.

To apply the filter to select worksheets in your workbook, select **Apply to worksheets > Selected worksheets.** In the Apply Filter to Worksheets dialog box, you can select to apply the filter to sheets that use the same data source or that use related data sources.
After you apply a filter to selected worksheets with related data sources, a different icon appears next to the field on the Filters shelf to indicate that it is a cross data source filter.

Quick Start: Forecasting

Forecasting is a calculation that predicts future trends based on current trends and data. Follow the steps below to add a forecast to your view.

1 Build the View

Build a view that shows a measure over time. The date or time field can be discrete or continuous. For example, the view below shows sales by Month and Year.
2 Add a Forecast to the View

To add a forecast to the view, drag **Forecast** from the **Analytics** pane and drop it on **Forecast** in the view. The time axis is extended and estimated values are shown.

![Forecast in view](image)

You can also add a forecast to the view by selecting **Analysis > Forecast > Show Forecast**.

3 Change the Forecast Options

You can modify the forecast options by selecting **Analysis > Forecast > Forecast Options**. In the **Forecast Options** dialog box, you can specify how far into the future to estimate, the date part that the forecast is based on, and the forecasting model to use.
4 View Forecast Details

To view the forecast model and the parameters used to create the forecast, select **Analysis > Forecast > Describe Forecast**.
Quick Start: Groups

Sometimes you will want to group several dimension members into categories that don't already exist in your data. For example, when looking at a list of customers, you may want to group them by outside information, such as the type of customer they are: regular, employee, etc.

1 Select the members to group

Select one or more members that you want to group.
2 Click Group on the toolbar

Click the **Group Members** icon on the toolbar.

![Image of Data pane with grouped members]

The members are grouped into a single member in the view and the new group field is shown in the Data pane.

3 Edit the name of the group

In the Data pane, right-click (control-click on Mac) the grouped field and select **Edit Group**. Select the group and then click, **Rename**.
You can also rename the name of the field itself using the text box at the top of the dialog box.

4 Add and remove members

In the Edit Group dialog box, add and remove members by dragging and dropping the selected members in the list to and from the group.
To quickly add members to a group, right-click (control-click on Mac) a member in the Edit Group dialog box and select Add to, then in the Add To Group dialog box, select the group you want to add them to.

Finding members

If you are working with a dimension that has a lot of members, you can search and select members that match a specific criteria using the Find button in the Edit Group dialog box.

Quick Start: Null Values

Null values along an axis are indicated in the lower right corner of the view. Click the indicator to open a dialog box that will help you decide how to handle these values. The options available in the dialog box depend on the type of data in the view. The options for geographic data, numbers, and dates are described below.
Unknown Geographic Locations

If you are mapping data using the built-in geographic roles in Tableau, you may have some unrecognized locations that cannot be mapped. To edit these locations, click **Edit Locations** in the *Special Values* dialog box. In the *Edit Locations* dialog box, match your data to known locations. For example, your data may include “Mass” instead of “Massachusetts” as a state name.
Null Numbers and Dates

If a numeric or date axis contains null values, you can choose to filter the data, which removes null values from the view and all calculations, or show them at a default position. The default positions are described in the following table.

<table>
<thead>
<tr>
<th>Type of Data</th>
<th>Default Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers</td>
<td>0</td>
</tr>
<tr>
<td>Dates</td>
<td>12/31/1899</td>
</tr>
<tr>
<td>Negative Value on a Log Axis</td>
<td>1</td>
</tr>
<tr>
<td>Unknown Geographic Locations</td>
<td>(0, 0)</td>
</tr>
</tbody>
</table>

By default, the values are shown with the indicator in the lower right corner of the view and are included in calculations. Right-click (control-click on Mac) the indicator to hide it.
Quick Start: Highlight Actions

You can highlight data in your views to make information stand out using a variety of methods. For example, you can use Highlight Actions to highlight related data in a variety of views based on your selection in the current view. Highlight Actions are particularly useful on a dashboard, where the highlight provides rich visual interaction between the views on the sheet.

For information about the different methods that you can use to highlight data, see Highlight Actions on page 1022

1 Turn on Highlighting

To turn on highlighting in a dashboard, click the Highlight icon on the toolbar and select an option. Select All Fields to highlight all fields in the view, select Dates and Times to highlight dates and times in the view, or select a specific field in the view to highlight.
2 Refine the Highlight Action

Select **Dashboard > Action** to open the **Actions** dialog box. Select an action and then click **Edit**.

Any action you create appears in the **Actions** dialog box. You can add Filter, Highlight, or URL actions.

3 Specify the Action Settings

In the **Edit Highlight Action** dialog box, select the source sheets, target sheets, and the fields to highlight. You can also select whether to run the action when you hover, select, or
right-click (control-click on Mac) the source sheet. When finished, click **OK**.

4 **See It in Action**

In your dashboard, hover, select, or right-click (control-click on Mac) the source view to see the related data highlighted in the target views.
A selection in the source view highlights the related information in all of the target views.

**Quick Start: Measure Distance in Maps with the Radial Tool**

While you explore data in Tableau maps, you might have questions about how the data relates to its surroundings.

For example, you might wonder how many earthquakes have occurred within 25 miles of a city, or how many public transit stops are within a kilometer of a popular tourist destination.

You can use the Radial tool to measure approximate distances between your data and the locations or landmarks in your map view.

1. **Show the View Toolbar**

   The Radial tool button is located on the view toolbar, which appears in the top-left corner of the view when you hover over a map. If the view toolbar doesn't appear in the view, it is hidden, and you can choose to show it.

   To show the view toolbar, right-click (control-click on Mac) anywhere in the view and select **Show View Toolbar**.
You can also use keyboard shortcuts to navigate the view and select marks. For more information, see Keyboard Shortcuts on page 1417.

2 Zoom In to an Area or Location

Before you can measure distance in your map view using the Radial tool, you need to first zoom in to a particular area or location in the map.

To zoom in, click the Zoom In button on the view toolbar. To zoom quickly to an area of the view, double-click the area on the map.
3 Select the Radial Tool

To select the Radial tool, hover over the arrow on the view toolbar and click the Radial tool button. Next, click a location, landmark, or area on the map that you want to measure from, and then drag across the view.

As you drag, the Radial tool selects the marks that are within the radius of the circle. In the example below, the radius is 25 miles. This means that the two marks selected are within approximately 25 miles of the chosen location.
Units of Measurement

By default, your workbook locale determines which units the Radial tool uses to measure distance. If your workbook locale is set to a country that uses the Imperial system, such as the United States or the United Kingdom, the Radial tool measures distance in feet and miles. If your workbook locale is set to a country that uses the Metric system, such as Brazil, the Radial tool measures distance in meters and kilometers.

To change the units the Radial tool uses to measure distance, select Map > Map Options. Next, under Units, click the drop-down menu and select an option. For more information, see Change the units of measurement on page 740.

Quick Start: Filter Modes

When you show a filter in the view, you can choose a filter mode that best fits your data. This quick start shows you the filter modes for categorical (dimension) filters. Quantitative (measure) filters have different filter modes.

1 Show a filter in the view

In the Data pane, or on the Filters shelf, click the field drop-down menu and select Show Filter. A filter card appears to the right of your visualization.
You can show filters for any field, whether the field is in the view or not.

2 Select a filter mode

In the view, click the filter card drop-down menu and select one of the following seven filter modes:

- **Single Value (List)**
  Select one value at a time in a list.

- **Single Value (Dropdown)**
  Select a single value in a drop-down list.

- **Single Value (Slider)**
  Drag a horizontal slider to select a single value.

- **Multiple Values (List)**

- **Multiple Values (Dropdown)**

- **Multiple Values (Custom List)**
Select one or more values in a list.

Select one or more values in a drop-down list

Search and select one or more values.

**Wildcard Match**

Select values containing the specified characters.

3 **Search filter values**

Some filter modes support search so you can quickly find and select values. To search a filter shown in the view, click the **Search** icon in the title area of the filter in the view, and then type the value you want to find. The matching results display below the search box where you can select or clear them.

Use the **(All)** option to quickly select and clear all values in the list.

**Quick Start: Rank and Percentile**

**Rank**

Use rank when you are interested in seeing the order of values in a list. For example, you could apply a rank table calculation to a table to see which product category ranked highest.
in sales over a four-year period.

Right-click a field (or control-click on a Mac) and choose **Add Table Calculation**. Then choose **Rank** as the **Calculation Type** and **Table (Down)** as the value for **Running along**.

![Table Calculation Example](image)

Tableau supports a range of ranking options, so you can specify how to rank data that contains duplicate values. For example, if you had a set of five values, and three of them were the same (10, 15, 15, 15, 24), you could configure the table calculation to rank them in any of the following ways:

- 1, 2, 2, 2, 5 (Competition ranking)
- 1, 4, 4, 4, 5 (Modified competition ranking)
- 1, 2, 2, 2, 3 (Dense ranking)
- 1, 2, 3, 4, 5 (Unique ranking)

Ranking functions that support these options are also available for use in calculated fields (for example, **DENSE_RANK**, **MODIFIED_RANK**).

### Percentile

Percentile is available as an aggregation and as a table calculation. To use one of the built-in percentile aggregations, right-click a measure in the view and select **Measure > Percentile** and then choose one of the numeric options.
The Percentile aggregation requires an extract.

If none of the numerical values listed is what you want, you can right-click a measure in the view and choose Add Table Calculation to configure a custom percentile.

You can compute multiple percentiles on the same measure to show different percentiles simultaneously. The view below shows Weight at three different percentages, to display a range of percentiles over time.
Quick Start: Relative Date Filters

Create filters to show a date period that is relative to when you open the view. For example, create dynamic filters to only show the current week, the year to date, or the past 10 days. Relative date filters make it easier to create lasting views that you can publish and share.

1 Drag a Date Field to the Filter Shelf

Right-click (control-click on a Mac) and drag a date field from the Data window to the Filters shelf, and then click Relative Date in the Filter Field dialog box.
Then click **Next**.

2 **Select a Time Unit**

In the Filter dialog box, click **Relative dates** and then select the unit of time you want to base your filter on. For example, to filter to only show the three most recent weeks, select **Weeks**.
3 Define the Date Period

Use the options in the lower part of the Filter dialog box to specify which weeks to include in the view. To show the last three weeks click Last and then select the number 3.

Date periods include the current unit of time. For example, if you select the last three weeks Tableau will include the current week and the two previous weeks. The range of time that you have selected is displayed in the upper right of the Filter dialog box.
4 Watch the View Update

The filter will now update to always show the three weeks preceding the current date.

Relative date filters, once created, can be displayed in the view as filter cards.

Quick Start: Secondary Axes

In addition to blending multiple measures on the same axis, you can add a secondary axis, or dual axis to a view to better compare measures of different scales. Follow the steps below to
add and remove a secondary axis.

1 Drag a measure to the view

Drag a continuous field from the Data pane to the view.

When you add a measure or continuous field to the view, an axis is created.

2 Add a second measure to the view

Drag a second measure to the view, but this time drag it to the far right side of the view. A dashed line and a ruler icon displays when you hover over the right side of the view.
3 Remove the secondary axis

To remove a secondary axis at any time, right-click (control-click on Mac) the secondary field on the Rows or Columns shelf and clear the check mark for Dual Axis.

Quick Start: Trend Lines

Trend lines, also known as best fit lines, are computed lines that predict data trends. Follow the instructions below to learn how to add trend lines to your view.

1 Add a Trend Line

From the Analytics pane, drag the Trend Line model to the view and drop it on a model type.
You can select one of the following model types to add to the view.

To remove a trend line, drag the trend line off the view, or select it in the view and click **Remove**.

2 **Exclude Fields from the Trend Line**

To edit a trend line, click it and select **Edit**. In the **Trend Lines Options** dialog box, if the trend is considering multiple factors, you can clear any dimensions that you don’t want to include as factors in the trend line model.
Another option in the Edit Trend Lines dialog box is **Allow a trend line per color**. When you have color encoding in your view, you can use this option to add a single trend line that models all of the data and ignores the encoding.
By default, trend lines are shown with upper and lower 95% confidence lines. In a view with multiple trend lines, these confidence lines can make the view "noisy" and difficult to read. If this is the case, clear the **Show Confidence Bands** option.

4 Describe the Trend Line

After you add trend lines, you can use the Describe feature to display statistics on the trend line. For example, you can see the formula as well as r-squared and p values. To view a description of a single trend line, right-click the trend line in the view and select **Describe Trend Line**.
To view a description of the entire trend line model, select Analysis > Describe Trend Model.

Quick Start: Turn Off Pan and Zoom in Maps

Sometimes you want to control how your audience interacts with your map view.

For example, if your audience is using a mobile device to explore your workbook, you might want to turn off pan in your map view so they can move from sheet to sheet with ease.

Similarly, if your map view is zoomed in to a particular city, you might want to ensure that people won’t zoom out.

In cases like these, you can turn off pan and zoom in a map view, as well as in a background image.

1 Clear the Allow Pan and Zoom Option

To turn off pan and zoom in your map view or background image, select Map > Map Options, and then clear Allow Pan and Zoom.

In a dashboard, select the map view first, and then select Map > Map Options > Allow Pan and Zoom to clear the check mark.
2 Review the changes to the view toolbar

When you turn off pan and zoom in a map view or background image, the pan tool and all zoom controls are removed from the view toolbar. Keyboard shortcuts for zooming in and out of the view, or panning, no longer work. For more information about the view toolbar and default tools, see View Toolbar on page 521 and Select Marks on page 522.

You can still use the view toolbar to select marks in the view, lock the map in place, or automatically zoom the map to all of your data. You can also click the map search icon to search for locations in the view.

Quick Start: Use Mapbox Maps

You can use Mapbox maps to create map views in Tableau.

For example, if you have a Mapbox map that fits your data or corporate style, you can connect it to Tableau Desktop and use it as a background map.

You can add a Mapbox GL map or a classic Mapbox map. For this example, learn how to add a classic Mapbox map. For information on how to add a Mapbox GL map, see Use Mapbox Maps on page 730.

When you use a Mapbox map in one of your views, you can publish that view to Tableau Server, Tableau Online, or Tableau Public so your audience can view your data and your Mapbox map without needing to have a Mapbox account.
Connect to your Mapbox map

1 Open the Add Mapbox Map dialog box

Click **Map > Background Maps > Maps Services**. This opens the Map Services dialog box.

In the Map Services dialog box, click **Add > Mapbox Maps**. This opens the Add Mapbox Map dialog box.

2 Enter a style name and API access token

In the Add Mapbox Map dialog box, click **Classic**. Give the map a style name, and then enter the API access token for the classic Mapbox map you want to add.
3 Add custom layers or choose a preset style

You can choose to add one or more map layers, or you can choose to use a Mapbox preset style.

To use a Mapbox preset style:
In the Add Mapbox Map dialog box, click Mapbox preset style, and then select a preset style from the drop-down menu.

To add one or more map layers:
In the Add Mapbox Map dialog box, click Custom, and then enter one or more map IDs. For more information about map IDs, see the Mapbox API help on the Mapbox website.

When finished, click Okay to exit the Add Mapbox Map dialog box, and then click Close to return to the view.

You can add as many Mapbox maps as you want to a workbook. Each Mapbox map you add appears as a background map in the Background Maps menu.
1 Build the map view

Select **Map > Background Maps**, select the Mapbox map you added from the list, and then build a map view. For more information about how to build map views, see **Build a Map View** on page 703.

2 Select which map layers appear in the view

Once you are connected to your Mapbox map, you might want to add or subtract map layers from the view.
To toggle between custom Mapbox layers, click **Map > Map Layers**, and then under the **Map Layers** section, select the layers you want to appear in the view.

By default, all map layers appear in the view when you first add a Mapbox map to your workbook.
Save your Mapbox map as a Tableau Map Source

After you add a Mapbox map to your workbook, it will be saved with the workbook and available to anyone with whom you share the workbook. You can also save a Mapbox map as a Tableau Map Source (.tms) that you can share with others so they can quickly connect to it and use it in their own workbooks.

1. Select **Map > Background Maps > Map Services**.
2. In the Map Services dialog box, select the Mapbox map you want to save, and then click **Export**.
3. In the Export Connection dialog box, enter a name for the file, choose a location for the file, and then click **Save**.

For more information, see **Save a Map Source** on page 741.

Quick Start: Visually Grouping Data

Groups combine dimension members into categories and enable you to analyze data as a group instead of as individual marks. For example, if you are looking at retail data, you might have a list of all your products. You can use groups to combine several of your small products into a group to analyze them as one mark, like combining binders, fasteners, labels and paper to create a group called organizational supplies. There are many ways to create groups in Tableau. Here are three options.

1. **Select headers**

One way to create a group is by selecting multiple headers in a table or values in a legend and then clicking the Group option (which looks like a paperclip) in the tooltip. This method is useful for fixing simple errors in your data or answering “what if?” questions.
The group's name is concatenated based on the members in the group. To rename the group, right-click it in the view (control-click on a Mac), and select **Edit Alias**. The group is also added to the Data pane as a separate field.

2 **Select marks in the view - all dimensions**

If you want to visually call out a set of marks in your view instead of combining them into a new mark you can create groups by selecting marks directly in the view and then select Group on the tooltip. A new group field is created automatically and placed on the color shelf. The group combines and aggregates the selected marks into one category and assigns all other values to an Other category. If the selected marks represents multiple dimensions (for example, Sub-Category and Region), you can either group on all dimensions or on a specific dimension.
Grouping on all dimensions creates a category that includes each relevant combination of Sub-Category and Region. These combinations are grouped into a single category and everything else is put in the Other category.

3 Select marks in the view - specified dimensions

Grouping selected marks on a specific dimension and then selecting a specific dimension from the Group menu on the tooltip creates a group based on that dimension. In this example, the specified dimension is Region and the selected marks contain product values including the Central, East and West regions. All qualifying marks are grouped into a category and all non-qualifying marks are assigned to the Other category.
The marks assigned to the group don’t all need to be included in the selection you used when you created the group. This is because the group is based on values for the dimension, not the marks you selected.

**Quick Starts about Calculations**

After you master the basics of building views in Tableau, you can modify the fields that Tableau extracts from your data source to dig deeper with your analysis. You can create new fields that don’t exist in your data source to explore new dimensions and find facts.

Use the calculation editor for customizing and creating fields, or, to stay in the flow and change course quickly, create ad hoc calculations that you can easily save and reuse.

The following Quick Start topics are designed to get you started using calculations.

**Quick Start: Ad-Hoc Calculations**

Ad-hoc calculations are calculations that you can create and update as you work with a field on a shelf in the view. Ad-hoc calculations, also known as type-in or in-line calculations, can be useful for testing a hunch, trying a what-if scenario, or debugging a complex calculation.

1. **Double-Click to Start Editing an Existing Field**

Double-click on an existing field in the view to start editing.

2. **Double-Click to Create a New Calculation**

Alternatively, you can double-click on an empty shelf or on an empty part of a shelf to create a new ad-hoc calculation.
3 Type or Drag Content to the Calculation

Type to update the expression, or drag new fields into the expression from the Data pane or elsewhere in the view.

4 Commit the Calculation to Update the View

When you're satisfied with the expression, press Enter or Tab, or click outside the expression to commit the expression and update the view.

Ad-hoc calculations are not named, but are saved when you close the workbook. If you want to save an ad-hoc calculation for use in other workbook sheets, copy it to the Data pane. Tableau will prompt you to name it.

Quick Start: New and Improved Calculation Editor

The calculation editor in Tableau Desktop has been redesigned to provide interactive editing, intelligent formula-completion, and drag-and-drop support. The editor is now also available when you're editing a view in Tableau Server or Tableau Online.
1 Interactive Editing

To open the calculation editor, click the drop down to the right of Dimensions on the Data pane and choose Create Calculated Field. The calculation editor is now non-modal, which means you can work in your view and work with a calculation at the same time. If you edit a field that's in the view and then click Apply, the view changes immediately and the editor remains open.

2 Auto-Completion for Formulas

As you work on a formula in the calculation editor, Tableau displays a list of options for completing the formula.

As you scroll the list, using mouse or keyboard, Tableau shows a short description when the current item is a function:

Click a keyword in the list or press Enter to select it. If the keyword is a function, Tableau displays syntax information so you know how to proceed:
3 Drag and Drop Between Editor and View

You can drag fields from the Data pane or from any of the shelves in the Tableau workspace into the calculation editor, or drag part or all of a calculation from the editor to the Data pane or to a shelf.

Quick Start: Creating Calculated Fields - Cubes

Tableau supports calculated fields on multidimensional data sources. There are two kinds of calculated fields: calculated measures and calculated dimensions. When you define a new calculated field, you create a new field in your data source based on existing measures in the data source as well as standard functions and operators. The steps below explain how to create calculated measures using Tableau formulas.

Tableau support multidimensional data sources only in Windows.

1 Open the Calculated Field Dialog Box

Click Analysis > Create Calculated Field.
2 Define a Formula

In the **Calculated Field** dialog box, give the new field a name and define a formula.

![Calculated Field dialog box example](image)

3 Use the New Field

Check that the formula is valid, and then click **OK** to save the new field. It will save to **Measures** on the **Data** pane.
4 Edit the Formula

If you need to change the formula for a calculated field, right-click (control-click on the Mac) the field in the data pane and select **Edit**. Keep in mind that the changes you make will affect any worksheets that use the new field.
Quick Start: Creating Calculated Members with MDX

Rather than use Tableau formulas to create new fields, you can also create calculated members using Multidimensional Expressions (MDX). With MDX you can create more complex calculations and reference both existing measures and dimensions. Calculated members can either be new measures or new dimension members depending on the hierarchy that you choose. Follow the steps below to learn how to create calculated members using MDX.

Tableau support multidimensional data sources only in Windows.

1 Open the Calculated Members Dialog Box

Click the Dimensions drop-down menu and select **Calculated Members**.

2 Create a New Calculated Member

In the Calculated Member dialog box, click **New**.
3 Specify a Calculated Member Definition.

Name the new member and select its location in the hierarchy. For calculated dimension members, specify a parent member. For calculated measure members, specify a result type.

Finally select a solve order for the member.
**Note:** Sometimes a single cell in your data source can be defined by two different formulas. The solve order defines the precedence given to each formula. Formulas with a lower solve order are solved first. The default solve order is zero.

### 4 Define a Formula

Type a formula that defines the new member and click **Check Formula** to validate. When finished, click **OK**. The new member displays in the Data pane under the parent member and hierarchy you specified.

![Calculated Member Definition](image)

**Quick Start: Parameters**

Parameters are dynamic values that can replace constant values in calculations. For example, you can create a calculated field that returns true if Sales is greater than $500,000 and otherwise return false. Then you can replace the constant value of “500,000” in the formula with a parameter that users can change dynamically using a parameter control.

#### 1 Create a Parameter

Click the drop down to the right of Dimensions on the **Data** pane and choose **Create Parameter**
2 Define the Parameter

Specify the following properties to define the parameter:

**Name** - A descriptive name for the parameter.

**Data type** - Parameters can be integers, floating point numbers, strings, Boolean values, dates, or date/times.

**Current Value** - An initial value for the parameter.

**Display format** - How to format the values.

**Allowable values** - The type of control to be used for selecting values. Parameters can be defined a text field (All), a List, or a Range of defined values.
3 Use the Parameter in a Calculation

Replace the constant value in a calculated field or filter with the parameter. You can double-click the parameter in the list to add it to the formula.
4 Show the Parameter Control

Parameters are global across the entire workbook and are shown at the bottom of the Data pane. Right-click a parameter and select Show Parameter Control to display a card where users can modify the parameter value.

You can move a parameter control to different locations in the view.

Quick Start: Table Calculations

Table Calculations are computations that are applied to the values in the entire table and are often dependent on the table structure itself. For example, in a sales environment, you can use table calculations to compute the running total of sales across a specified date range or to compute each product’s contribution to the total sales in a quarter.

1 Open the Table Calculation Dialog Box

Right-click a measure in the view (control-click on a Mac) and select Add Table Calculation.
2 Choose a Calculation Type

In the Table Calculation dialog box, choose the type of calculation you want to apply.

- Difference From - show absolute change.
- Percent Difference From - show rate of change.
- Percent From - show as % of other specified value.
- Percent of Total - show values as % of the total.
- Rank - rank values numerically.
- Percentile - compute percentile values.
3 Choose one of the Compute Using options

In the bottom half of the Table Calculation dialog box, define the calculation using the drop-down lists. The options vary for different types of calculations.

4 Check your view and decide

As you experiment with different calculation types and Compute Using options, highlighting in the view shows the effect of your choices. Continue to experiment and try different options until the result is the one you want.
The "Quick" Alternative

Tableau offers common pre-configured table calculations that you can apply quickly without having to go through the steps for defining the calculation. If the result meets your needs, you're done. Right-click a measure in the view, choose **Quick table calculation**, and pick a calculation type. If not, open the calculation in the Table Calculations dialog box.

<table>
<thead>
<tr>
<th>Quarter of Year</th>
<th>Month of Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>January</td>
<td>$-3,136</td>
<td>$-7,913</td>
<td>$4,326</td>
<td>$-24,430</td>
</tr>
<tr>
<td></td>
<td>February</td>
<td>$59,880</td>
<td>$30,200</td>
<td>$28,319</td>
<td>$33,925</td>
</tr>
<tr>
<td>Q2</td>
<td>April</td>
<td>$-27,396</td>
<td>$-4,272</td>
<td>$11,938</td>
<td>$-13,759</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>$-4,643</td>
<td>$-4,064</td>
<td>$17,442</td>
<td>$5,539</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>$10,947</td>
<td>$-5,334</td>
<td>$12,761</td>
<td>$2,406</td>
</tr>
<tr>
<td>Q3</td>
<td>July</td>
<td>$-6,489</td>
<td>$3,960</td>
<td>$9,090</td>
<td>$169</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>$-5,037</td>
<td>$8,133</td>
<td>$5,175</td>
<td>$13,086</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td>$93,863</td>
<td>$70,698</td>
<td>$39,643</td>
<td>$28,973</td>
</tr>
<tr>
<td>Q4</td>
<td>October</td>
<td>$-55,324</td>
<td>$-33,191</td>
<td>$16,445</td>
<td>$-12,696</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>$47,175</td>
<td>$44,958</td>
<td>$5,729</td>
<td>$34,553</td>
</tr>
<tr>
<td></td>
<td>December</td>
<td>$-3,083</td>
<td>$-1,253</td>
<td>$5,045</td>
<td>$-21,652</td>
</tr>
</tbody>
</table>

**Discrete**
- Continuous
- Edit in shelf
- Add table calculation...
- Quick table calculation

**Running total**
- Difference
- Percent difference
- Percent of total
- Rank
- Percentile
- Moving average
- YTD total
- Compound growth rate
- Year over year growth
- YTD growth
Quick Start: Table Calculations Enhancements

Table calculations got a lot easier in Tableau 10. Here's how:

1 Instant updates as you configure a calculation

Click a measure in the view and choose **Add Table Calculation** to open the Table Calculation dialog box. While you work in the redesigned dialog box, you can see how your **Calculation Type** and **Compute Using** selections affect the view. Continue to experiment and try different options until you see the result that you want.

2 Highlighting

What is the difference between **Table (Across)** and **Pane (Across)**? Or between **Pane (Across then Down)** and **Pane (Down then Across)**? To make it easy to see what these options mean, Tableau now highlights part of your view while you work in the Table Calculations dialog box to show exactly how the current **Compute Using** option defines the scope of your calculation.
With good visual feedback, you can get the result you want. Table calculations are powerful, but often you don’t know exactly what you’re aiming for until you can see it in front of you. Now table calculations can be part of your creative “flow” in Tableau.

Quick Start: Computing Totals

Tableau supports grand totals and subtotals for both relational and multidimensional data sources.

**Grand Totals**

Grand totals can be computed for rows or for columns.

**Row Grand Totals**

For Rows: Choose Analysis > Totals > Show Row Grand Totals.
<table>
<thead>
<tr>
<th>Container</th>
<th>Department</th>
<th>Africa</th>
<th>Asia</th>
<th>Europe</th>
<th>North America</th>
<th>South America</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumbo Box</td>
<td>Furniture</td>
<td>$46,236</td>
<td>$157,241</td>
<td>$75,163</td>
<td>($1,358)</td>
<td>$4,731</td>
<td>$278,833</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$12,783</td>
<td>$37,862</td>
<td>$18,527</td>
<td>$46,809</td>
<td>$24,851</td>
<td>$140,531</td>
</tr>
<tr>
<td>Jumbo Drum</td>
<td>Furniture</td>
<td>$95,769</td>
<td>$250,466</td>
<td>$61,124</td>
<td>$119,529</td>
<td>$51,796</td>
<td>$577,977</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
<td>$7,894</td>
<td>$43,600</td>
<td>$17,333</td>
<td>$27,538</td>
<td>$36,689</td>
<td>$314,232</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$170,950</td>
<td>$316,764</td>
<td>$40,826</td>
<td>$190,078</td>
<td>$82,310</td>
<td>$808,936</td>
</tr>
<tr>
<td>Large Box</td>
<td>Furniture</td>
<td>$8,434</td>
<td>$147,055</td>
<td>$19,328</td>
<td>$53,560</td>
<td>$41,827</td>
<td>$270,004</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
<td>$9,964</td>
<td>$1,278</td>
<td>$5,763</td>
<td>($56,751)</td>
<td>($15,325)</td>
<td>($32,961)</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
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<td>$101,492</td>
<td>$178,650</td>
<td>$122,807</td>
<td>$538,786</td>
</tr>
<tr>
<td>Medium Box</td>
<td>Furniture</td>
<td>$20,169</td>
<td>$19,064</td>
<td>$7,644</td>
<td>$44,942</td>
<td>$3,920</td>
<td>$96,376</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
<td>$218</td>
<td>$23,778</td>
<td>$5,046</td>
<td>$5,008</td>
<td>$2,079</td>
<td>$39,319</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$4,505</td>
<td>$119,792</td>
<td>$8,181</td>
<td>$45,947</td>
<td>$53,027</td>
<td>$126,167</td>
</tr>
<tr>
<td>Small Box</td>
<td>Furniture</td>
<td>$4,843</td>
<td>$17,992</td>
<td>$7,750</td>
<td>$28,253</td>
<td>$14,546</td>
<td>$73,540</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
<td>$143,447</td>
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<td>$50,570</td>
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<td>$311,983</td>
<td>$1,768,075</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
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<td>$147,000</td>
<td>$393,937</td>
<td>$362,191</td>
<td>$1,345,595</td>
</tr>
<tr>
<td>Small Pack</td>
<td>Furniture</td>
<td>$7,753</td>
<td>$31,674</td>
<td>$5,325</td>
<td>$22,157</td>
<td>$6,499</td>
<td>$90,207</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
<td>$6,011</td>
<td>$15,672</td>
<td>$1,543</td>
<td>$3,837</td>
<td>$1,022</td>
<td>$28,086</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$9,899</td>
<td>$84,756</td>
<td>$16,500</td>
<td>$48,690</td>
<td>$38,390</td>
<td>$197,930</td>
</tr>
<tr>
<td>Wrap Bag</td>
<td>Furniture</td>
<td>$500</td>
<td>$8,854</td>
<td>$5,652</td>
<td>($3,137)</td>
<td>$1,876</td>
<td>$14,037</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
<td>$7,770</td>
<td>$27,015</td>
<td>$4,569</td>
<td>$5,556</td>
<td>$6,040</td>
<td>$54,257</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$1,262</td>
<td>$25,671</td>
<td>$4,716</td>
<td>$12,391</td>
<td>$3,936</td>
<td>$47,405</td>
</tr>
</tbody>
</table>

**Column Grand Totals**

For Columns: Choose **Analysis > Totals > Show Column Grand Totals**.
Subtotals can be turned on for a selected dimension or for all qualifying dimensions.

Subtotals for a Selected Dimension

When Grand Totals are on for a dimension in the view, right-click the dimension (or control-click on a Mac) and then choose Subtotals to turn on subtotals for the selected dimension.
Subtotals for All Relevant Dimensions

To turn on subtotals for all relevant dimensions, choose **Analysis > Totals > Add All Subtotals**.
<table>
<thead>
<tr>
<th>Container</th>
<th>Department</th>
<th>Africa</th>
<th>Asia</th>
<th>Europe</th>
<th>North America</th>
<th>South America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jumbo Box</td>
<td>Furniture</td>
<td>$46,239</td>
<td>$157,241</td>
<td>$75,163</td>
<td>($1,358)</td>
<td>$4,731</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$12,783</td>
<td>$37,662</td>
<td>$18,627</td>
<td>$48,609</td>
<td>$24,451</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$59,022</td>
<td>$214,903</td>
<td>$93,790</td>
<td>$45,251</td>
<td>$74,582</td>
</tr>
<tr>
<td>Jumbo Drum</td>
<td>Furniture</td>
<td>$85,789</td>
<td>$250,496</td>
<td>$61,124</td>
<td>$119,529</td>
<td>$51,796</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
<td>$7,034</td>
<td>$43,400</td>
<td>$17,333</td>
<td>$27,530</td>
<td>$30,069</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$170,056</td>
<td>$316,764</td>
<td>$40,826</td>
<td>$198,078</td>
<td>$82,310</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$265,862</td>
<td>$610,659</td>
<td>$119,263</td>
<td>$345,145</td>
<td>$172,775</td>
</tr>
<tr>
<td>Large Box</td>
<td>Furniture</td>
<td>$6,434</td>
<td>$147,055</td>
<td>$19,326</td>
<td>$53,560</td>
<td>$41,627</td>
</tr>
<tr>
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<td>Office Supplies</td>
<td>($3,964)</td>
<td>$1,278</td>
<td>$5,763</td>
<td>($56,751)</td>
<td>($15,325)</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$16,079</td>
<td>$97,707</td>
<td>$10,482</td>
<td>$179,050</td>
<td>$122,607</td>
</tr>
<tr>
<td></td>
<td>Total</td>
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<td>$246,030</td>
<td>$126,663</td>
<td>$176,458</td>
<td>$149,100</td>
</tr>
<tr>
<td>Medium Box</td>
<td>Furniture</td>
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<td>$19,064</td>
<td>$7,844</td>
<td>$44,942</td>
<td>$3,920</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
<td>$310</td>
<td>$23,770</td>
<td>$5,045</td>
<td>$8,090</td>
<td>$2,079</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>$4,505</td>
<td>$119,792</td>
<td>$8,181</td>
<td>$49,947</td>
<td>$53,027</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$25,011</td>
<td>$162,634</td>
<td>$20,670</td>
<td>$102,908</td>
<td>$59,026</td>
</tr>
<tr>
<td>Small Box</td>
<td>Furniture</td>
<td>$4,843</td>
<td>$17,922</td>
<td>$7,750</td>
<td>$28,253</td>
<td>$1,456</td>
</tr>
<tr>
<td></td>
<td>Office Supplies</td>
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<td>$697,153</td>
<td>$88,570</td>
<td>$531,999</td>
<td>$311,863</td>
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<td>$551,146</td>
<td>$147,000</td>
<td>$390,937</td>
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<td>$530</td>
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<td>($3,137)</td>
<td>$1,876</td>
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<tr>
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<tr>
<td></td>
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<td>$15,237</td>
<td>$17,840</td>
<td>$11,952</td>
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<td>$642,751</td>
<td>$1,718,555</td>
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</table>
Totals on Multidimensional Data Sources

When you turn on grand totals or subtotals using the above instructions, the computation is performed on the server. If you are using a multidimensional data source, it is sometimes impossible for the server to compute totals accurately. In this case you can specify that the computation be performed locally using the data that you see in the table.

To do this, right-click the measure being totaled and select Total Using. Then select an aggregation from the sub-menu.

Quick Starts about Dashboards and Stories

After you create your data visualization, there are many ways to use it. For example, you might want to compare it with other visualizations of the same data to see how different conclusions jump out from different ways of looking at the data.
You might want to share your findings. You can present your visualization to your team, share it with the public, or even arrange visualizations into a sequence to support a narrative. Dashboards and stories are excellent tools for analyzing and presenting data.

- A **dashboard** is a collection of several worksheets and supporting information shown in a single place so that you can compare and monitor a variety of data simultaneously.

- A **story** is a sheet that contains a sequence of worksheets or dashboards that work together to convey information.

The following Quick Starts give you a glimpse into the power of presentation. To learn even more, see the [Dashboards on page 1044](#) and [Stories on page 1080](#) sections of the documentation.

**Quick Start: Design Device Layouts for Dashboards**

You can create a dashboard that adapts its layout and contents to any device that displays the dashboard. After you publish the dashboard to Tableau Server, people who view it experience a dashboard tailored for viewing on their phone, tablet, or desktop. As the author, you only have to create a single dashboard and deliver a single URL.

1 **Create a Dashboard**

Click the **New dashboard** tab at the bottom of your workbook then click and drag worksheets from the **Dashboard** pane to the dashboard on the right.
2 Preview Device Layouts

Previewing is the first step to adding a new layout. Click **Show Preview**, then click a **Device type** arrow to advance through the available layouts.
The frame shows the display size for the device you select.

3 Add Device Layouts

To create custom layouts for phones, tablets, or laptops, click Add Layout and start moving sheets in or out of the worksheet. Fit all is an easy way to adjust the dashboard to fit a specific screen size.
Before you can add an object or sheet to your layout, it must exist in the default dashboard.

4 Publish the Dashboard

When you’ve finished creating layouts, publish your dashboard to Tableau Server by selecting Server > Publish workbook.
People viewing your dashboard can use a single URL. The layout they see is appropriate for their device screen size.

Quick Start: Filter Actions

Use the Filter Actions filter to show related information between a source sheet and one or more target sheets. This type of action works well when you are building guided analytical paths through a workbook or in dashboards that filter from a master sheet to show more details.

1. Select a View to Use as a Filter

On a dashboard, click the drop-down menu of a sheet and select **Use as Filter**.
A filter action is created so when you select a mark in the view the rest of the dashboard updates to show only related data.

2 Edit the Action

Select Dashboard > Actions to open the Actions dialog box. Select an action and then click Edit.
Any action you create displays in the **Actions** dialog box. You can add Filter, Highlight, or URL actions.

### 3 Specify the Action Settings

In the **Edit Filter Action** dialog box, select the source sheets, target sheets, and the fields to filter. You can also select whether to run the action when you hover, select, or right-click the source sheet. When finished, click **OK**.

To remove the filter when you deselect the data in the source sheet, select **Exclude All Values** in the **Clearing the Selection Will** section.
4 See it in Action

Hover, select, or right-click the source sheet and watch the other sheets update to show related data.

In this example, when you select the East region in the top sheet, the rest of the sheets filters to show sales information for this region.

Quick Start: Workbook Formatting

You can change the look of views and dashboards across your entire workbook at once by using formatting at the workbook level, instead of applying formatting individually at the view, dashboard, or story level. For example, you might want to change a workbook's font so that all the views, dashboards, and stories in the workbook adhere to your company's brand.

1 Open the Format Workbook pane

In Tableau Desktop, open an existing workbook or create a new one by clicking the New Workbook icon. On the Format menu, click Workbook to open the Format Workbook pane.
2 Change the Font Workbook-Wide

Under **Fonts**, click the **All** drop-down arrow to select a new font. Your font choice is applied to all text that appears in your workbook’s views.
The Tableau typeface was designed to be paired with data visualizations and is optimized to be highly legible at small sizes.

3 Fine-Tune Title Fonts and Sizes

After you've changed the font used throughout your workbook, you can adjust just your workbook's titles. For example, you can fine-tune the fonts and sizes used by worksheet titles vs. dashboard titles.
The gray dot indicates that the font has been changed from the default. Clicking the dot returns the setting to its default.

**Quick Start: Layout Containers**

Layout containers help you organize sheets and other objects on a dashboard. These containers create an area in the dashboard where objects automatically adjust their size and position based on the other objects in the container. For example, a dashboard with a filter action that changes the size of a view will automatically adjust the other views when the filter is applied.

1. **Add a Layout Container**

Create a new dashboard and drag a horizontal or vertical layout container to the view.
2 Add Sheets

Drag sheets into the layout container. A gray rectangle indicates where the sheet will be placed in the layout container.

The corresponding quick filters and legends are automatically added with each sheet.
3 Create and Edit a Filter Action

To have the views automatically resize depending on what is selected in the view, create a filter action. To create a filter action in the dashboard, click the drop-down menu of a sheet and select **Use as Filter**. Next, go to **Dashboard > Actions** and edit the generated filter action you just created. In the **Edit Filter Action** dialog box, select **Exclude all values**.

4 Watch Objects Move and Resize

Click a mark in the view with the filter applied to it to update the other view. In the example, when a mark is selected in the map view, the bar chart updates to display the profit and sales for that mark; when no marks are selected in the map view, the map automatically expands to fill the dashboard.

| With mark selected | No selection |
Remove a Layout Container

To remove a layout container, click the drop-down menu of a sheet and select **Select Layout Container**. The layout container is highlighted blue. Click the layout container drop-down menu and select **Remove from Dashboard**. The container and all of its contents are removed.

**Quick Start: Stories**

A story is a sheet that contains a sequence of worksheets and dashboards that work together to convey information. Use stories to make your case more compelling by showing how facts are connected, and how decisions relate to outcomes. You can then publish your story to the web, or present it to an audience.

1 **Create a New Story**

To create a story, click the (new story) tab.
2 Add the First Story Point

To create the first point in your story, drag a worksheet or dashboard to the story and drop it in the center of the view. Add a caption, and then customize your story point.
Hover over a worksheet or dashboard to see a preview before adding it to your story.

3 Add More Story Points to Build Your Story

To add a new story point based on a different sheet, click **New Blank Point**. To use the same sheet in the next story point, click **Duplicate**.

Use the navigator to move through the story.

4 Format Your Story

To format your story, click **Format > Story**. In the **Format Story** pane, you can change the background colors for the story and the navigator bar, and change the appearance of the
Publish Your Stories to the Web

You can save your workbook that contains the story to Tableau Public or publish it to Tableau Server and Tableau Online.

**Quick Start: Tiled and Floating Dashboard Layouts**

A dashboard is a collection of worksheets and objects on a single sheet so you can compare and monitor a variety of data simultaneously. Dashboard objects can be tiled or floating. Tiled objects are arranged in a grid while floating objects can be layered on top of other objects.

1. **Add a Sheet as Tiled**

   To add a sheet to the tiled layout, click **Tiled** and then drag a sheet to the view.
Adding a tiled sheet places it in a layout container and arranges it into a grid.

2 Add a Sheet as Floating

To add a sheet to the floating layout, click Floating and then drag a sheet to the view.
Adding a floating sheet places it on top of the other objects in the dashboard.

3 Reorder Floating Objects

You can change the order of floating objects by rearranging the sheets in the Layout area of the Dashboard pane. Objects at the top of the list display in the front, while objects at the bottom of the list display in the back.

Right-click (control-click on the Mac) an object in the layout area to show/hide legends and filters, go to sheet, and more.
4 Resize Floating Objects

When you select an object in the dashboard, the size and position properties are shown at the bottom of the Dashboard pane. You can make small adjustments to the size and position as well as toggle between whether it is floating or tiled.

Holding the shift key while dragging an object toggles whether it is floating or tiled.

Quick Starts about Using Tableau Server

Tableau Server is an online solution for sharing, distributing, and collaborating on content created in Tableau.

You can create views in Tableau Desktop and then publish them to Tableau Server.

Quick Start: Stay Connected with Automatic Sign-In

When you connect to Tableau Server or Tableau Online, Tableau Desktop keeps you signed in from session to session, if you don't sign out. Next time you launch Tableau Desktop, you are automatically signed in to your most recent server connection. As you sign in to different servers and sites, you can easily switch between your available server and site connections.

Note: Automatic sign-in is available for servers configured for Windows Authentication only, and must be enabled by a server administrator in the server’s Settings page, under Connected clients. Automatic sign-in is not available for servers that use Kerberos or SAML authentication.

1 Sign in

Launch Tableau Desktop and then sign in to Tableau Server or Tableau Online. If you have access to multiple sites on the server, select the site you want to use.
2 Launch Tableau Desktop again

Next time you launch an instance of Tableau Desktop, you are signed in to your most recent server connection – no need to enter your credentials. You can see the server and site you are signed into, as well as who you are signed in as in two places. The **Server** menu shows the server and site that you are signed in to. **Sign out** shows you are signed in as. If you hover
Hover over the user name in the status bar to see the currently signed in user, the server, and the site.

3 Switch servers, switch sites

To switch servers, on the Server menu, click **Sign in to another server**, and then enter the server name and your sign-in credentials, or select a different server name from the drop-down menu. To switch sites, on the Server menu, click **Sign in to another site**, and then select the site.
4 Sign out or clear all saved connections

Click **Server > Sign out** to clear your sign-in credentials for the current connection. To clear all sign-in credentials, click **Help > Settings and performance > Clear saved server sign-ins**.

![Sign out or clear all saved connections](image)

**More about automatic sign-in**

- When you sign in to a server, your server authentication token is stored in secure storage on your computer. This token is used to authenticate you every time you connect to the server.

- If you are signed in to a server or site when you close Tableau Desktop, your sign-in credentials are saved. Also, when you switch sites or servers, Tableau Desktop saves your sign-in credentials.

- When you click **Sign Out** on the **Server** menu, Tableau Desktop deletes your sign-in credentials for that connection. To delete credentials for every server and site you have previously signed into, click **Help > Settings and performance > Clear saved server sign-ins**.

- If you have access to a single-site server, or you have access to only one site on a server you are signing in to, **Sign in to another site** will not be available.

**Upgrade Tableau Desktop**

This section includes information on upgrading from a previous or a beta version, and on how to turn the product update feature off or on.
Upgrade from a Previous or Beta Version

When you upgrade to Tableau 10.0 from previous versions, your repository is upgraded. Any bookmarks, workbooks, and data sources that you had in your old repository will still be accessible by the application. In addition, the new sample data sources and workbooks will replace the old samples unless you have modified them and saved them as your own.

**Note:** When you download a new version of Tableau Desktop, the product update installers are downloaded to the Downloads/TableauAutoUpdate folder. If the Downloads folder doesn't exist, the installers are downloaded to the TEMP/TableauAutoUpdate folder.

If you have participated in the Tableau Software Beta program, you also have a beta repository. While this folder will still exist after you install Tableau 10.0, the application will no longer access it. To make your beta workbooks accessible in Tableau 10.0, copy the workbooks from the beta repository to your new 10.0 repository.

Turn Product Updates Off or On

To ensure that you always have the most up-to-date features, security resolutions, and corrected issues, Tableau Desktop includes a product update feature. When you start Tableau Desktop, product updates prompts you to download an updated maintenance version of Tableau Desktop, if one exists. The update downloads immediately and then installs when you exit Tableau. You can also choose to postpone or skip the update.

**Note the following:**

- The product update installers are downloaded to the Downloads/TableauAutoUpdate folder. If the Downloads folder doesn't exist, the installers are downloaded to the TEMP/TableauAutoUpdate folder.
- Updates are not downloaded and installed on your computer if your Product Maintenance has expired. For more information, see the [Product Maintenance FAQ](#).
- You may not be prompted for product updates. For more information see [Why Am I Not Prompted for Product Updates](#) in the Tableau Knowledge Base.

Turn off product updates

Product updates is on by default. You can turn off product updates from the Help menu, or on Windows, by running the installer.

**Use the Help menu**

Select **Help > Settings and Performance > Disable Product Updates for Me.**
Run the installer (Windows only)

To turn off product updates on Windows, run the Tableau Desktop installer, and then click Customize. In the Custom setup dialog box,

1. Clear the Check for Tableau product updates check box.
2. Click Install.

To turn product updates on again, run the installer, click Customize, and select the check box.

Administrators control product updates

As an administrator, you can turn product updates off or on for your users. You can also determine the Tableau Desktop version that your users will update to. Rather than having users update to the version of their choice (or choose not to update), you can make sure that your users update to the version you choose. For more information, see Control Product Updates for Your Users in the Tableau Knowledge Base.

Accessing the Help

Tableau offers multiple ways to access the help topics. First, you can always view the online help by selecting Help > Open Help in the application. You must have an internet connection to view these pages. However, you can download a copy of the help files to your hard drive so that you can open them even when you are not connected to the internet. Finally, you can choose to download a printable PDF version of the help. This section explains each of the three ways to view the help.

Viewing the Online Help

The online help is the best way to access the most current documentation. You can open the help by selecting Help > Open Help in the application or by pressing F1 on your keyboard. You must have an internet connection to access this help.

Download the Offline Help

Although it is more efficient to view the help online, there may be times when you do not have access to the internet. In these cases, you may want a copy of the help stored on your computer. Download the offline help from the Product Help page on the Tableau website.

You must have an internet connection to initially download the help, but any subsequent times you want to access the help you are not required to be online.

If you choose to download the help and use the offline version, please remember to update your local files periodically in order to ensure you are viewing the most recent information. Anytime you want to update your offline help files, repeat the download and overwrite the existing files.
If you download the offline help, Tableau will always open the local files when you select **Help > Open Help** in the application. You can view the online help by visiting the Product **Help** page on the Tableau website.

**Download a PDF**

You must have Adobe Reader to view this file. Adobe Reader is a free software that can be found on Adobe’s Web site: www.adobe.com. You can download the PDF from the Product **Help** page on the Tableau website.

**Managing Queries**

Queries are automatically generated every time you add a field to a shelf and interact with the view. Tableau offers several ways you can manage these queries once they are sent to the underlying data.

**Turn off Automatic Updates to Boost Performance**

When you place a field on a shelf, Tableau generates the resulting view by querying the data source. When you create a dense data view that involves many fields, these queries can be time-consuming. You can instruct Tableau to turn off automatic updates to improve performance.

**Automatic updates for worksheets**

By default, automatic updates are turned on and the toolbar button is highlighted . However, it is sometimes more efficient for Tableau to execute the queries you need only for your final view, rather than for every intermediate step required to compose that view. You can turn off updates for worksheets by clicking the **Pause Auto Updates** toolbar button.

You can also turn automatic updates on and off by pressing F10 (Option-Command-0 on a Mac) on your keyboard.

You can update the view at any time while automatic updates are off by pressing F9 (Shift-Command-0 on a Mac) or clicking the **Run Update** button on the toolbar.

**Note:** It is possible to enter an invalid state when automatic updates are turned off. When this happens, the view is desaturated and invalid commands are disabled. The view and commands become available again when you click **Run Update** on the toolbar.
For example, the view below has automatic updates turned off. When the aggregation for Profit is changed from a summation to an average, the view is desaturated to let you know that you have made a change to the view that has made the current view invalid.

**Automatic updates for filters**

When you change a filter, even when you turn off automatic updates for worksheets, Tableau continues to query the data source to update the view.

When you work with a large data set, this continuous query action can degrade performance, so Tableau also gives you an option to pause automatic updates for filters.

If you pause automatic updates for filters, you can make as many changes as you need without having to wait for Tableau to update the filter each time.

To pause automatic updates for filters, click the drop-down arrow on the **Pause Auto Updates** button on the toolbar and select **Auto Update Filters** to clear the check mark.

To resume automatic updates for filters, click the drop-down arrow on the **Pause Auto Updates** button on the toolbar and select **Auto Update Filters** again. You can also click the **Run Update** button on the toolbar to manually update the view at any time.

**How Automatic Updates Affect Dashboards and Stories**

You configure automatic updates on a per-view basis. This means that you can have a dashboard where some views update automatically, and others don’t. Similarly, you can have a
story where some story points update automatically, and others don’t. But when dashboards or stories are published to Tableau Server, automatic updates affect either none of the contributing views in a story or dashboard, or all of the views.

**Cancel Query**

This command is used any time you want to stop a query that is in process. You may want to cancel a query that is taking a long time to complete due to the size of the data source. When a query is taking a long time to complete, a progress dialog box opens.

Click **Cancel** in the Processing Request dialog box.

After canceling a query the view becomes invalid because it is in an in-between state. The result is a blank view although all your fields are still on the shelves. To resume working with Tableau, alter the view in anyway and allow the query to complete.

Canceling a large number of queries can result in performance degradation in the underlying database. Although the query has been abandoned by Tableau, it is still executing on the database.

**Abandoned Queries**

When you cancel a query in Tableau, the database is told to stop processing the query. However, some databases do not support cancel (MS Excel, MS Access, Essbase, Microsoft Analysis Services 2000). If you cancel a query using one of these types of data sources, the query is abandoned by Tableau but is still running in the background and using resources. When you have abandoned queries, an indicator appears in the bottom right corner of the workbook showing the number of queries still running. As queries in the background complete, the number will go down. It is important to monitor the number of queries running and not let the number get too high, otherwise you will see performance degradation of both Tableau and the underlying database.
Note: Text, Microsoft Excel, and Microsoft Access data sources may be temporarily unavailable after canceling a query because of a lock performed internally. You may have to wait until the abandoned query has completed before re-connecting.

Precision Warnings

When you add a field to a view that contains values with more precision than Tableau can model, a warning icon⚠️ is displayed in the bottom right corner of the status bar. For example, a value in the database may have 22 decimal places but Tableau only supports up to 15. When you add that field to the view, you get a precision warning. If you click on the warning, you can read more details including the number of decimal places that have been truncated in the view.

Remember that the precision of the data displayed in Tableau will always first be dependent on the data in your database. If the values in your database exceed 15 decimal places, when you add them to the view, the value is truncated and a precision warning appears.
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Contact

Support

1. Search our support resources.
2. Review the search results to see if your question is answered.
3. If you can't find what you need, scroll to the bottom of the search results, and click Continue and Create Case.