Overview of Data Sources and Data Items

Each data source that is available in SAS Visual Analytics includes one or more data items that you can use in reports. For example, a data source named Order Information might include standard data items such as Order ID, Product ID, Unit Cost, Order Date, and Order Amount. You decide which data items to use. You can select all of the data items in the data source or a subset of the data items.

Most tasks related to data sources and data items are initiated from the Data pane. For more information, see “About the Data Pane”.

Note: The name of a sensitive data item should not be part of an automatic object name, custom object name, automatic object title, or custom object title in any report. Instead, you can specify a custom object name that does not include the sensitive data item name or you can rename the sensitive data item in the Data pane. You can specify a custom object title that does not include the sensitive data item name or you can use the No title option. For more information, see “Work with an Object’s Name” in SAS Visual Analytics: Working with Report Content or “Work with an Object’s Title” in SAS Visual Analytics: Working with Report Content.

About the Data Pane

The Data pane enables you to select a data source (or data sources) and the data items for your report. You can add, remove, change, refresh, or filter a data source using the icon beside the data source name. Using the icon, you can also add and work with data source joins and data views, map data sources, set a unique identifier data item, view the details for the measures in the data set, and create a new aggregated data source.

You can show or hide data items using the icon at the top of the pane. You can expand or collapse the list of data items.

Using the New data item menu in the Data pane, you can define a hierarchy, a custom category, a calculated item, or a geography item. You can add parameters. If your site has licensed SAS Visual Statistics, you can create an interaction effect, a spline effect, or a partition.

When you click beside the data item name in the Data pane, SAS Visual Analytics provides information about a selected data item or custom category, including the name, classification, format, and aggregation. (Not all
data items have all of these properties.) These data item properties can be modified, which impacts all of the objects that use the data item.

When a report has multiple data sources, the Data pane provides information about the data source and data items for the selected object. When you select an object that has a different data source, the Data pane updates automatically to provide information about the selected data source.

When you select at least one data item, a toolbar is displayed at the bottom of the Data pane. You can use it to clear your selection, duplicate the selected data item, or delete a data item. The toolbar provides the : icon with additional menu selections (for example, Add to selected object, Add to current page, Add to new page, Hide, Custom sort, as well as additional items). Here is an example of the Data pane with one data item selected.
Basic Tasks for Data Sources in Reports

About Data Sources

Many data sources that are available in SAS Visual Analytics are prepared by a data administrator or analyst so that you can easily define a report. Data administrators load tables into memory. Analysts can use SAS Data Studio to prepare data, perform data transforms, and view table profiles. For information about SAS Data Studio, see SAS Data Studio: User’s Guide.

The Data pane can be used to add or import data sources. If you have permission, then you can import data from a file into SAS Visual Analytics. Supported files are SAS data sets, Microsoft Excel spreadsheets, and delimited text files (such as CSV files). If you can import data sources, then the Open Data Source window will include an Import tab. For more information about importing, see “Import Tab: Work with Local Files, Social Media Content, or Esri Data” in SAS Data Explorer: User’s Guide.

All data sources contain data items, which can refer to calculations or columns in physical data (tables). Reports can include query results from more than one data source.

**TIP** If you have two data sources with the same name and you want more information about one of those data sources, click ▼ beside the data source name. Hold your pointer over the data source name in the list. The CAS server name and the library are displayed.

You can create an aggregated data source for a report or you can join data sources. For more information, see “Working with Aggregated Data Sources” on page 13 and “Working with Data Source Joins in Reports” on page 7.

Add a Data Source to a Report

You can use one or more data sources in a report in SAS Visual Analytics.

1. Do one of the following:
   - In the Welcome to SAS Visual Analytics window, click Data. The Open Data Source window is displayed.
   - If SAS Visual Analytics is already running and you have not selected any data sources, click 🔄. The Open Data Source window is displayed.
   - If SAS Visual Analytics is already running and you already selected at least one data source, click 🔄, and then select Add data source. The Open Data Source window is displayed.

2. In the Open Data Source window, click either the Available tab or the Data Sources tab to select a data source that is loaded on the CAS server. For more information, see “Data Sources Tab: Work with Databases or Remote File Systems” in SAS Data Explorer: User’s Guide.

**TIP** Use the Filter field on the Available tab to narrow the list of data sources that are displayed in the Open Data Source window. The filter feature searches through the data source names. It is a “contains” search rather than a “begins with” search.

**Note:** If a table is no longer loaded on the CAS server, it is not displayed on the Available tab.

If you know that the source of an unloaded table is in the deployment, you can select the Data Sources tab to find the source in the list. Right-click the source, and then select Load.
3 (Optional) If the data source that you want to use is not available on either the Available tab or the Data Sources tab, you can use the Import tab to import the file. For more information, see “Import a Data Source for a Report”.

4 Select the name of the data source that you want to open, and then click OK. The Data pane is populated with a list of all of the data items that are in the data source.

### Import a Data Source for a Report
If you are authorized, then you can import a data source into SAS Visual Analytics.

*TIP* You can drag and drop an Excel file or a SAS data set onto the canvas as a shortcut for importing data. When the import completes, the Excel file or SAS data set is added to the Data pane.

1 Do one of the following:
   - In the Welcome to SAS Visual Analytics window, click Data. The Open Data Source window is displayed.
   - If SAS Visual Analytics is already running and you have not added a data source, click . The Open Data Source window is displayed.
   - If SAS Visual Analytics is already running and you have added a data source, click , and then select Add data source. The Open Data Source window is displayed.

2 Click the Import tab.

3 Specify whether the data source is Local File, Social Media, or Esri.
   - **Local File**
     You can import data from a Microsoft Excel spreadsheet, a comma-separated value (CSV) or text file, or a SAS data set (SASHDAT or SAS7BDAT).

     For information, see “Importing Local Files” in SAS Data Explorer: User’s Guide.
   - **Social Media**
     You can import from a Twitter feed, Facebook feed, Google Analytics feed, YouTube feed, or Google Drive feed.

     After authenticating with Twitter, Facebook, Google Analytics, or YouTube and providing search criteria, you can import data to a CAS server.

     For more information, see “Importing Data from Social Media” in SAS Data Explorer: User’s Guide.
   - **Esri**
     If your organization has an Esri ArcGIS Online Services account, then you can combine Esri enrichment data with data and geocoded coordinates with data from a table that you select in your CAS environment. The resulting output table contains new columns of Esri data that are associated with geographic location codes in the source table. For example, you could combine Esri demographic information for the ZIP codes listed in a source table.

     For more information, see “Importing Esri Data for Geo-enrichment and Geocoding” in SAS Data Explorer: User’s Guide.

4 Click Import Item.

5 Click OK to add the data source to the report.
Add Additional Data Sources to a Report

1 Click and then select Add data source. The Open Data Source window is displayed.
   Alternatively, click beside the data source name, and then click Add data source at the bottom of the list.

2 Select the name of the data source that you want to add, and then click OK.
   When you add multiple data sources, the last data source that you selected is displayed in the Data pane. If one of the data sources that you selected is not available, the last available data source that you selected is displayed in the Data pane.

   Note: When you open a saved report that has multiple data sources, SAS Visual Analytics displays the same data source that was displayed in the Data pane when the report was saved.

Remove a Data Source from a Report

You can remove all references to a data source from a report. Be aware that removing a data source means that all related data items are also removed from the objects within the report.

Note: Other reports that use the same data source are not affected when you remove a data source from a report.

To remove a data source:

1 In the Data pane, select the data source name from the drop-down list.

2 Click , and then select Remove data source.

Change a Data Source for a Report

To change a data source in a report:

1 In the Data pane, select the data source.

2 Click , and then select Change data source. The Change Data Source window is displayed.

3 In the Change Data Source window, click either the Available tab or the Data Sources tab to select a data source that is loaded on the CAS server.
   Select the name of the data source that you want change to.
   Note: If a data item that is used in the report is not present in the new data source, you can specify a replacement data item from the new data source.

4 Click OK.
   Note: If there are data items in the report that are missing in the new data source, then the Repair Report window is displayed. Select a data item in the list, and then select the replacement data item from the pop-up menu. When you are finished mapping data items, click Continue With Change Data Source.

5 Click Close in the confirmation message that is displayed.

Note: If the locale for the new data source is different from the original data source, any currency data items in the new data source will use the format appropriate for the locale of the original data source. You must manually adjust the format as needed.
Refresh a Data Source for a Report

You can refresh the columns in a data source at any time. Be aware that refreshing a data source means that all objects that are connected to that data source will have their queries rerun.

Here are some key points about refreshing a data source:

- Refreshing a data source adds any new columns that have been added to the table metadata in the CAS server. The default formats and names of existing columns are also updated.
- Data is refreshed from the table that is currently loaded into the CAS server.
- When you refresh a data source for a report, columns that have been deleted from the table metadata in the CAS server are automatically removed if they do not impact any objects in the report.

To refresh a data source for a report:

1. In the Data pane, select the data source.
2. Click , and then select Refresh data source.

Map Data Sources Using the Data Pane

The source and target of an action or link should be based on the same data source. If they are not based on the same data source, you need to map data sources so that an action or link works properly.

You can use the Data pane to globally map data sources. This can save you time because you are not prompted to map data sources for individual reports. SAS Visual Analytics does not prompt you to map data sources for automatic actions. For more information about automatic actions, see "Using Automatic Actions" on page 69.

Note: When you are working in the Actions pane, you are prompted to map data sources. For more information about when you might be prompted to map data sources, see "Map Data Sources for Actions and Links" on page 74.

Here are some key points about mapping columns in data sources:

- A column in one data source can be mapped only once to another data source. If you need to map a column more than once, then the column needs to be duplicated in the data source.
- Mapped columns must share the same format for filters to work. For example, if the format of the source column is MMDDYYYY and the format of the target column is DDMMYYYY, then a filter will not work.
- Data items in a hidden data role can participate in the mapping of data sources.
- You cannot map a column to a custom category data item or to a calculated data item.

To map data sources for automatic actions using the Data pane:

1. In the Data pane, make sure that both data sources are available by clicking beside the data source name. Select the name of the data source that you want to use as the source for the mapping.
2. Click , and then select Map data sources. The Map Data Sources window is displayed.
3. Select the Enable data source mapping check box.

Here is an example of the Map Data Sources window:
4 Use the **Source** drop-down list to select a column from the first data source.

5 Use the **Target** drop-down list to select a corresponding column from the second data source.

6 (Optional) Click **+** to add more source and target pairs.

7 Click **OK**.

---

**View Measure Details**

You can view the details about all of the measures in a data source, as long as there are fewer than 500 measures. To view the details:

1 In the **Data** pane, click **[ ]**, and then select **View measure details**. The Measure Details window is displayed.

2 (Optional) Select a row or measure in the table to see more details (for example, the standard deviation, standard error, and variance).

3 Click **Close**.

---

**Working with Data Source Joins in Reports**

**Overview of Data Source Joins**

**What is a Data Source Join?**

Data source joins enable you to combine two data sources. A data source join creates a new data source that contains data from each of the two original data sources.

The criteria that you specify for the join determine which rows in the data are considered to be a match. The **Join type** that you select determines which matching and non-matching rows are included in the data source join (output data source).
Matching rows overlap in the output data source, and non-matching data rows do not overlap. For any non-matching rows in the output data source, each data item that originated in the opposite data source has a missing value. "Join Example" on page 8 compares the output for matching and non-matching rows.

Join Example

In this example, the following two tables are joined:

**Table 1**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joe</td>
<td>11</td>
<td>60</td>
</tr>
<tr>
<td>Bob</td>
<td>12</td>
<td>58</td>
</tr>
</tbody>
</table>

**Table 2**

<table>
<thead>
<tr>
<th>Name (Table 2)</th>
<th>Name</th>
<th>Age</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joe</td>
<td>Joe</td>
<td>11</td>
<td>100</td>
</tr>
<tr>
<td>Bob</td>
<td>Bob</td>
<td>12</td>
<td>97</td>
</tr>
</tbody>
</table>

If you perform a full join on these tables where the condition is **Name** = **Name**, then the following output table is produced:

**Table 3**  
**Full Join Output Where All Rows Match**

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Height</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joe</td>
<td>11</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>Bob</td>
<td>12</td>
<td>58</td>
<td>97</td>
</tr>
</tbody>
</table>

If you perform a full join on these tables where the condition is **Name** = **Age**, then the following output table is produced:

**Table 4**  
**Full Join Output Where No Rows Match**

<table>
<thead>
<tr>
<th>Name</th>
<th>Name (Table 2)</th>
<th>Age</th>
<th>Age (Table 2)</th>
<th>Height</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joe</td>
<td>Joe</td>
<td>11</td>
<td>.</td>
<td>60</td>
<td>.</td>
</tr>
<tr>
<td>Bob</td>
<td>Joe</td>
<td>.</td>
<td>11</td>
<td>.</td>
<td>100</td>
</tr>
<tr>
<td>Bob</td>
<td>Bob</td>
<td>12</td>
<td>.</td>
<td>58</td>
<td>.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name</th>
<th>Name (Table 2)</th>
<th>Age</th>
<th>Age (Table 2)</th>
<th>Height</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joe</td>
<td>Joe</td>
<td>11</td>
<td>.</td>
<td>60</td>
<td>.</td>
</tr>
<tr>
<td>Bob</td>
<td>Joe</td>
<td>.</td>
<td>11</td>
<td>.</td>
<td>100</td>
</tr>
<tr>
<td>Bob</td>
<td>Bob</td>
<td>12</td>
<td>.</td>
<td>58</td>
<td>.</td>
</tr>
</tbody>
</table>
Considerations for Data Source Joins

Here are some key points about data source joins:

- Data source joins and data source filters cannot be used together. If a data source has a data source filter, then it cannot be used in a data source join. If a data source is used in a data source join, then you cannot add a data source filter to it.

  **TIP** To join a data source that has a data source filter, convert it to an aggregated data source.

- Calculated items and custom categories cannot be included in a data source join. However, you can add calculated items and custom categories to a joined data source.

- Date values are evaluated using their formatted data values for matching purposes.

  This means that the same date in two data sources might not match if the format of the data item in each data source is different. Changing the format in one of the data sources using the Data pane is one way to work around this issue.

- SAS Visual Analytics generates temporary tables in your personal library when you perform a data source join or when you open a report that contains a data source join. Each temporary table might appear in the Open Data Source window with a name that begins with _VA_. The temporary tables for each user are cleaned up automatically when that user closes the report.

  The temporary tables for data source joins can be very large. If many users access the report concurrently, then the temporary tables for all of these users could create performance issues. If your data joins involve large data sets and your report is intended for a wide audience, consider creating permanent joins as part of your data preparation.

Create a Custom Data Source Join

To create a data source join with custom settings:

1. Add one of the data sources to your report.

2. On the Data pane, click 

3. Specify the Name for the new data source join.

4. From the Join type drop-down list, select one of the following:

   - **Inner Join**: specifies that only the rows that match the join conditions are included in the output data source.

   - **Left Join**: specifies that non-matching rows from the first data source only are included in the output data source. Matching rows from both data sources are included in the output data source.

   - **Right Join**: specifies that non-matching rows from the second data source only are included in the output data source. Matching rows from both data sources are included in the data source join.

   - **Full Join**: specifies that all matching and non-matching rows from both data sources are included in the output data source.

5. Specify the two data sources to join. You can select a data source that is already included in the report or click Choose to select or import a new data source.
6 Specify the conditions for the join.
   For each condition, select a data item from each data source. In order for each condition to be met, the
   values for the selected data items must match.
   To add additional conditions, click Add. In order for each row in the join to be a match, all of the join
   conditions must be met.
   To remove a condition, click .
7 Click Choose Columns to select the data items that are included in the output data source.
   Note: In the Choose Columns window, the data source for each selected data item is appended to the data
   item name. For example, Revenue (INSIGHT_TOY_DATA).
   This version of the data item name is used in the output data source if both of the following are true:
   - Both of the data sources have a data item with the same name.
   - The data item is from the second data source for the join (Data source 2).
8 Click OK to perform the data source join. In the Data pane, the new data source is selected.

Join Data to the Current Data Source
To create a data source join with the current data source using default settings:
1 On the Data pane, select the first data source for the join.
2 Click , and then select Join data to data-source.
3 In the Open Data Source window, select the second data source for the data source join, and then click OK.
A quick data source join uses the Left Join type and selects the join conditions automatically.
Any categories that have matching labels or names in both data sources are selected as join conditions. If no
categories have matching labels or names, then any measures with matching labels or names are used for join
conditions. If no categories or measures have matching labels or names, then an error message appears.

Edit a Data Source Join
To edit a data source join:
1 In the Data pane, select a data source that is the output data source of a data source join.
2 Click , and then select Edit data source join. The Edit Data Source Join window appears.
3 Modify the data source join, and then click OK.

Working with Data Views in Reports

Overview of Data Views
You can use data views to save and apply all of the settings for a data source in your report.
Here are some of the settings that are stored in a data view:
- Data item settings such as names, formats, classifications, and aggregations
Data source filters
Hierarchies
Calculated items
Custom categories
Duplicate data items
Show and hide statuses for data items
Unique row identifier selections

Here are some key points about data views:

- Each data view is specific to one data source. You cannot apply a data view to a data source other than the one that it was created for.
- Data views are saved separately from your reports. If you create a data view in one report, you can apply it to other reports.
- A data view acts as a template for data source settings. If the data view is updated, your reports are not automatically updated with the new settings.
- A data source can have a default view, which is set by an administrator. You can also set the default view (for yourself, only). A default data view is automatically applied anytime you add the data source to a report.
  
  For information about administrator default data views, see “Manage Administrator Default Data Views” on page 12.

**Save a Data View**

To save a data view:

1. In the Data pane, click \[\text{Save data view}\], and then select **Save data view**. The Save Data View window appears.

   **Note:** Saving a data view is disabled if your data source contains derived data items (for example, leaf IDs from a decision tree) To enable saving a data view, remove all derived data items from the data source.

   Saving a data view is disabled for aggregated data sources if they are based on a data source that contains derived data items.

2. Enter a **Name**. (Optional) Enter a **Description** for the data view.

3. (Optional) Select **Default data view** to automatically apply the data view whenever you add the current data source to a report.

4. (Optional) Select **Shared data view** to make the data view available to other users.

   **Note:** This option is available only if you are a member of the Application Administrators group.

5. Click **Save** to save the data view.

**Apply a Data View**

To apply a data view to your report:

1. Add the data source to your report.

2. In the Data pane, click \[\text{Data views}\], and then select **Data views**. The Data Views window appears.

3. Select the data view that you want to apply.
Note: Only the data views for the current data source are available.

4 Click **Apply** to apply the data view to your report.

Note: When you apply a data view to a data source that is already in your report, any differences in data items are applied additively. Any data items that exist in the current report but do not exist in the data view are retained. Any conflicts between the data in the current report and the data view are resolved by creating duplicate data items.

For example, if your data source has a category named Country, and your data view changes the category name to Country Name, then your report will contain both of these categories when you apply the data view.

Note: If a data view is set as the default for a data source, then all of the settings from the data view are automatically applied when you add the data source to a report.

**Update a Data View**

To update a data view with your current settings:

1. In the **Data** pane, click **Save data view**, and then select **Save data view**. The Save Data View window appears.

2. Select the data view that you want to update.

   Note: You cannot update a shared data view that was created by another user.

3. Click **Save** to update the data view with your current settings.

   Note: Changes to a data view are not automatically applied to your reports.

**Manage Data Views**

To manage your existing data views:

1. In the **Data** pane, click **Data views**, and then select **Data views**. The Data Views window appears.

2. Select a data view, and then perform any of the following tasks:
   - click **Save** to edit the name, description, default status, and shared status of the data view.
   - click **Remove** to remove a data view.
   - click **Sort by** to toggle between sorting by date modified and by name.
   - click **Refresh** to refresh the list of data views.

3. When you are finished, click **Close**.

**Manage Administrator Default Data Views**

If you are a member of the Application Administrators group, then you can manage the default data views for each data source that is shared by all users.

Note: Each user can set their default data view, which overrides the administrator default data view.

To manage the administrator default data views:

1. Select **Edit administration settings** from the menu bar. The **Administration Settings** window is displayed.

2. Select **Default Data View** from the side menu.
   
   Any existing default data views are displayed.
To create a new default data view, click **New**. Click **Choose** to select the data source and data view for that data source from the drop-down list.

**Note:** Only shared data views are available for administrator default data views.

To delete a default data view, click **Delete**.

---

**Working with Aggregated Data Sources**

**Overview of Aggregated Data Sources**

You can aggregate a data source based on an original data source. An aggregated data source can have fewer columns, depending on the filters and data items that are assigned, which will typically reduce the number of rows as well. If you use an aggregated data source for multiple objects, your reports might be displayed faster and use fewer resources.

Here are some key points about aggregated data sources for reports:

- The aggregated data source is generated when the report is open, but is available only for this report.
- When you omit category columns, the rows in the aggregated data source are aggregated based on the categories that are selected. This results in fewer rows, and these rows represent data that is already aggregated.
  
  The rows are aggregated based on the aggregation in the original data source. If the aggregation in the original data source changes at a later time, then the aggregated data source is regenerated based on the new aggregation.
- You can join two aggregated data sources that do not have any data source filters. For more information, see “Working with Data Source Joins in Reports” on page 7.
- When you create an aggregated data source using a date or datetime data item, the data is stored in the aggregated data source using the format that is in the original data source. For this reason, format changes in the aggregated data source are limited to what is supported by formats in the original data source. For example, if the original format includes only month and year, then the aggregated data source stores only month and year. You cannot later specify to use a format that includes day in the aggregated data source. If you do, the day value returned is always 1. For maximum flexibility with date and datetime formats in the aggregated data source, ensure that the formats in the original data source include the level of detail that you need.
- If you create an aggregated data source with a user-defined format, then the user-defined format no longer displays as a user-defined format in the Data pane. The values in the aggregated data source are formatted using the user-defined format. However, you cannot remove or change the format of values in the aggregated data source.
- When Frequency and Frequency Percent are included in an aggregated data source, they are automatically renamed to Aggregated Frequency and Aggregated Frequency Percent. They are both listed under the **Measure** heading in the Data pane.

**Create an Aggregated Data Source**

1. In the **Data** pane, select a data source.

2. Click **Aggregated Data Source** and then select **New aggregated data source**. The New Aggregated Data Source window is displayed.
3 (Optional) Change the name of the aggregated data source in the **Name** field. The automatic name provided by SAS Visual Analytics is the original data set name followed by _AGGREGATED_. For example, suppose the original data set name is **SALES**. The automatic name is **SALES_AGGREGATED**.

4 Select the data items that you want to add to the aggregated data source in the **Available items** list. The list of available data items includes all data items except for hierarchies, geography items, spline effects, partitions, scoped calculated items, interaction effects, and calculations that contain a suppressed or time-period calculation or that use the AggregateCells operator.

5 Do one of the following:
   - Select a data item that you want to add in the **Available items** list. Then, click to move it to the **Selected items** list.
   - Click to move all of the available data items to the **Selected items** list.

   **TIP** To select multiple data items, press the Ctrl key.

   **Note:** The **Preview** area displays the data items that you selected in a list table.

6 (Optional) Add a new filter for the aggregated data source. Click **New filter**. Select the data item that you want to filter or select **Advanced filter**. Clear the check boxes for the categories or measures that you do not want to include in the filter.

   **TIP** Select **Advanced filter** if you want to subset data using any number of data items and operators (for example, OR and AND) in the same expression. For more information about using the Advanced Filter window, see “About Advanced Report Filters” on page 58.

   **Note:** It is recommended that you avoid adding multiple-value parameter filters using the New Aggregated Data Source window.

   The **Preview** area refreshes after you add a filter.

7 Click **OK**. The new aggregated data source is available in the **Data** pane.

Once you have created an aggregated data source for a report, you can add new data items (for example, hierarchies and custom categories) and modify existing data items in that aggregated data source.

### Edit an Aggregated Data Source

1 In the **Data** pane, select the aggregated data source.

2 Click and then select **Edit aggregated data source**. The Edit Aggregated Data Source window is displayed.

3 (Optional) Edit the **Name**.

4 Add or remove **Selected items** or add a **New filter**.

   **Note:** It is recommended that you avoid adding multiple-value parameter filters using the Edit Aggregated Data Source window.

5 Click **OK**.
Working with Data Items in a Report

About Data Items

You decide which data items to use to define a query for each object. You can use all the data items in the data source or a subset of data items. Each data item is classified as either a category or a measure.

**TIP** If you are using multiple data sources, and you want to know which data source a data item comes from, select the data item in the Data pane. Information about the data item is displayed in a tooltip. If you have two data sources with the same name, and you want more information about one of the data sources, click ▼ beside the data source name. Position your pointer over the data source name in the list. The CAS server name and the library are displayed.

SAS Visual Analytics can display data items using an existing user-defined format that has already been specified externally for a data column in a data source. However, you cannot specify a new or different user-defined format for a data item. For more information, see User-Defined Formats.

You can create a custom sort for the distinct values in a category data item so that they sort in a non-default way. (By default, the values in a category data item sort alphabetically.) Calculated items that are categories and custom categories also support custom sorts. For more information, see “Using a Custom Sort” on page 44.

**Table 5  Data Items That Are Available in SAS Visual Analytics**

<table>
<thead>
<tr>
<th>Data Item</th>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregated Measure or Time Period Calculation</td>
<td>![Icon]</td>
<td>A data item that represents special predefined operations, like distinct count, percentage of totals, percentage of subtotals, or frequency percent. Or, users can define their own aggregated measure calculations. Aggregated measures can be used in only some objects. They cannot be used in filters, controls, sparklines, or models. Percentage of subtotal items (including row total, row subtotal, column total, and column subtotal) can be used only in crosstabs.</td>
</tr>
<tr>
<td>Calculated Item</td>
<td>![Icon]</td>
<td>A data item that is calculated from existing data items by using an expression. For example, you could create a calculated data item called Profit, which is created by using this expression: [Revenue] − [Cost], where Revenue and Cost are measures in a data source. Calculated dates and times are treated as categories with distinct values being governed by the date or time format that you have chosen. Numeric calculated items can be treated as measures (with an aggregation type such as Sum, which is applied to each distinct category combination). Or, you can change numeric calculated items into category data items with distinct values being governed by the number of decimal places in the numeric format.</td>
</tr>
<tr>
<td>Data Item</td>
<td>Icon</td>
<td>Description</td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Category</td>
<td>📊</td>
<td>A data item whose distinct values are used to group and aggregate measures. There are five types of categories: alphanumeric, date, datetime, time, and numeric. Alphanumeric categories can be made up of all letters, all digits, or a combination of the two. Categories that have values that are all digits might be physically stored as character or numeric data. The data type affects how values are handled in relation to some functionality, such as filtering, sorting, and formatting. Examples of alphanumeric categories include data items such as <em>Product ID</em>, <em>Country</em>, <em>Employee Number</em>, and <em>Employee Name</em>. Alphanumeric categories sort lexically. Date, datetime, time, and numeric categories are sorted by their underlying numeric values. Category data items can also be numeric. A category data item sorts differently than an alphanumeric data item. Numeric category data items sort by number. <strong>Note:</strong> If you change a measure to a category, then it uses this category icon. User-defined format categories can be based on underlying numeric or character data.</td>
</tr>
<tr>
<td>Custom Category</td>
<td>📊</td>
<td>A data item that you create based on either a category or measure data item. A custom category data item is always a category data item with an alphanumeric value.</td>
</tr>
<tr>
<td>Date and Time</td>
<td>📅</td>
<td>A category data item whose distinct values are used to group and aggregate measures. There are three types of date categories: date, datetime, and time. Examples of date, datetime, and time categories are <em>Order Year</em>, <em>Date and Time of Sale</em>, and <em>Customer Wait Time</em>.</td>
</tr>
<tr>
<td>Frequency</td>
<td>🕒</td>
<td>A measure data item whose value represents the number of times an observation occurs in the selected data source. SAS Visual Analytics automatically adds this data item to the Data pane under the <strong>Measure</strong> heading when you select a data source. You cannot change the classification for the frequency data item. However, you can change the name, the format, or both. The frequency data item is automatically displayed in a crosstab when no measures are assigned. It is also automatically assigned to objects that require a measure when you have not specified one (for example, a bar chart).</td>
</tr>
<tr>
<td>Frequency Percent</td>
<td>🕒</td>
<td>A measure data item whose value is based on the percentage of occurrence in the selected data source. SAS Visual Analytics automatically adds this data item to the Data pane under the <strong>Aggregated Measure</strong> heading when you select a data source. You cannot change the classification for the frequency percent data item. However, you can change the name, the format, or both.</td>
</tr>
<tr>
<td>Geography</td>
<td>🌍</td>
<td>A category data item whose values are mapped to geographical locations or regions. Geography data items can be used in reports to show your data on a geographic map. For example, a geography data item can identify geographic information that is specific to your organization (for example, sales regions, warehouse locations, oil platforms, and so on). <strong>Note:</strong> If a geography data item is used in a model that does not use geographic values, then the geography data item is treated as a regular category data item.</td>
</tr>
<tr>
<td>Geographic Hierarchy</td>
<td>🌍</td>
<td>A hierarchy that is based on geography.</td>
</tr>
<tr>
<td>Hierarchy</td>
<td>🌍</td>
<td>A data item whose values are arranged with more general information at the top and more specific information at the bottom. The first level in the hierarchy is the root level. For example, you might have a <em>Date</em> hierarchy, which includes the <em>Year</em> (the root level), the <em>Quarter</em>, and then the <em>Month</em>. You can also have geographic hierarchies.</td>
</tr>
</tbody>
</table>
## Assign Data Items

You can use the Data pane to manually assign data items. Or, you can drag and drop data items onto an object, and let SAS Visual Analytics automatically assign the data item to a data role. For more information, see “Automatic Data Item Assignment” on page 18.

1. If the Data pane is not already displayed, click 📊.
2. Click ▼ beside the data source name to display a list of available data sources. Select a data source, and the Data pane is populated with a list of all of the data items that are in the data source.
   
   If the data source that you want is not in the list, follow these steps:
   
   a. Click 📜, and then select Add data source. The Open Data Source window is displayed.
   b. Double-click the data source that you want. The Data pane is populated with a list of all of the data items that are in the data source.

   If you do not want to use the data source that you originally selected, click 📜, and then select Remove data source.

3. Do one of the following:
   
   - Select an object on the page that uses the corresponding data source or add a new object to the page. Then, drag and drop the data item onto the object.
   - Drag and drop a data item onto an object. The data item is automatically assigned a data role. For more information, see “Automatic Data Item Assignment” on page 18.
   - Right-click a data item, and select Add to current page or Add to new page.

### Data Item Table

<table>
<thead>
<tr>
<th>Data Item</th>
<th>Icon</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction Effect</td>
<td>🌟</td>
<td>An interaction effect is a user-created data item that can be used when there is a nonadditive relationship between two variables. That is, the effect of variable A on the model changes as variable B changes. An interaction effect can help capture these changes in your model. Your site must license SAS Visual Statistics to use this feature. For more information, see “Interaction Effects” in SAS Visual Analytics: Working with SAS Visual Statistics.</td>
</tr>
<tr>
<td>Measure</td>
<td>📊</td>
<td>A data item whose values can be used in computations. These values are numeric. Examples of measures include Sales Revenue, Units Sold, and Salary. SAS Visual Analytics assigns a default aggregation method to every measure. Almost all measures are assigned Sum. You can change the aggregation method. You can change measures into category data items with distinct values being governed by the number of decimal places in the numeric format.</td>
</tr>
<tr>
<td>Parameter</td>
<td>☢</td>
<td>A variable whose value can be changed and that can be referenced by other objects. You can use parameters in calculations, display rules, filters, and ranks.</td>
</tr>
<tr>
<td>Spline Effect</td>
<td>♨</td>
<td>A spline function is a piecewise polynomial function in which the individual polynomials have the same degree and connect smoothly at certain points. Spline functions are used to fit smooth curves to a wide variety of data. SAS Visual Statistics creates thin-plate regression spline effects that are based on thin-plate smoothing splines. Your site must license SAS Visual Statistics to use this feature. For more information, see “Spline Effects” in SAS Visual Analytics: Working with SAS Visual Statistics.</td>
</tr>
</tbody>
</table>

Note: Other data items might be available depending on the products licensed at your site.
4 (Optional) To view or edit data item properties, select the data item, and then click 
. The Name, Classification, Format, and Aggregation are displayed below the data item. Not all data items have all of these properties. For example, an alphanumeric category data item has only Name and Classification properties.

Here is an example of the properties for a measure data item called Expenses:

Note: For a category data item with a user-defined format that has an underlying numeric value, you can specify Sort Options.

Automatic Data Item Assignment

When you drag and drop a data item onto an object on the canvas, SAS Visual Analytics automatically assigns it to a data role. Each data item is assigned to an “open” data role that accepts a data item. An “open” data role is one that has not yet met its maximum capacity. Precedence is given to required data roles whose maximum capacity has not been met.

Note: The Group role, Animation role, and Data tip values role are not automatically assigned.

For more information about data roles, see “Working with Data Role Assignments” on page 38.

Show or Hide Data Items in the Data Pane

You can specify which data items you want to see for the data source in the Data pane. Your selections for which data items are shown or hidden are stored with the report. For example, suppose that you hide data items in one report, and then you open a second report that uses the same data source. The data items in the second report are not hidden unless you specifically hide them in that report, too.

Note: Hiding data items in the Data pane does not hide them in the entire report. This feature is not a way to implement column-level security.

To show or hide data items:

1. If the Data pane is not already displayed, click 
2. Click ‣ , and then select Show or hide data items. The Show or Hide Data Items window is displayed.
3 Do one of the following:

- Select the data items that you want to hide in the **Displayed items** list. Then, click \( \rightarrow \) to move them to the **Hidden items** list.
- Select the data items that you want to show in the **Hidden items** list. Then, click \( \leftarrow \) to move them to the **Displayed items** list.

**TIP** To select multiple data items, press the Ctrl key.

4 Click **OK**. The list of data items in the **Data** pane is updated.

Alternatively, you can right-click the data item in the **Data** pane, and select **Hide**.

### Sorting Data Items

SAS Visual Analytics enables you to right-click an object on the canvas, and select **Sort**. For example, suppose that you have a bar chart with a data item called **Expenses**. To sort by the data item, right-click on it in the bar chart, and select **Sort**. Then, you can select **Expenses: Ascending** or **Expenses: Descending**. Depending on the object type and the data items assigned, you might see additional data items listed in the menu. For more information, see “Sorting Data in Reports” on page 43.
Replace or Remove Data Items in an Object

You can right-click a data item in an object on the canvas, and then use the pop-up menu to replace or remove the data item. For example, suppose that you have a list table with a column based on a data item called Revenue. To replace the data item, right-click the list table, and select Replace. SAS Visual Analytics provides a list of available data items.

Suppose that you want to remove the Revenue data item. Right-click the list table, and select Remove. Then, you can select the Revenue data item, any other data item assigned to the table, or you can also remove All role assignments.

Add New Data Items

You can add new data items that are needed for analysis in SAS Visual Analytics. Using the Data pane, you can click New data item.

Here are the data items that you can add:

- Duplicate data items
- Derived items
- Hierarchies
- Custom categories
- Calculated items
- Geography items
- Parameters

If SAS Visual Statistics is licensed at your site, you can also add the following items:

- Interaction effects
- Partition variables
- Spline effects

You can right-click a data item in the Data pane, and select New data-item-type. The available data item types depend on which data item you clicked. For example, if you select a category data item, the new types can include custom category, calculation, geography items, and parameters.

Duplicate Data Items

You can duplicate both measure and category data items in SAS Visual Analytics.

Duplicating measure data items enables you to see different aggregations of a data item side by side in a table. For a list of the available aggregation types, see “Reference: Aggregations for Measures” on page 84. You can duplicate a numeric measure if you want to use it as a category to group other values in some tables or graphs. If you save a report with duplicate data items, then those data items are available when you edit the report the next time.

You can duplicate a calculated data item to make a variation of a calculation. For example, you might make similar calculations involving miles per gallon for a vehicle, but you create one calculation using MPG (City) and another using MPG (Highway). You can duplicate any data item if you want to use it with more than one format in your report. For example, you might change Month to Year for a date data item.

To duplicate a data item:

1. In the Data pane, right-click the data item that you want to duplicate. Select Duplicate.
All of the properties of the original data item are copied to the duplicate data item. The duplicate data item appears in the list of data items in the Data pane. For example, if the original data item name is Engine Size, then the duplicate data item is displayed as Engine Size (1). If you choose to duplicate the same data item again, then it is displayed as Engine Size (2).

2 (Optional) Rename the duplicate data item.

3 (Optional) Change the format or aggregation for the duplicate data item.

4 (Optional) Edit the calculation for a calculated data item or aggregated measure.

5 (Optional) Change the sort options for a category data item with a new custom sort or sort by the underlying numeric value for user-defined formats.

6 (Optional) Change the classification for the data item. For example, a numeric data item that has been duplicated and is not yet assigned to an object can be a category or a measure.

Alternatively, you can duplicate data items by selecting one or more data items in the Data pane, and then clicking on the toolbar at the bottom of the pane.

Search for Data Items

Use the search field to narrow the list of data items that are displayed. The search feature uses a “contains” search rather than a “begins with” search.

1 In the Data pane, enter the partial or full name of a data item in the search field.

2 Click to clear the search term and display all of the data items in the data source. The search does not include hidden data items.

Modify Data Item Properties

Rename Data Items

1 In the Data pane, select a data item that you want to rename, and then click beside the data item name. The Name property is displayed.

2 Enter a new name. The name cannot be used by another data item in the same data source.

3 Press Enter to update the data item name.

Modify a Data Item’s Classification

You can modify a data item’s classification. For example, you might want to modify a measure data item to be a category data item.

A data item’s classification might not be able to be modified if that data item is in use in the report. If a measure data item is in use, then you cannot change its classification. If a category or geography data item is in use, then its classification can be changed. However, if you change the classification for a geography data item to category while the data item is in use, then the data item is automatically removed from the object role.

Here are some key points about modifying a data item’s classification:

- You can modify a category data item to be a measure data item only if the data item started as a numeric measure. For example, if you change a measure to a category in the report, then SAS Visual Analytics allows you to change it back to a measure.
A data item’s classification cannot be modified if the data item can have only one classification. However, duplicating the data item allows the new data item to have a different classification. For more information, see “Duplicate Data Items” on page 20.

- You cannot change the classification for the frequency data item or the frequency percent data item.
- You cannot change the classification for an aggregated measure.
- You cannot change the classification for a measure data item that is in use by one or more objects.

1. In the Data pane, select a data item, and then click  beside the data item name. The Classification property is displayed.

2. Click ▼ to open the drop-down menu. The available classifications depend on the selected data item. Options might include Measure, Category, or Geography. Your change is saved automatically.

3. If you select Geography for the classification, then the Geography Classification window is displayed. You can select a Geography. Additional options might be Country/Region, Latitude (y), Longitude (x), and Coordinate Space.

**Modify the Format of a Numeric Measure Data Item or a Date, Datetime, or Time Data Item**

You can modify the format of a numeric measure data item or a date, datetime, or time data item. You can also modify the format of a data item with a user-defined format if the user-defined format is based on an underlying numeric value. For more information, see “Modify User-Defined Formats” on page 22.

To change the format:

1. In the Data pane, select one or more numeric measure data items or date, datetime, or time data items.

2. Right-click the data item, select Format, and then select a format or select More formats.

3. In the Format window, you can select the format, the Width, and the number of Decimals (for numeric measure data items). A sample of your format is displayed below the Decimals field. (There is no Decimals field for date, datetime, or time data items.)

   - **Note:** There are different format variations available in the Format window for some format types for date, datetime, and time data items.

   - **Note:** The Reset to Default option is displayed only if the format has been changed from the default.

   - **Note:** The Reset to Default option is available for a user-defined format after it has been modified to a standard numeric format as long as the formatted data item is still a category data item.

4. Click OK to save your changes.

**TIP** You can change the format of multiple data items of the same data type to the same format by selecting them in the Data pane, right-click, and then select Aggregation. Select an aggregation type from the list.

**Modify User-Defined Formats**

In SAS Visual Analytics, user-defined formats that are defined in the CAS server are applied to the results. You can change the format for an underlying numeric data item, but you cannot change the format for an underlying character-based data item. If you change the format for an underlying numeric data item, you can restore the user-defined format by selecting Reset to Default.

The Format property of the data item displays the name for a user-defined format.
The icon identifies a category data item with an active user-defined format in the Data pane.

**Modify How a Measure Is Aggregated**

You can change the aggregation method for a measure in a data source using the Data pane.

**Note:** You need to understand your data because some aggregation methods are not always appropriate. For example, an average of an average is not valid.

1. In the Data pane, select one or more measure data items.
2. Right-click the measure data items, select **Aggregation**, and then select the aggregation that you want to apply. For more information, see “Reference: Aggregations for Measures” on page 84.

   When you select an aggregation method, your change is saved automatically.

   **Note:** Depending on the aggregation, a format might be overridden when the aggregation is used in an object. For example, skewness becomes a floating point number with four decimals.

Alternatively, select one or more measure data items in the Data pane, and click in the toolbar at the bottom of the pane. Select **Aggregation**, and then select the aggregation that you want to apply.

**Create Derived Items**

You can create derived data items that are aggregated measures. The aggregated measure does not contain data values in itself, but when it is used in an object, it displays the value for the measure and formula type on which it is based. An example is a percentage of total.

Here are some key points about derived items:

- Derived data items cannot be used in filters or controls.
- Period calculations cannot be derived from measures with certain aggregations.

1. In the Data pane, right-click a measure data item or a category data item, and select **New calculation**. The Create Calculation window is displayed.
2. Specify the **Type** of calculation. Measure data items and category data items have different derived calculation types.
   - If the derived item is based on a category, select one of the following:
     - **Distinct count**: Displays the number of distinct values for the selected category. A distinct count query is useful in many ways. For example, you might want to know the number of distinct products that were purchased during a specific time period. Or, you might want to know which products have the most customers or which products have the most customers in a particular geographic region. You can create a distinct count for category data items only.

     **Note:** If your category contains missing values, then by default the distinct count is increased by one. A configuration setting can modify this behavior.

     - **Count**: Displays the number of nonmissing values for the selected category.
     - **Number missing**: Displays the number of missing values for the selected category.

   - If the derived item is based on a measure, select one of the following:
     - **Cumulative total**: Displays a running total of all of the values for the measure on which it is based.
For example, in a list table, each cell for the cumulative total displays the sum of the current value and all of the previous values, according to the sorted order of the rows in the list table.

**Data suppression**

Obscures aggregated data if individual values could easily be inferred. Data suppression replaces all values for the measure on which it is based with asterisk characters (*) unless a value represents the aggregation of a specified minimum number of values. You specify the minimum in the **Suppress data if count less than** parameter. The values are hidden from view, but they are still present in the data query. The calculation of totals and subtotals is not affected.

Some additional values might be suppressed when a single value would be suppressed from a subgroup. In this case, an additional value is suppressed so that the suppressed value cannot be inferred from totals or subtotals.

A common use of suppressed data is to protect the identity of individuals in aggregated data when some crossings are sparse. For example, if your data contains testing scores for a school district by demographics, but one of the demographic categories is represented only by a single student, then data suppression hides the test score for that demographic category.

When you use suppressed data, be sure to follow these best practices:

- Never use the unsuppressed version of the data item in your report, even in filters and ranks. Consider hiding the unsuppressed version in the **Data** pane.
- Avoid using suppressed data in any object that is the source or target of a filter action. Filter actions can sometimes make it possible to infer the values of suppressed data.
- Avoid assigning hierarchies to objects that contain suppressed data. Expanding or drilling down on a hierarchy can make it possible to infer the values of suppressed data.

**Difference from previous parallel period**

Displays the difference between the value for the current time period and the value for the previous parallel time period within a larger time interval. For example, you might derive the difference between sales for the current month and sales for the same month of the previous year.

**Note:** This derived item is not available if your data source does not contain a date data item that includes the year.

**Difference from previous period**

Displays the difference between the value for the current time period and the value for the previous time period. For example, you might derive the difference between sales for the current month and sales for the previous month.

**Note:** This derived item is not available if your data source does not contain a date data item that includes the year.

**Percent difference from previous parallel period**

Displays the percentage difference between the value for the current time period and the value for the previous parallel time period within a larger time interval. For example, you might derive the percentage difference between sales for the current month and sales for the same month of the previous year.

**Note:** This derived item is not available if your data source does not contain a date data item that includes the year.

**Percent difference from previous period**

Displays the percentage difference between the value for the current time period and the value for the previous time period. For example, you might derive the percentage difference between sales for the current month and sales for the previous month.

**Note:** This derived item is not available if your data source does not contain a date data item that includes the year.
Percent of subtotal
Displays the percentage of the subtotal value for the measure on which it is based. You can create a percentage of subtotal only when the source data item has an aggregation of Sum or Count.

Note: The Percent of subtotal derived item is available only for crosstabs when two or more categories or a hierarchy are assigned.

Note: The Percent of subtotal derived item is relative to the subset of data that is selected by your filters and ranks.

Percent of total - Sum
Displays the percentage of the total value for the measure on which it is based. You can create a percentage of total only when the source data item has an aggregation of Sum or Count. For example, you might create the percentage of the total value for a measure that contains revenue values. If you create a bar chart of the aggregated measure and a category that contains product lines, then the bar chart shows the percentage of total revenue for each product line.

Note: The Percent of total - Sum value is relative to the subset of data that is selected by your filters and ranks.

Period to date
Displays the aggregated value for the current time period and all of the previous time periods within a larger time interval. For example, you might derive the year-to-date total for each month.

Note: This derived item is not available if your data source does not contain a date data item that includes the year.

Moving average
Displays a moving average (rolling average) for the measure on which it is based. The moving average calculates the average for each value with its preceding values. You specify the number of values to average in the Number of cells to average parameter. For example, if you specify 5, then the current value and the four preceding values are averaged together.

Year over year growth
Displays the percentage difference between the current time period and an equivalent time period from the previous year. For example, you might derive the difference in sales between the current month and the same month of the previous year.

The year-over-year growth calculation subsets the data for each year using today’s date (where today is evaluated each time you view the report). To display a percentage of growth using full periods, use Percent difference from previous parallel period or edit the generated formula.

For the month that contains today’s date, the data for an earlier year is subset to the same corresponding date.

Note: This derived item is not available if your data source does not contain a date data item that includes the year.

Year to date
Displays the aggregated value for the current time period and all of the previous time periods within the year. For example, you might derive the year-to-date total for each month.

The year-to-date calculation subsets the data for each year using today’s date (where today is evaluated each time you view the report). To use all data for every period, edit the expression for the derived item.

Note: This derived item is not available if your data source does not contain a date data item that includes the year.

Year to date growth
Displays the percentage difference between the year-to-date value for the current time period and the year-to-date value for the same time period of the previous year. For example, you might derive the difference in year-to-date sales between the current month and the same month of the previous year.
The year-to-date calculation subsets the data for each year using today’s date (where today is evaluated each time you view the report). To use all data for every period, use a Period to date item or edit the expression for the derived item.

For the month that contains today’s date, the data for an earlier year is subset to the same corresponding date.

Note: This derived item is not available if your data source does not contain a date data item that includes the year.

3 Click OK.

The derived data item appears below the Aggregated Measure heading in the Data pane with a name that is derived from the original name. For example, if the original data item name is Outstanding Balance, and the type is Difference from previous parallel period, then the data item is displayed as Outstanding Balance (Difference from previous parallel period).

Delete Data Items

You can delete data items that you have created in SAS Visual Analytics (for example, calculated data items or duplicated data items) so that they no longer appear in the Data pane.

Here are some considerations about deleting data items:

- You cannot delete a data item that is inside a hierarchy if it reduces the hierarchy to a single level.
- You cannot delete a data item if it is the last or only reference to a column in the original data source.
- You cannot delete a data item if it is used in a calculated data item, aggregated measure, a geography data item, or a custom category.

In the Data pane, right-click the data item that you want to delete, and select Delete. The data item is removed from the list of data items, as well as from any objects, filters, or ranks that were using it.

Alternatively, you can hide a data item that cannot be deleted.

Working with Hierarchies in a Report

About Hierarchies

Creating hierarchies enables you to add drill-down functionality to your reports. A hierarchy is an arrangement of category columns that is based on parent-child relationships. The levels of a hierarchy are arranged with more general information at the top and more specific information at the bottom. For example, you might create a hierarchy of datetime columns with Year as the top level, Month as the next level, and Day as the bottom level.

You can also have a date hierarchy or a geographic hierarchy. For example, you might have a hierarchy with Region as the top level, State as the next level, and City as the bottom level.

Keep the following considerations in mind:

- List tables and gauges do not support hierarchies.
- Crosstabs can have either a hierarchy or categories on each row or column, but not both.
- Time series plot objects allow only datetime data items in a hierarchy.
- Geo bubble maps, geo coordinate maps, and geo region maps allow only geographic data items in a hierarchy.
Avoid assigning hierarchies to objects that contain suppressed data. Expanding or drilling down on a hierarchy can make it possible to infer the values of suppressed data.

Note: When you drill-down in a hierarchy, any reference lines might be removed depending on the type of data item that is assigned to the axis with the hierarchy.

SAS Visual Analytics generates an automatic name for a hierarchy. If you do not want to use the automatic name, you can enter a custom name in the Name field in the New Hierarchy window. For more information, see “Add a New Hierarchy to a Report” on page 27.

If you drag and drop a hierarchy onto either the report prompt area or the page prompt area, then a set of linked controls is created. Controls are created for each level of the hierarchy. For example, you might have a hierarchy for cars, which has Country of Origin as the top level, Manufacturer as the next level, and Model as the bottom level. When you drag this hierarchy and drop it onto the page prompt area or the report prompt area, the auto control feature in SAS Visual Analytics creates a button bar for the Country of Origin, a drop-down list for the Manufacturer, and a text input for the Model. The Country of Origin button bar filters both Manufacturer and Model. The Manufacturer drop-down list filters only Model. The type of control that is created for each level of the hierarchy follows the rules for automatic controls. For more information, see “Automatic Controls for Report Prompts” in SAS Visual Analytics: Working with Report Content.

Add a New Hierarchy to a Report

1. If the Data pane is not already displayed, click .
2. Click New data item, and then select Hierarchy. The New Hierarchy window is displayed.
3. (Optional) Enter a Name if you do not want to use a generated name.
   - SAS Visual Analytics generates an automatic name for a hierarchy. The generated name is based on the selected data items and the order that you select them. For example, suppose that you want to create a new hierarchy with data items Region, State, and City. When you add these data items in this order in the New Hierarchy window, the automatic name of the hierarchy is Region — State — City. If a hierarchy exists with the same name, then the automatic name is distinguished from the existing hierarchy name. Using the previous example, if the hierarchy name exists, the automatic name becomes Region — State — City (1).
4. Select at least two categories in the Available items list, and move them to the Selected items list.
5. (Optional) Use the up and down arrows to arrange the data items in the list.
6. Click OK to save the new hierarchy. The icon identifies the new hierarchy.

Alternatively, you can create a hierarchy using the Data pane and selecting two or more category data items. Right-click the data items, and then select New hierarchy. The category data items are added to the new hierarchy in the same order that you selected them in the Data pane.

Add a Date Hierarchy to a Report

You can create a hierarchy from either a date data item or a datetime data item. A hierarchy for a date data item has levels for year, quarter, month, and day. A hierarchy for a datetime data item has levels for year, quarter, month, day, hour, minute, and second. Depending on the format of the data item, some of the levels might not be created.

Note: You cannot create a date hierarchy for a data item with the TIMEAMPM format.

1. If the Data pane is not already displayed, click .
2. Right-click a date or datetime data item, and then select New date hierarchy. The icon identifies the new date hierarchy, which is displayed under the Hierarchy heading in the Data pane.
Note: The automatic name for a hierarchy based on date or datetime data items is **data-item-name Hierarchy**.

## Edit a Hierarchy for a Report

1. Right-click the hierarchy name in the **Data** pane, and select **Edit**. The Edit Hierarchy window is displayed.
2. (Optional) Edit the **Name**.
3. Add and remove categories. There must be at least two categories.
   - **Note:** If a geographic hierarchy is used in a geo bubble map, geo coordinate map, or geo region map, only geographic data items are displayed when you edit the hierarchy.
4. Click **OK** to save the updated hierarchy.
   - If the hierarchy that you edit is already used in an object and is drilled or expanded, it returns to the top level after it is edited.

## Delete a Hierarchy for a Report

Right-click the hierarchy name in the **Data** pane, and select **Delete**. The hierarchy is removed from the list of data items, as well as from any objects, filters, or ranks that were using it.

## Working with Custom Categories in a Report

### About Custom Categories

You can create a custom category based on either a category or measure data item. A custom category data item is always a category data item with an alphanumeric value. When you create a custom category from a measure, you can use intervals, ranges, or specific values to group the data.

**TIP** The labels for your custom categories must use characters that are compatible with the locale of the data source. If the data source uses Unicode, then your labels can contain characters from any locale.

### Create a Custom Category

1. If the **Data** pane is not already displayed, click 📊.
2. Click **New data item**, and then select **Custom category**. The New Custom Category window is displayed.
3. Specify a **Name** for the new custom category. The default name is **Custom Category 1**.
4. From the **Based on** drop-down list, select the category or measure data item that the custom category is based on.
5. For numeric data items, select the **Group by** method. Select **Distinct values** to specify values individually, or select **Intervals** to specify a range of values.
6. Select the **Values** that you want to include. Drag and drop the values onto the area under the **Value Groups** label.
Note: To select a range of values, click the first value, hold the Shift key, and then click the text of the last value. Do not click the check box for the last value.

TIP: To rename a value group label, click the value group heading, and enter a new name.

7 As needed, click + to create new value groups. Repeat the previous step.

8 (Optional) Specify the Remaining Values. You can specify a name when you select Group as. The default label for Group as is other. Alternatively, you can specify Show as is or Show as missing.

Note: The Show as is option is available only for data items that are based on string categories. It is not available for numeric or date values.

9 Click OK. The icon identifies the new custom category in the Data pane.

Edit a Custom Category

To edit a custom category, right-click the category in the Data pane, and then select Edit.

Working with Calculated Items in a Report

About Calculated Data Items

SAS Visual Analytics enables you to calculate new data items from your existing data items by using an expression. For example, you might want to calculate a company’s profits by subtracting expenses from revenues.

In addition to performing mathematical calculations on numeric values, you can use calculated data items to create date and time values. For example, if your data contains separate categories for month, day, and year, then you can calculate a date value from those categories.

Here are some key points about calculated data items:

- All calculations are performed on unaggregated data. The calculation expression is evaluated for each row in the data source before aggregations are performed. To perform calculations on aggregated data, see “Add a New Aggregated Measure to a Report” on page 30.

- Calculated data items can accept parameters. For more information, see “Working with Parameters in Reports” on page 35.

- A hierarchy can contain calculated data items as long as they are categories.

- Calculated data items can be changed into geographic data items and used in geo maps.

You can work with calculated data items or aggregated measures.

Add a New Calculated Data Item to a Report

1 In the Data pane, click New data item, and then select Calculated item. The New Calculated Item window is displayed.

2 Enter a Name.

3 Select the data type for your calculated item from the Result Type drop-down list.

4 Select a Format by clicking .
Use the **Visual** layout to build the expression for your calculated data item by dragging **Data Items** and **Operators** onto the expression in the right pane. For each rectangular field in the expression, you can insert a data item, an operator, or a specific value.

When you drag and drop data items or operators onto your expression, the precise location of the cursor determines where and how the new element is added to the expression. As you drag the new element over the expression, a preview appears that displays how the expression changes if you drop the element at that location. For example, if your current expression is \(( \text{Profit} / \text{Revenue} )\), and you drag and drop the \(x - y\) (subtract) operator inside the open parenthesis symbol, then the expression changes to \((\text{[number]} - (\text{Profit} / \text{Revenue}))\). If you drag and drop the operator over the division symbol, then the expression changes to \((\text{Profit} - \text{Revenue})\), and so on.

Alternatively, you can use the **Text** layout to enter the expression.

There are a large number of operator types available to perform mathematical functions, process datetime values, handle text, and evaluate logical processing such as IF clauses. For more information, see “Reference: Operators for Data Expressions” on page 85.

Click **OK**. The new calculated data item appears in the **Data** pane.

Sum is the default aggregation for new numeric calculated data items. You can change the aggregation for numeric calculated data items using the **Data** pane by clicking \(\checkmark\) beside the data item name.

**Preview the Expression for a Calculated Data Item**

For calculated data items only, you can preview the results of your expression by clicking \(\mathbb{R}\) in the Add Calculated Item window.

You can preview the results of a subset of your expression by right-clicking a part of your expression, and then selecting **Preview Sub-expression Results**. The results are displayed in the Preview Result window.

**Edit a Calculated Data Item**

1. Right-click on a calculated data item in the **Data** pane, and select **Edit**. The Edit Calculated Item window is displayed.

2. Modify the **Data Items** and **Operators** for the calculated data item as needed. For more information about the operators that are available, see “Reference: Operators for Data Expressions” on page 85.

   **Note:** If the calculated data item has not been used in a report, then you can modify the result type.

3. Click **OK**.

You can duplicate, rename, hide, and delete calculated data items using the same steps as any other data item. If a calculated data item is used inside another calculated data item, then it cannot be deleted.

**TIP** You can cut and paste from the **Text** layout between different reports to transfer calculations or to email them to others. For more information, see “Reference: Editing a Data Expression in Text Mode” on page 82.

**Add a New Aggregated Measure to a Report**

Aggregated measures enable you to calculate new data items by using aggregated values. For example, you might want to calculate a company's profit margin by region by taking the aggregated sum of the profit for all of the stores in a region group and dividing it by the aggregated sum of the revenue for all of the stores in that same region group. Aggregations are evaluated as part of a calculated expression.
To add an aggregated measure:

1. In the **Data** pane, click **New data item**, and then select **Calculated item**. The New Calculated Item window is displayed.

2. Enter a **Name**.

3. From the **Result Type** drop-down list, select **Aggregated Measure**.

4. Select a **Format** by clicking ✶.

5. (Optional) Define scopes for your aggregated item. The default **Base expression** scope applies to all data contexts that are not defined in a scope.
   
   To create a new scope, click ✷. The New Scope window appears. Select one or more categories from the **Available items** list and move them to the **Selected items** list. The new scope defines a specific crossing of categories, and will apply only when exactly those specified categories are included in the data query.

6. For each scope, build the expression for your aggregated measure. In the **Visual** layout, drag and drop **Data Items** and **Operators** onto the expression in the right pane. For each field in the expression, you can insert a data item, an operator, or a specific value.

   **Note:** To create an aggregated measure, your expression must contain at least one aggregated operator.

   When you drag and drop data items and operators onto the expression, the precise location of the cursor determines where and how the data item or operator is added to the expression. As you drag the new element over the expression, a preview appears, which displays how the expression would change if you drop the element at the current location.

   Alternatively, you can use the **Text** layout to enter the expression.

   There are a large number of operator types available to perform mathematical functions and evaluate logical processing such as IF clauses. For more information, see “Reference: Operators for Data Expressions” on page 85.

7. For each aggregation in your expression, select the aggregation context. A drop-down list beside each aggregation enables you to select one of the following context values:

   **ByGroup**
   
   calculates the aggregation for each subset of the data item that is used in a visualization. For example, in a bar chart, an aggregated measure with the **ByGroup** context calculates a separate aggregated value for each bar in the chart.

   **ForAll**
   
   calculates the aggregation for the entire data item (after filtering). For example, in a bar chart, an aggregated measure with the **ForAll** context uses the same aggregated value (calculated for the entire data item) for each bar in the chart.

   By using the **ForAll** and **ByGroup** contexts together, you can create measures that compare the local value to the global value. For example, you might calculate the difference from mean by using an expression such as the following:  
   \[
   \text{Avg } \text{ByGroup}(X) - \text{Avg } \text{ForAll}(X)
   \]

8. Click **OK**. The new aggregated item appears in the **Data** pane.

**Edit an Aggregated Measure**

1. Right-click an aggregated measure in the **Data** pane, and select **Edit**. The Edit Calculated Item window is displayed.

2. Modify the **Data Items** and **Operators** for the aggregated measure as needed. For more information about the operators that are available, see “Reference: Operators for Data Expressions” on page 85.
Note: If you edit an aggregated measure that is included in an aggregated data source, then you cannot add scopes, periodic operators, tabular operators, or the Suppress operator.

3 Click OK.

You can duplicate, rename, hide, and delete aggregated measures using the same steps as any other data item.

TIP You can cut and paste from the Text layout between different reports, to transfer calculations, or to email them to others. For more information, see “Reference: Editing a Data Expression in Text Mode” on page 82.

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### Working with Geography Data Items

#### About Geography Data Items

A geography data item is a category whose values are mapped to geographical locations or regions. Geography data items can be used with geo maps and other objects to visualize your data on a geographic map.

You can create a geography data item by using predefined roles such as country names, or you can define a custom geographic role. Custom geographic roles can be defined either as custom coordinates that use latitude and longitude values from the current data source, or as custom map regions that use polygon data from a separate data source.

Custom polygon data can be read either from an Esri feature service or from an Esri shapefile or a SAS map data set that is loaded as a CAS table. For more information, see “Loading Geographic Polygon Data as a CAS Table” in SAS Viya Administration: Data.

#### Create a Geography Data Item By Using Predefined Names and Codes

1 In the Data pane, click  beside the name of the category that you want to use for the geography data item, and then select Geography from the Classification drop-down list.

   You can also create a new geography data item by clicking New data item on the Data pane, or by right-clicking a category and then selecting New geography.

2 Specify the Name of the geography data item, and the data item that the geography is Based on.

3 From the Geography data type drop-down list, select Predefined geographic names and codes.

4 From the Name or code context drop-down list, select one of the following values:

   - **Country or Region Names**
     
     specifies countries or regions by name.

   - **Country or Region ISO 2-Letter Codes**
     
     specifies countries or regions by using two-letter country codes from the ISO 3166-1 standard.

   - **Country or Region ISO Numeric Codes**
     
     specifies countries or regions by using three-digit numeric country codes from the ISO 3166-1 standard.

   - **Country or Region SAS Map ID Values**
     
     specifies countries or regions by using the two-letter codes that are used with the MAPSGFK library that is included with SAS/GRAPH.

     Note: The two-letter SAS Map ID country values are identical to the ISO 3166-1 two-letter country codes.
Subdivision (State, Province) Names
specifies country subdivisions (for example, states and provinces) by using the subdivision names.

Subdivision (State, Province) SAS Map ID Values
specifies country subdivisions (for example, states and provinces) by using the two-letter codes that are used with the MAPSGFK library that is included with SAS/GRAPH.

US State Names
specifies states and territories in the United States by using the state and territory names.

US State Abbreviations
specifies states and territories in the United States by using two-letter postal codes.

US ZIP Codes
specifies five-digit ZIP codes for the United States.

Note: The values of your geography data items must match the lookup values that are used by SAS Visual Analytics. To view the lookup values, see http://support.sas.com/va83geo.

5 For the Subdivision (State, Province) Names geography type, select a Country/Region.

6 Verify that your data values map correctly. A preview displays the percentage of values that map correctly and displays the values as points on a map. If any values did not map correctly, then the first five values that did not map are displayed.

Click OK.

Create a Geography Data Item By Using Custom Coordinates

1 In the Data pane, click ☰ beside the name of the category that you want to use for the geography data item, and then select Geography from the Classification drop-down list.

   You can also create a new geography data item by clicking New data item on the Data pane, or by right-clicking a category and then selecting New geography.

2 Specify the Name of the geography data item, and the data item that the geography is Based on.

3 From the Geography data type drop-down list, select Custom coordinates.

4 Specify the Latitude (y), Longitude (x), and the Coordinate Space that is used to project the longitude and latitude.

   Note: The coordinate space should match the projection that your data is in.

5 Verify that your data values map correctly. A preview displays the percentage of values that map correctly and displays the values as points on a map. If any values did not map correctly, then the first five values that did not map are displayed.

   Click OK.

Create a Geography Data Item By Using Custom Polygonal Shapes

1 In the Data pane, click ☰ beside the name of the category that you want to use for the geography data item, and then select Geography from the Classification drop-down list.

   You can also create a new geography data item by clicking New data item on the Data pane, or by right-clicking a category and then selecting New geography.
2 Specify the **Name** of the geography data item, and the data item that the geography is **Based on**.

3 From the **Geography data type** drop-down list, select **Custom polygonal shapes**.

4 From the **Custom polygon provider** drop-down list, select an existing polygon provider or define a new polygon provider.

   **Note**: Special user permissions are required to define and edit polygon providers. Create, Delete, and Update permissions must be granted on the `/maps/providers` URI. For more information, see “Identity Management: Access to Functionality” in SAS Viya Administration: Identity Management.

To create or edit a polygon provider:

   a Provide the following information in the New Polygon Provider window

      **Name**
      specifies a unique name for the polygon provider. The name must be fewer than 32 characters. The characters must be letters, numbers, underscores, hyphens, spaces, or DBCS characters.

      **Label**
      specifies the label that is displayed for the polygon provider. The name can be up to 256 characters.

      **Type**
      specifies whether the polygon data is stored in a SAS Cloud Analytics Services table (**CAS Table**) or an **Esri feature service**.

   b If you selected **CAS Table**, then specify the following additional properties:

      **Server**
      specifies the CAS server where the polygon data is loaded.

      **Library**
      specifies the library that contains the polygon data.

      **Table**
      specifies the table that contains the polygon data.

      **ID Column**
      specifies the column in the polygon data that identifies each polygon (map region).

      **Sequence Column**
      specifies a column in the polygon data that identifies the correct order for the polygon segments.

      The following **Advanced** properties are set automatically, but you can modify them:

      **Segment Column**
      specifies the column that identifies each polygon segment.

      **Latitude (y) Column**
      specifies the column that contains the latitude values.

      **Longitude (x) Column**
      specifies the column that contains the longitude values.

      **Coordinate Space**
      specifies the coordinate space for the polygon data. You can specify EPSG spatial references or proj.4 syntax. For more information about EPSG, see spatialreference.org. For more information about proj.4, see proj4.org.

      **Note**: The default value, EPSG:4326, is equivalent to and compatible with the World Geodetic System (WGS84) coordinate system.

   c If you selected **Esri feature service**, then specify the following information:

      **URL**
      specifies the URL of a feature service that contains one or more polygon feature layers.
If your feature service is on a secured custom service, be sure to specify the credentials for that service in the **Esri Custom Services Credentials** setting. For more information, see “Modify SAS Visual Analytics Settings” in SAS Visual Analytics: Designing Reports.

**Feature Service Layer**
- specifies the map layer from the feature service that contains the polygons that you want to use. The feature layer must have the geometry type esriGeometryPolygon.

**ID Column**
- specifies the column in the feature service that identifies each polygon.

When you have finished defining your polygon provider, click **OK**.

5 Specify the **Region ID** data item. The values of **Region ID** should match the values of the ID column from the polygon provider data.

   The same data item can be assigned to both the **Based on** and the **Region ID** properties.

6 (Optional) Specify the **Latitude (y)** and **Longitude (x)** columns. The coordinates from these columns are used for the **Bubbles** and **Coordinates** map types. If you do not specify these properties, then only the **Regions** map type is available for this geography.

7 Specify the **Coordinate Space** for the geography coordinates.

   The coordinate space should match the projection and coordinate space that your data is in. If you select **Custom**, then you can specify EPSG spatial references or proj.4 syntax. For more information about EPSG, see [spatialreference.org](http://spatialreference.org). For more information about proj.4, see [proj4.org](http://proj4.org).

8 Verify that your data values map correctly. A preview displays the percentage of values that map correctly and displays the values as points on a map. If any values did not map correctly, then the first five values that did not map are displayed.

   Click **OK**.

---

**Edit a Geography Data Item**

To edit an existing geography data item, click ✕ beside the name of the geography data item and then click ☑.

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**Working with Parameters in Reports**

**Overview of Parameters in Reports**

A *parameter* is a variable whose value can be changed and that can be referenced by other objects. SAS Visual Analytics supports parameters for controls in reports. If a control has an associated parameter, then when the value of the control changes, the parameter is assigned that changed value. When the value of the parameter changes, any objects that reference the parameter detect the change accordingly.

Whenever a parameter value is updated, then all display rules, ranks, calculations, and filters that use that parameter are updated. Any object in the report that uses the display rule, rank, calculation, or filter is updated accordingly. For an example of how parameters can be used in a complex report, see “Example: Using Parameters in a Report” on page 38.

**Where Parameters Can Be Used**

You can use parameters in calculations, display rules, filters, and ranks. You can create, modify, and manage parameters using the **Data** pane.
The following controls support parameters:

- The text input control supports a character, numeric or datetime parameter.
- The button bar control or drop-down list control accepts a character parameter, a datetime parameter, or a numeric parameter if a discrete numeric data item is assigned.
- The slider (single-point only) accepts a numeric or datetime parameter.
- The list control accepts a multiple-value character parameter.

Parameters can be used with the following features:

- **Calculations**
  - calculated items and aggregated measures allow parameters. Parameters are supported wherever it makes sense to have a numeric or character value. Multiple-value parameters can be used only with the In, NotIn, and IsSet operators.

- **Display rules**
  - numeric parameters can be specified as the value of an expression rule.

- **Filters**
  - (detail filters, aggregated filters, and data source filters)
    - a character or numeric parameter is supported wherever it makes sense to have a numeric or character value. Multiple-value parameters can be used only with the In, NotIn, and IsSet operators.
      - The data source filter is a special case. Ordinarily, a data source filter applies to all of the objects on the canvas. However, if the data source filter contains a parameter, then the filter is not applied to the control that has that parameter assigned to it.

- **Ranks**
  - for a rank, a numeric parameter can be included for the \( n \) value of the rank. It is supported for **Top Count** or **Bottom Count** and **Top Percent** or **Bottom Percent**.

- **URLs**
  - parameters in a report URL can be modified. For example, suppose that you have the following URL for a report: http://host/SASVisualAnalytics/?reportPath=%2FUser%20Folders%2Fsasdemo%2FMy%20Folder&reportName=Parameterized%20Calculations%20DR&type=Report.BI&Origin%20Parameter=Europe&Cost%20of%20gas=3.35
    - The first parameter is called **Origin Parameter**, which enables you to specify a different continent of origin. The second parameter is called **Cost of gas**, which enables you to specify different costs to see how different gas prices change the report.
    - Note: A parameter cannot be used to pass credentials. However, credentials can be used as the value of a parameter.

- **Text objects**
  - text objects can display the current value of a parameter.

---

**Create a New Single-Value Parameter for a Report**

**TIP** If you duplicate a control with a parameter, the parameter is not copied from the original control.

To create a new parameter with a single value:

1. In the Data pane, click **New data item**, and then select **Parameter**. The New Parameter window is displayed.

2. (Optional) Modify the **Name** of the parameter.

3. Select the **Type** for the parameter.
Depending on the parameter type, specify additional information:

**Character**  
(Optional) Specify the **Current value** for the parameter.

**Numeric, Date, or Datetime**  
Specify the following options:
- **Minimum value** (required).
- **Maximum value** (required).
- **Format**. Click to open the Format window where you can select a format type, **Width**, and **Decimals**. Click **OK** in the Format window.
- **Current value** (required).

Click **OK**. The icon identifies the new parameter in the **Data** pane.

### Create a New Multiple-Value Parameter for a Report

**TIP** If you duplicate a control with a parameter, the parameter is not copied from the original control.

Parameters with multiple values can be used with the In, NotIn, and IsSet operators in filters and calculated expressions. The value of a multiple-value parameter can be set only by a list control that has the **Allow multiple selections** option enabled.

To create a new parameter with multiple values:

1. In the **Data** pane, click **New data item**, and then select **Parameter**. The New Parameter window is displayed.
2. (Optional) Modify the **Name** of the parameter.
3. Select the **Type** for the parameter.  
   **Note:** Numeric multiple-value parameters can be used with discrete numeric data only.
4. Select **Multiple values**.
5. For numeric, date, and datetime parameters, specify the **Format**. Click to open the Format window where you can select a format type, **Width**, and **Decimals**. Click **OK** in the Format window.
6. Click **OK**. The icon identifies the new parameter in the **Data** pane.

### Edit a Parameter for a Report

1. Right-click the parameter in the **Data** pane, and select **Edit**. The Edit Parameter window is displayed.
2. Make changes to the parameter.  
   **Note:** For parameters with multiple values, the current value can be set only by a control.
   **Note:** You cannot change the type of an existing parameter.
3. Click **OK** to save your changes.
Delete a Parameter for a Report

Right-click the parameter in the Data pane, and select Delete. The parameter is removed from the list of data items in the Data pane.

Note: You cannot delete a parameter that is being used by a calculation, rank, filter, or display rule.

Example: Using Parameters in a Report

You can use parameters to adjust values that affect multiple objects. Here is an example of a report with a parameter:

The report has a slider, a list table, and a bar chart. The slider lets you adjust the number of miles that you drive each day. The parameter value from the slider is used to calculate the daily fuel consumption for each model of car. For example, you can see what happens to the list table when you change the parameter for Miles per Day from 25 to 100. The values of the calculated data item are also displayed in the bar chart.

Working with Data Role Assignments

About Data Roles

A data role is a designation that describes how a particular data item is to be used in an object. In SAS Visual Analytics, each object has data roles. Some data roles are required and others are optional. For example, the
data roles for a bar chart are **Category**, **Measure**, **Group**, **Lattice columns**, **Lattice rows**, **Data tip values**, **Animation**, and **Hidden**. For the bar chart, the category and measure data roles are required.

If an object does not have the required data roles assigned, an informational message is displayed in the middle of the object. Not all objects have the same data roles. For example, the **Color** data role is available for only scatter plots, bubble plots, treemaps, geo maps, and word clouds.

SAS Visual Analytics assigns data roles automatically when you drag and drop data items onto an object on the canvas. Or, you can use the **Data Roles** pane to add or modify data roles. For more information about automatic assignment, see "Automatic Data Item Assignment" on page 18.

There is a **Hidden** data role, which enables you to include a data item in the query results when you want its values, but you do not want it to be displayed. For more information, see "Understanding the Hidden Data Role" on page 39.

For more information about specific data roles for each object, refer to the following:

- SAS Visual Analytics: Working with Report Content
- SAS Visual Analytics: Working with SAS Visual Data Mining and Machine Learning

### Understanding the Hidden Data Role

Data items that are assigned to the **Hidden** data role are available for color-mapped display rules, external links, and mapping data sources. This data role accepts one or more category or date data items.

Here are key points about the **Hidden** data role:

- The **Hidden** data role is not available for all objects.
- A data item should be assigned to the **Hidden** data role only if it will not increase the number of rows in the query.
- The **Hidden** data role is not for column-level security purposes.
- A data item cannot be assigned to the **Hidden** data role and the **Data tip values** data role at the same time.

**Example 1: External Links and the Hidden Data Role**

Suppose that you have a bar chart with an external link to Wikipedia. The bar chart has the **Car** and **Sales** columns assigned to data roles. Because the Wikipedia article uses **Chevrolet** and your **Cars** data set uses **Chevy**, you create a custom category to map the car manufacturer to the appropriate label in the Wikipedia article. Then, you assign the custom category (**car_ID**) to the hidden data role and use it in the external link.

In this example, there is a one-to-one relationship between the **Car** column and the **car_ID** column.

**Example 2: Display Rules and the Hidden Data Role**

Suppose that you have a bar chart that shows **States** and **Expenses**. You assign the **Region** column to the hidden data role. Then, you create a display rule to color the Southeast region yellow. You could create a display rule for each individual state. However, it is easier to create the display rule for the region. In this example, there is one **Region** and many **States**. Therefore, the query results do not change. Conversely, if you assign **Region** to the visible data role and assign **States** to the hidden data role, the query would expand, and you would see undesirable results. This is because each **Region** has many **States**.

**Note:** SAS Visual Analytics does not prevent you from assigning a **Hidden** data role that has a one-to-many relationship. However, a one-to-many relationship will expand the query and might produce undesirable results.
Understanding the Data Tip Values Data Role

Data items that are assigned to the Data tip values data role are included in the data tips for the object. These can be categories, measures, or both. If you change a measure’s aggregation, then the data tip reflects that change.

Here are key points about the Data tip values data role:

- The Data tip values data role is not available for all objects.
- A category data item should be assigned to the Data tip values data role only if it will not increase the number of rows in the query. For example, suppose that you have a bar chart that has four bars (which means that four rows were returned from the query). You should not assign a category data item to the Data tip values data role that returns more than four rows or four rows that are assigned differently.
- The Data tip values data role is not for column-level security purposes.
- A data item cannot be assigned to the Hidden data role and the Data tip values data role at the same time.

Add Data Role Assignments to an Object

1. If the Data Roles pane is not already displayed, click ➔.

2. Click Add under a data role label, and then select the data item or data items that you want to assign to the role.

   If only one data item can be added to the role, selecting a data item adds it to the role. If more than one data item can be added to the role, then you must click OK to add your selections.

   Note: The Hidden data role is not available for crosstabs, box plots, correlation matrices, heat maps, histograms, word clouds, or sliders. It is not available for any analytics, SAS Visual Statistics, or SAS Visual Data Mining and Machine Learning objects. For more information, see “Understanding the Hidden Data Role” on page 39.

3. (Optional) Drag a data item from one role, and drop it onto the Add field of another role in the Data Roles pane.

   Alternatively, you can do one of the following:

   - Drag one or more data items from the Data pane, and drop them onto the Add field for the target role in the Data Roles pane.
   - Drag one or more data items from the Data pane, and drop them onto an object on the canvas. SAS Visual Analytics determines the roles to which the items are assigned. You can later modify the assigned data roles using the Data Roles pane.
   - Drag a data item from the Data pane, and position your cursor over an object without releasing the mouse button. A list of data roles appears. Drop the data item onto a role.
   - Right-click a data item on the Data pane, and then select Add to selected object.

Add Data Roles for Lattice Columns or Lattice Rows in a Graph

A lattice is a multi-cell graph where the plot in each cell represents a specific crossing of category values. In SAS Visual Analytics, you can create a multi-cell graph by using data roles to add lattice columns, lattice rows, or both.

1. Select an object in the canvas that has one or more data items assigned and that allows a lattice data role.
2 If the roles are not already expanded, click \( \triangleright \) beside the **Lattice columns** or **Lattice rows** role. Click **Add**, and then select one or more data items in the Add Data Items window.

3 Click **OK**.

**Modify Data Role Assignments**

You can modify a data role assignment that you have made or modify one that was automatically assigned. For example, SAS Visual Analytics automatically assigns frequency to a measure role, which enables you to see the data quickly. You can replace frequency by dragging a different data item and dropping it on the role that has frequency assigned. For more information, see “Automatic Data Item Assignment” on page 18.

To modify a data role:

1 Select an object in the canvas that has one or more data items assigned.

2 Do one of the following:
   - Select the data item in the **Data Roles** pane that you want to replace. The Replace Data Item window is displayed so that you can select a replacement data item.
   - Drag a data item from one role, and drop it onto the **Add** field of another role in the **Data Roles** pane.
   - You can select an assigned data item in the **Data Roles** pane and drag it and drop it onto another assigned data item to swap the data roles.

TIP Press the Alt key while you drag and drop an assigned data item onto another assigned data item to replace the source data item with the target data item.

   - Drag a data item from the **Data** pane, and drop it onto the data item in the **Data Roles** pane that you want to replace.
   - You can right-click a data item in an object on the canvas, and select **Replace** \( \Rightarrow \) **data-item-name**.

   For data roles that allow multiple items, you can reorder the data items in the **Data Roles** pane by dragging an item and dropping it in a new position within the same role.

**Remove Data Role Assignments from Objects**

To remove data items from their assigned data roles in a specific object:

1 Select an object in the canvas.

2 Do one of the following:
   - Right-click a data item in the **Data** pane, and select **Remove** **data-item-name**.
     If multiple data items are assigned to a data role, then you can select **Remove all**. All data items are removed from the assigned data role as well as from data-dependent features like display rules. An informational message might be displayed in the middle of the object to let you know that the required data roles are not assigned.
   - You can right-click a data item in an object on the canvas, and select **Remove** \( \Rightarrow \) **data-item-name**.

Alternatively, you can click \( \vdash \), and then select **Remove all role assignments**.
Stop a Slow-Running Query for an Object

To stop a slow-running query for an object on the canvas, position your pointer over the loading message in the middle of the object. When the text of the loading message changes to *Stop query*, click the loading message.

Here is an example of the loading message for a crosstab with a slow-running query:

Here is an example of the confirmation message that is displayed when you stop a slow-running query:

To restart a query that you stopped, click the confirmation message in the object.
Sorting Data in Reports

How Sorting Can Help with Analysis

Information can be easier to understand when it appears in an intentional order. Applying a sort order to one or more data items in SAS Visual Analytics enables you to arrange rows and columns in tables and axis labels on charts in some order, such as alphabetically or highest to lowest numerically. Interactively changing the order of data can provide you with a different perspective that often facilitates valuable insight. For example, in a report, sales employees who are initially arranged alphabetically can be re-sorted by sales amount.

You can create a custom sort so that data items in a table or graph can sort to the top or to the bottom. For more information, see “Using a Custom Sort” on page 44.

Ranking can help reduce the amount of visible data and is often used in combination with sorting. For more information, see “Ranking Values in Reports” on page 75.

Note: SAS Visual Analytics uses the locale of the CAS server to sort data items. For example, if you want to sort data items in the Swedish language, then the table needs to be loaded into a CAS server that is initialized for the Swedish locale (sv_SE).

Sort Data in a List Table

List tables are automatically sorted in ascending order by the first data item (or column) added to the table.

You can click a column heading to sort the column or toggle an existing sort. An arrow appears in the column heading to indicate the sort order.

There are two ways to sort multiple columns:

- Press the Ctrl key to select multiple columns, and then click one of the column headings to sort all of the columns.
- Right-click a column heading, and select Sort. Then, select either data-item-name: Ascending, data-item-name: Descending, data-item-name: Add Ascending, or data-item-name: Add Descending. When you select data-item-name: Ascending or data-item-name: Descending, then the current sort is replaced. When you select data-item-name: Add Ascending or data-item-name: Add Descending, you are extending the current sort.

Sort Data in a Crosstab

To sort by category or measure values in a crosstab, right-click a column or row heading, and then select Sort. Select either data-item-name: Ascending or data-item-name: Descending. When you select data-item-name: Ascending or data-item-name: Descending, then the current sort is replaced.

You can also sort categories, rather than measures, by right-clicking the category name.

Sort Data in a Graph

To sort by values in a graph, right-click on a measure name or category name, and select Sort. Then, select either Ascending or Descending.

Note: Generally, sorting for a graph is based on the measure. If you do not use a measure, then sorting is based on the frequency (and automatically applied).
By default, a bar chart is sorted in descending order by the value of the first measure. If a bar chart is sorted by a measure data item and has a category data item assigned to the group role, then each category data item’s sort value is determined by summing the measure values of the bars for the category (even when the bars themselves represent something other than a sum). For example, suppose that you are evaluating test scores. There is a TestScores measure that has been assigned an aggregation of Max. You have created a bar chart that shows regional TestScores grouped by Gender. Each bar represents the high test score of a particular Gender within a particular Region. However, the TestScores value that is used to sort each Region is determined by summing the male high test score in that Region with the female high test score in that Region.

**Using a Custom Sort**

**Add a Custom Sort**

You can create a custom sort for the distinct values in a category data item so that they sort in a non-default way. (By default, the values in a category data item sort alphabetically.) Calculated items that are categories and custom categories also support custom sorts. For example, suppose that your company has manufacturing facilities in multiple cities across the country. You can use a custom sort to make sure that certain cities are always sorted before or after other cities in a list table.

Here are some key points for custom sorting:

- For graphs, a custom sort works only if the data item containing the custom sort is on the X axis (the Category role), Y axis (the Measure role), or the outermost lattice role.
- For graphs, a custom sort does not work if the data item is assigned to one of the legend data roles (either Color or Group). The same restriction applies when sorting on the raw values of a data item that has a user-defined format.
- For graphs, a custom sort does not affect the details table in maximize mode.
- A custom sort takes precedence over user-defined formats.
- A custom sort is not available for a pie chart with a Group role.
- Analytics objects or SAS Visual Statistics objects (for example, a cluster matrix) that have multiple results cannot have a custom sort displayed in SAS Report Viewer (the report viewer).

To create a custom sort:

1. In the Data pane, select a category data item. Right-click, and select Custom sort. The Add Custom Sort window is displayed.

2. Select the category data items that you want to sort. Then, click to move them to the Sorted items list.
TIP To select multiple category data items, press the Ctrl key.

3  (Optional) Use the up and down arrows to arrange the data items in the Sorted Items list.

4  Click OK.

**Edit a Custom Sort**

1  In the Data pane, select a category data item with a custom sort. Right-click, and select **Edit custom sort**. The Edit Custom Sort window is displayed.

2  Modify the Sorted Items list.

3  Click OK.

**Delete a Custom Sort**

You can delete a custom sort in the Data pane. Select a category data item with a custom sort. Right-click, and select **Delete custom sort**.

When you delete a custom sort, the values that were specified in the custom sort are sorted alphabetically with the rest of the values for the data item.
Working with Display Rules

About Display Rules

Display rules include all types of highlighting of objects. They provide a flexible structure to specify conditions. There are several types of display rules. Display rules enable conditions to be shared across objects, but not all display rules apply across all object types.

The Rules pane enables you to populate intervals, add intervals, or add color-mapped values for the object that is currently selected on the canvas. You can use this pane to specify both report-level or object-level display rules, depending on what you have selected on the canvas. The Rules pane always shows the unformatted value that is used in the display rule.

Note: Analytics objects (for example, forecasting) and heat map objects do not support display rules.

You can drag and drop a data item onto the Rules pane to create a new display rule.

You can use the Rules pane to add alerts when you create an expression-based display rule. An alert for a display rule notifies users via email when the alert condition is met. You can specify how frequently the system checks to see whether the alert condition has been met. You can also specify how often users are notified.

Note: An alert is not created or updated until the report is saved.

Expression-based display rules can accept numeric parameters. For more information about parameters, see “Working with Parameters in Reports” on page 35.

For list tables and graphs, you can create display rules that reference a measure that is not included in the currently displayed object. This feature is not available for crosstabs.

Here are some key points about color-mapped display rules for all objects:

- Color-mapped values for an object can be applied only to category data items.
- Color-mapped values cannot be applied to date or datetime data items.
- Color-mapped display rules are not applied if there are two measures assigned to the same axis.
- Color-mapped display rules can be added to a waterfall chart only if you clear the Color by direction of value change check box in the Options pane.
- Color-mapped display rules can use a data item in the hidden data role.
- Alerts are not available for color-mapped display rules.

Note: There are some specific considerations for color-mapped display rules for graphs. For more information, see “Add Display Rules to a Graph Using Color-Mapped Values” on page 53.

Add Report-Level Display Rules

A report-level display rule applies to all objects in a report.

1. If the Rules pane is not already displayed, click Rules.
2. Without any objects on the canvas selected or the page selected, click New rule. The New Display Rule window is displayed.
3. Click +. Enter a value for the display rule in the field.
4. Select a color for the display rule.
5  (Optional) Repeat the steps for entering a value and selecting a color.

6  (Optional) Select the Other check box. Then, select a color for any other categories that do not have an assigned color.

7  Click OK. The objects in the report update with the new report-level display rule.

8  (Optional) Position your pointer over the report-level display rule name in the Rules pane, and then click  to edit the new report-level display rule.

**Adding Table-Level Display Rules**

You can add three different types of display rules to tables. You cannot create a display rule to highlight dates in a table.

Note: Cell graphs can be added to table columns that are based on measure data items. Cell graphs are different from display rules. For more information, see “Add Cell Graphs to a Crosstab” in SAS Visual Analytics: Working with Report Content and “Add Cell Graphs to a List Table” in SAS Visual Analytics: Working with Report Content.

**Add Display Rules to a List Table Using an Expression**

1  If it is not already selected, select the list table on the canvas that you want to update.

2  If the Rules pane is not already displayed, click .

3  Click New rule, and then select a measure from the list. The Rule Type should be Expression.
4 Select the Operator. You can select =, <, >, BetweenInclusive, <=, >=, Missing, or NotMissing. The default is >.

5 Enter or select a Value.

6 Modify the font, style, and color. Select a background color.

7 Select the row or column in the Placement drop-down list to specify where you want to apply the colors.

8 (Optional) Select Allow alerts for this rule. Then, do the following:
   a Select the Recipients. Click 👤 to select recipients. The Choose Members window is displayed. When you have selected all of the recipients or groups, click OK.
   b Select the Notification frequency. You can select Daily, Hourly, or Every minute. Then, specify the Interval for the notifications.
   c Select the Query frequency. You can select System default, Daily, Hourly, or Every minute. Then, specify the Interval for the query.

9 Click OK. The list table updates with the new display rule.
10 (Optional) Position your pointer over the display rule name in the Rules pane, and then click to edit the new display rule.

Add Display Rules to a List Table Using a Gauge

1. If it is not already selected, select the list table on the canvas that you want to update.

2. If the Rules pane is not already displayed, click .

3. Click New rule, and then select a measure from the list.

4. Select Gauge for the Rule Type.

5. Define the intervals and colors for the rule:
   - Enter the individual values for the intervals, and then select a color. You can click the operator between the intervals to change it.
   - Click Recalculate to automatically populate the intervals and replace any previously entered values. The Recalculate Intervals window is displayed. You can specify Number of intervals, Lower bound, and Upper bound. Click OK to return to the New Display Rule window.

6. Select a Gauge type from the drop-down list. Your choices are Bullet, Icon, Slider, or Thermometer. Icon is the default gauge type.
Using the Specify column and placement of gauge drop-down lists, select which column the rule should be based on in the report and where the gauge should appear in the column. For placement, your choices are Left of text, Right of text, or Replace text.

Click OK. The table updates with the new display rule.

(Optional) Position your pointer over the display rule name in the Rules pane, and then click to edit the new display rule.

Add Display Rules to a List Table Using Color-Mapped Values

If it is not already selected, select the list table on the canvas that you want to update.

If the Rules pane is not already displayed, click .

Click New rule, and then select a category from the list. The New Display Rule window is displayed.

Select the column or value to which you want to apply the display rule.

Note: Color-mapped values cannot be applied to date or datetime data items.

Select a color for the display rule.

Enter a value for the display rule in the field.

(Optional) Click . Repeat the steps for entering a value and selecting a color.

(Optional) Select the Other check box. Then, select a color so that any of the other categories that do not have a color will have the one that you just selected.

Select the row or column in the Placement drop-down list to specify where you want to apply the colors.

Click OK. The table updates with the new display rule.

(Optional) Position your pointer over the display rule name in the Rules pane, and then click to edit the new display rule.
Add Display Rules to a Crosstab

1. If it is not already selected, select the crosstab on the canvas that you want to update.

2. If the Rules pane is not already displayed, click $\text{rules}$.

3. Click New rule, and then select a measure from the list. The New Display Rule window is displayed.

4. Select the Operator. You can select $=$, $<$, $\leq$, $>$, $\geq$, Missing, or NotMissing. The default is $>$. 

5. Enter or select a Value.

6. If your crosstab contains a hierarchy, then you can specify the hierarchy levels in which the display rule is applied.
   a. Click Specify Intersections. The Specify Intersections window is displayed.
   
   Specify Intersections
   
   Specify the levels in which a display rule is applied:
   - Facility Region
   - Facility Region / Facility State
   - Facility Region / Facility State / Facility City
   - Grand Total

   Select one or more hierarchy levels, the grand total, or all of the levels.
   c. Click OK to return to the New Display Rule window.

7. Modify the font, style, and color. Select a background color.
   Note: These fields are not required. However, the Format or Background Color should be specified so that the display rule is apparent in the crosstab.

8. Select the row or column in the Placement drop-down list. For crosstabs, the Placement drop-down list displays only the measures that have been added to the crosstab. There are no row or column options.

9. (Optional) Select Allow alerts for this rule. Then, do the following:
   a. Select the Recipients. Click $\text{members}$ to select recipients. The Choose Members window is displayed. When you have selected all of the recipients or groups, click OK.
   b. Select the Notification frequency. You can select Daily, Hourly, or Every minute. Then, specify the Interval for the notifications.
   c. Select the Query frequency. You can select System default, Daily, Hourly, or Every minute. Then, specify the Interval for the query.

10. Click OK. The crosstab updates with the new display rule.
11 (Optional) Position your pointer over the display rule name in the Rules pane, and then click to edit the new display rule.

**Adding Graph-Level Display Rules**

**Add Display Rules to a Graph Using an Expression**

Note: You can create an expression-based display rule for a 100% stacked bar chart, which uses the Grouping style and Grouping scale options. However, the display rule cannot be based on a percentage.

To specify a new expression-based display rule for a graph:

1. If it is not already selected, select the graph on the canvas that you want to update.
2. If the Rules pane is not already displayed, click .
3. Click New rule, and then select a measure from the list. The New Display Rule window is displayed.

```
New Display Rule

Expenses
Operator:
> ▼

Value:
0 ▼

Style Area:
Background ▼

Style:

Transparency:
0.8

[ ] Allow alerts for this rule

OK Cancel
```

4. Select the Operator. You can select =, < >, BetweenInclusive, <, <=, >, >=, Missing, or NotMissing. The default is >.

5. Enter or select a Value.
If your graph contains a hierarchy, then you can specify the hierarchy levels in which the display rule is applied.

- Click Specify Intersections. The Specify Intersections window is displayed.
- Select one or more hierarchy levels, the grand total, or all of the levels.
- Click OK to return to the Add Display Rule: Expression window.

Modify the Style Area, which includes a graph or a background.

Note: Background is available only for bar charts, bubble plots, line charts, needle plots, scatter plots, series plots, vector plots, and waterfall charts.

Specify a Style color.

(Optional) Adjust the Transparency slider.

(Optional) Select Allow alerts for this rule. Then, do the following:

- Select the Recipients. Click to select recipients. The Choose Members window is displayed. When you have selected all of the recipients or groups, click OK.
- Select the Notification frequency. You can select Daily, Hourly, or Every minute. Then, specify the Interval for the notifications.
- Select the Query frequency. You can select System default, Daily, Hourly, or Every minute. Then, specify the Interval for the query.

Click OK. The graph updates with the new display rule.

(Optional) Position your pointer over the display rule name in the Rules pane, and then click to edit the new display rule.

Note: A warning badge is displayed on a graph when the color is overloaded. This happens when multiple measures are assigned, a color or group role is assigned, or multiple overlays are present (which have cycling colors).

Add Display Rules to a Graph Using Color-Mapped Values

In addition to the key points for color-mapped display rules for all objects, which are described in “About Display Rules” on page 46, here are some key points about color-mapped values for graphs:

- Color-mapped display rules are not allowed if there are multiple graph overlays.
- If a color-mapped display rule is applied to a graph with one measure, and you add a second measure to the same axis, then the display rule is ignored because it conflicts with the graph’s own colors that have important meaning. For example, suppose that you add two measures to the Measure data role for a bar chart. The two bar charts will be displayed and the color-mapped display rule is applied as you expect to each bar chart. However, if you change the Measure layout option to Shared Axis, then the graph’s color has meaning in the single bar chart, and the color-mapped display rule is no longer applied.

To specify a new display rule for a graph using color-mapped values:

1. If it is not already selected, select the graph on the canvas that you want to update.
2. If the Rules pane is not already displayed, click $\text{Rules}$.
3. Click New rule, and then select a category from the list. The New Display Rule window is displayed.
   
   Note: Color-mapped values for an object can be applied only to category data items.
Select a color for the display rule.

Enter a value for the display rule in the field.

(Optional) Click +. Repeat the steps for entering a value and selecting a color.

(Optional) Select the Other check box. Then, select a color so that any of the other categories that do not have a color will have the one that you just selected.

Click OK. The graph updates with the new display rule.

(Optional) Position your pointer over the display rule name in the Rules pane, and then click to edit the new display rule.

Add Display Rules to a Geo Map or a Network Using Icons

For a coordinates geo map or for a network analysis object that has a geo map background, you can use display rules to replace the markers on the map with icons.

To specify a new display rule using icons:

1. If it is not already selected, select the geo map or network analysis object that you want to update.
   
   Note: The Coordinates map type must be selected for geo maps. The Map background option must be enabled for network analysis objects.

2. If the Rules pane is not already displayed, click $rules$.

3. Click New rule, and then select the geography data item that is currently assigned to the object. The New Display Rule window is displayed.

4. Click the style button to add a color and an icon for the display rule.

5. Enter a value for the display rule.

6. (Optional) Click +. Repeat the steps for entering a value and selecting a color and icon.

7. (Optional) Select the Other check box. Then, select a color and an icon so that any of the other values that do not have a color will have one. When Icon is selected, you can select Custom to select or upload custom images to use as icons.

8. Click OK. The graph updates with the new display rule.

9. (Optional) Position your pointer over the display rule name in the Rules pane, and then click to edit the new display rule.

Reorder Display Rules

If you have multiple display rules, you can change their order using the Rules pane. For a crosstab, you can reorder only display rules that are based on the same measure. Position your pointer over the display rule name that you want to move. Click and drag the indicator, and drop the display rule in a different position in the list.

Edit a Display Rule

Position your pointer over the display rule name in the Rules pane, and then click to edit the display rule.
Change an Object-Level Display Rule to a Report-Level Display Rule

You can easily change an object-level display rule based on a category to a report-level display rule using the Rules pane. If there are multiple display rules, then the priority is the order in which they appear in the list. The first display rule has highest priority, and so on.

Do one of the following:

- Position your pointer over the object-level display rule name in the Rules pane, and then click ‣ to move the display rule below the Report Level heading.
- Position your pointer over the object-level display rule name in the Rules pane. Click and drag the || indicator and drop the display rule below the Report Level heading.

Delete a Display Rule

Position your pointer over the display rule name in the Rules pane, and then click ⌼ to delete the display rule.

Working with Alerts

You can use the Rules pane to add alerts when you create an expression-based display rule. An alert for a display rule notifies users via email when the alert condition is met. You can specify how frequently the system checks to see whether the alert condition has been met. You can also specify how often users are notified.

Here are some key points about alerts:

- The alert is evaluated based on the default report state, which is the state of the report when the report designer saved it. This is different from the view state of the report, which can include the results of a user making changes to controls, navigation, drill states, and so on, in SAS Report Viewer.
- Alerts are delivered only to recipients who have signed in to SAS Visual Analytics. If a user has never signed in, then the application is unable to determine whether the alert should be sent. If a group of users is subscribed as the recipient of an alert, only the members of the group who have signed in at some point receive the alert.
- Email addresses for alerts cannot be added or modified using SAS Visual Analytics. For more information, see “Identity Management: Overview” in SAS Viya Administration: Identity Management.

For more information about alerts, see the following:

- “About Display Rules” on page 46
- “Add Display Rules to a List Table Using an Expression” on page 47
- “Add Display Rules to a Crosstab” on page 51
- “Add Display Rules to a Graph Using an Expression” on page 52
Working with Report Filters

About Report Filters

In SAS Visual Analytics, you can create filters to subset your data. These types of filters are available:

- **Detail Report Filters**
  - Basic filters
    - subset the data for individual objects in your reports by using a single data item. A basic filter is constrained to use only the data item that was selected when the basic filter was created. For more information, see “About Basic Report Filters” on page 57.
  - Advanced filters
    - subset the data for individual objects in your reports by using any number of data items and operators (for example, OR and AND) in the same expression. For more information, see “About Advanced Report Filters” on page 58.
  - Data source filters
    - subset the data for the entire report. The data source filters that you create are applied to every object in the report that uses that data source. For more information, see “About Data Source Filters” on page 60.

- **Post-aggregate Report Filters**
  - subset the data for individual objects in your reports by using the aggregated values, not the detail data values. For more information, see “About Post-Aggregate Report Filters” on page 62.

All filters except for data source filters can be configured as common filters, which can be shared between objects in your report. See “Using Common Filters” on page 63.

Here are some key points about report filters:

- All of your filters are saved when you save your report.
- Filters can accept parameters. For more information, see “Working with Parameters in Reports” on page 35.
- If you change a report filter from a detail filter to a post-aggregate filter, then all of the selections for the filter will be lost. The same is true if you change a post-aggregate filter to a detail filter. There is a warning message for both cases.
- One data item cannot have both a detail data item filter and a post-aggregate data item filter.
- From the main menu, select **Disable auto-refresh** to disable automatic updates to your data query until you have finished modifying your filters. When you are finished modifying your filters, either click the button on the application toolbar to manually refresh the data query, or select **Enable auto-refresh** from the main menu to re-enable automatic updates to the data query.
- Filters can be added to an object before the complete set of data roles are assigned. However, at least one data role must be assigned.

**Note:** Report links and page links are types of filters. The report page that is the target of the link is filtered by the values selected in the linked object. For more information, see “Creating Links” on page 71.
Using Detail Report Filters

About Basic Report Filters

For certain objects, you can subset your data by using the Filters pane. You can base your filters on any data item in the current data source for this object, regardless of whether the data item is assigned to an object in the current report.

Note: If you have multiple basic filters, SAS Visual Analytics assumes that there is an AND operator between the filters.

Create a Basic Report Filter

1. If it is not already selected, select the object on the canvas that you want to filter. The object must have at least one data item assigned.

2. Click Filters. The Filters pane is displayed.

3. Click New filter, and select a data item from the list.

4. Select the data values for the filter.
   For a basic filter that uses discrete values, a check box is displayed for each distinct value that uses the current format applied to the data item. To the right of each value, a bar indicates the frequency. Select the data values that you want to include or clear the selections for the data values that you want to exclude.
   If your data item includes more than 1,000 values, then only the most frequent 1,000 values are displayed. To exclude the values that are not displayed in the filter, clear the Include unlisted values check box.
   For a filter that uses continuous values, a slider shows you the maximum values and the minimum values that exist for the data item using the current data item format. Use the slider to select a range of target values. You can also specify the minimum and maximum values by clicking each slider, and then entering the value in the text box.

   TIP Use the arrow beside the filter name in the Filters pane to expand or collapse the filter details when you are working with multiple filters.

5. (Optional) If your data contains missing values, and you want to exclude those missing values from your report, then clear the Include missing values check box.

6. Click (to the right of the delete icon) for options. The available options depend on whether you are filtering characters, dates, or numerics. You can sort the values or frequencies in the filter.
   For continuous data, you can select the Condition type for your filter. For example, you can change the filter to select values that are outside of the selected range.

7. (Optional) If you have disabled auto-refresh, then click the button when you are ready to apply your filter changes.

Create a Basic Report Filter from a Data Selection

1. If it is not already selected, select the object on the canvas that you want to filter. The object must have at least one data item assigned.

2. Select the data values in the object that you want to isolate or exclude.
From the object toolbar, select ➡️, select **New filter from selection**, and then select one of the following options:

**Include only selection**  
creates a filter that shows only the selected data values.

**Exclude selection**  
creates a filter that hides the selected data values.

**Note:** You can edit or remove the filter on the **Filters** pane.

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**Edit a Basic Report Filter**

1. If it is not already selected, select the object on the canvas that you want to filter. The object must have at least one data item assigned.
2. Click 🔍. The **Filters** pane is displayed.
3. Edit your filter.
4. (Optional) Edit the expression for your filter. Click ✗ (to the right of the delete icon) for options. Then, select **Advanced edit**. The Edit Filter Expression window is displayed.
   - You can edit an expression using both **Visual** and **Text** modes.
   - You can drag and drop conditions and operators onto the expression in **Visual** mode.
   - You can enter the expression in **Text** mode. For more information, see “Reference: Editing a Data Expression in Text Mode” on page 82.
   
   For more information, see “Reference: Conditions for Filters” on page 108.

   **Note:** The AND and OR operators can accept more than two conditions. To add a new condition, right-click the AND or OR operator in the expression, and then select **Add ➔ New Condition**
5. Click **OK** to apply the filter.

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**Delete a Basic Report Filter**

To delete a basic report filter, click 🗑️ beside the filter in the **Filters** pane.

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**About Advanced Report Filters**

For most objects, you can create advanced filters to subset your data by using the **Filters** pane in SAS Visual Analytics.

Advanced filters enable you to create filters that use more than one data item.

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**Create an Advanced Report Filter**

1. If it is not already selected, select the object on the canvas that you want to filter. The object must have at least one data item assigned.
2. Click 🔍. The **Filters** pane is displayed.
3. Click **New filter** and then select **Advanced filter** instead of selecting a specific data item. The Advanced Filter window is displayed.
4. Specify a **Name**. The filter name identifies the advanced filter in the **Filters** pane.
5. Create a condition for the filter. You can use **Visual** mode, **Text** mode, or a combination of both modes.
To create a condition using **Visual** mode:

a From the **Data Items** list, select the data item on which the condition is based.

b From the **Conditions** list, select a condition. For more information, see “Reference: Conditions for Filters” on page 108.

c Drag and drop the condition onto the expression.

d For any required operator parameters, select the parameter, and enter a value, or right-click on the parameter field, and select **Replace with** to select a data item.

For information about **Text** mode, see “Reference: Editing a Data Expression in Text Mode” on page 82.

6 (Optional) Add operators to the expression. You can use **Visual** mode, **Text** mode, or a combination of both modes.

   To add operators using **Visual** mode:

   a From the **Operators** list, select an operator to join the conditions in your expression. For more information, see “Reference: Conditions for Filters” on page 108.

   b Drag and drop the operator onto the expression.

   c From the **Conditions** list, select another condition. Then, drag and drop the additional condition onto the expression. Complete any required operator parameters.

      **TIP** Right-click the AND or OR operator in the expression, and then select **Add ⇒ New Condition**.

7 Click **OK** to apply the filter.

8 (Optional) If you have disabled auto-refresh, then click the button when you are ready to apply your filter changes.

**Edit an Advanced Report Filter**

1 If it is not already selected, select the object on the canvas that you want to filter. The object must have at least one data item assigned.

2 Click **菲尔**. The **Filters** pane is displayed.

3 Click **⇒** (to the right of the delete icon) for options. Then, select **Advanced edit**. The Edit Filter Expression window is displayed.

4 Edit or add a condition for the filter. You can use **Visual** mode, **Text** mode, or a combination of both modes.

   To add conditions using **Visual** mode:

   a From the **Data Items** list, select the data item on which the condition is based.

   b From the **Conditions** list, select a condition. For more information, see “Reference: Conditions for Filters” on page 108.

   c Drag and drop the condition onto the expression.

   d For any required operator parameters, select the parameter, and enter a value, or right-click the parameter field, and select **Replace with** to select a data item.

For information about **Text** mode, see “Reference: Editing a Data Expression in Text Mode” on page 82.
(Optional) Replace a condition by dragging and dropping a new condition onto the existing condition in the expression in the **Visual** mode. Or, remove a condition using the **Text** mode.

(Optional) Add an operator to the expression. You can use **Visual** mode, **Text** mode, or a combination of both modes.

To add an operator using **Visual** mode:

a. From the **Operators** list, select an operator to join the conditions in your expression. For more information, see "Reference: Conditions for Filters" on page 108.

b. Drag and drop the operator onto the expression.

c. (Optional) Add a condition.

**TIP** Right-click the AND or OR operator in the expression, and then select **Add ⇒ New Condition**.

(Optional) Delete part of an expression by highlighting the part of the expression that you want to delete, and then right-click and select **Clear**.

Click **OK** to apply the advanced filter.

**Delete an Advanced Report Filter**

To delete an advanced filter, click beside the filter in the **Filters** pane.

**About Data Source Filters**

Data source filters are used to restrict the data that is displayed in a report. The data source filters that you create in SAS Visual Analytics are applied to every object in the report that uses the data source. A report that has multiple data sources can contain multiple data source filters.

You can use either continuous values or discrete values to create a data source filter. Continuous value filters can be used only for measures. Discrete value filters can be used for any character; numeric; or date, datetime, or data item; as long as the total number of distinct values does not exceed a maximum number.

Data source filters are not displayed in the **Filters** or the **Data** panes. A data source filter updates the cardinality values that appear in the **Data** pane.

There is a limit of one data source filter per data source. However, if you want to filter on more than one data item, you can create a combination filter.

**Create a Data Source Filter**

1. In the **Data** pane, click  and then select **Apply data source filter**. The Apply Data Source Filter window is displayed.

   **Note:** You cannot add a data source filter to a data source that is used in a join.

2. Add a condition for the filter. You can use the **Visual** mode, **Text** mode, or a combination of both modes.

   To add conditions using the **Visual** mode:

   a. From the **Data Items** list, select the data item on which the condition is based.

   b. From the **Conditions** list, select a condition. For more information, see “Reference: Conditions for Filters” on page 108.

   c. Drag and drop the condition onto the expression.
d) For any required operator parameters, select the parameter, and enter a value, or right-click the parameter field, and select Replace with to select a data item.

For information about Text mode, see “Reference: Editing a Data Expression in Text Mode” on page 82.

3 (Optional) Replace a condition by dragging and dropping a new condition onto the existing condition in the expression on the Visual mode. Or remove a condition using the Text mode.

4 (Optional) Add an operator to the expression. You can use the Visual mode, Text mode, or a combination of both modes.

To add an operator using the Visual mode:

a) From the Operators list, select an operator to join the conditions in your expression. For more information, see “Reference: Conditions for Filters” on page 108.

b) Drag and drop the operator onto the expression.

c) (Optional) Add a condition.

TIP Right-click the AND or OR operator in the expression, and then select Add ➔ New Condition.

5 (Optional) Delete part of an expression by highlighting the part of the expression that you want to delete, and then right-click and select Clear.

6 Click OK to apply the filter.

Edit a Data Source Filter

1 In the Data pane, click and then select Edit data source filter. The Edit Data Source Filter window is displayed.

2 Add or modify the condition for the filter. You can use the Visual mode, Text mode, or a combination of both modes.

To edit conditions using the Visual mode:

a) From the Data Items list, select the data item on which the condition is based.

b) From the Conditions list, select a condition. For more information, see “Reference: Conditions for Filters” on page 108.

c) Drag and drop the condition onto the expression.

d) For any required operator parameters, select the parameter, and enter a value, or right-click the parameter field, and select Replace with to select a data item.

For information about Text mode, see “Reference: Editing a Data Expression in Text Mode” on page 82.

3 Edit the operator in the expression. You can use the Visual mode, Text mode, or a combination of both modes.

4 Click OK to apply the data source filter.

Delete a Data Source Filter

In the Data pane, click and then select Delete data source filter.
Using Post-Aggregate Report Filters

About Post-Aggregate Report Filters
Post-aggregate filters subset the data for individual objects in your reports by using the aggregated values, not the detail data values. You can use the Filters pane to filter data in an object using an aggregated value instead of a detail value. Post-aggregate filters are available only for measure data items. When an object has both ranks and post-aggregate filters applied, the ranks are applied before the post-aggregate filters.

Here are some key points about post-aggregate filters:

- Post-aggregate filters are not available for objects that use detail data.
- Crosstabs, time series plots, and dual axis time series plots do not support post-aggregate filters.
- Advanced analytics objects do not support post-aggregate filters.

Create a Post-Aggregate Report Filter

1. If it is not already selected, select the object on the canvas that you want to filter. The object must have at least one data item assigned.

   **TIP** Clear the Auto-update check box above the report canvas until you are ready to apply your filter changes.

2. Click \(\small{\text{Filters}}\). The Filters pane is displayed.

3. Click New filter, and select a measure data item from the list. The filter appears in the Filters pane.

4. Select the **Filter aggregated values** check box. A slider shows you the maximum and minimum data values that exist for the data item using the current data item format. Use the slider to select a range of target values.

   **Note:** Filtering aggregated values is disabled if hierarchies are assigned to the object.

   **Note:** The post-aggregate filter tracks the aggregation associated with the data item. If you change the aggregation using the Data pane, then the filter name in the Filter pane reflects that change. For example, if you create a post-aggregate filter for a data item called Sales, it is initially displayed in the Filters pane as Sales (Sum). In the Data pane, you change the aggregation to Average. In the Filters pane, the filter name is displayed as Sales (Average). The post-aggregate filter attempts to keep the same range of data values that you originally selected for the aggregation.

   **TIP** Use the arrow to the left of the filter name in the Filters pane to expand or collapse the filter details when you are working with multiple filters.

5. (Optional) Click the \(\small{\text{}}\) beside the filter name to change the operator. Select **Condition type**, and then select an operator.

6. (Optional) Change the lower and upper values for the post-aggregate filter by clicking the value sliders, and then entering a new value.

7. (Optional) If your data contains missing values, and you want to exclude those missing values from your report, then clear the **Include missing values** check box.

8. (Optional) If you have disabled auto-refresh, then click the \(\small{\text{}}\) button when you are ready to apply your filter changes.
Delete a Post-Aggregate Report Filter

To delete a post-aggregate filter, click ☑️ beside the post-aggregate filter in the Filters pane.

Using Common Filters

About Common Filters

You can create common filters. Common filters are filters that can be shared between objects in your report. When you edit a common filter, it is updated everywhere that the common filter is used.

Common filters are specific to a report and cannot be shared between reports.

Create a Common Filter

To create a common filter:

1. Select an object that uses the appropriate data source, and then select the Filters pane.
2. Create a detail filter or a post-aggregate filter.
3. Click ☑️ for the filter, and then select Change to common filter. A new name is generated for the filter, and the filter is now available in the Data pane.
   Note: Path filters for path analysis objects cannot be converted to common filters.

Apply a Common Filter to an Object

To apply a common filter to an object:

1. Select the object that you want to apply the filter to.
2. In the Data pane, right-click the common filter, and then select Add to selected object. Or, drag and drop the common filter onto the object.

Edit a Common Filter

To edit a common filter, select any object that the filter is applied to, and then edit the filter in the Filters pane. The common filter is updated in every object that uses it.

Remove a Common Filter from an Object

To remove a common filter from an object, click ☑️ beside the filter in the Filters pane. The common filter remains for any other objects that use it.

Delete a Common Filter from Your Report

To delete a common filter from your report, right-click it in the Data pane, and select Delete. If the filter is applied to any objects, then a message indicates which objects are affected.

Convert a Common Filter to an Object-Specific Filter

For a specific instance of a common filter, you can convert the common filter to an object-specific filter. You might do this if you want to make changes to the filter that affect only the current object, and that do not affect all of the other objects that use the filter.
To convert an instance of a common filter to an object-specific filter, select the Filters pane, and then click beside the common filter. Select Copy to object-specific filter. The common filter is replaced in this object with an object-specific filter.

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**Working with Report Actions and Links**

**Overview of Report Actions**

Actions are used to direct a report viewer’s attention to specific results in a report. (Prior to the 8.1 release, actions were known as report interactions.) Actions enable users to understand data within a particular context.

There are these types of report actions:

- **linked selection**
  enables you to show the same data selected simultaneously in two or more tables, graphs, or controls. (Prior to the 8.1 release, linked selection was known as data brushing.) The linked selection highlights a percentage that reflects the number of shared observations in the data set. The linked selection does not highlight a percentage that corresponds to the aggregated value. The data for the linked selection has the same appearance in each object, which makes the data easily apparent to report viewers.

  A linked selection can also be an automatic action for pages or objects.

- **filter**
  is used to restrict the data that is returned from a query to a data source. Filters are simply a set of rules or conditions that you specify to subset the data that is displayed in a table or graph. The goal is to display only the data that you need to see to perform your analysis.

  Automatic actions for pages and objects can be one-way filters or two-way filters.

- **link**
  enables single-step access to a report or web page that is related to the current report. You can add a link from an object to another report, to a specific page in the current report, or to an external URL. If a destination report contains multiple pages, then you are able (when defining the link) to choose the initial page of the destination report that you want to open first.

  Linking has elements of both a filter and an action. A report page that is the target of a link is filtered by the values that are selected in the linked object. And, like actions, objects that display detail data cannot be the source of a link.

The **Actions** pane in SAS Visual Analytics enables you to specify which actions you want to add to tables, graphs, and controls in a report. It enables you to use automatic actions for objects on a page. It provides an easy way to set up a single filter; a linked selection; or a page, report, or URL link.

The Actions Diagram is an alternative to using the **Actions** pane. In addition to all the features that the **Actions** pane offers, the Actions Diagram provides a quick, visual way for you to see how multiple actions and links are related or to create many actions at one time.

You can create actions between controls in the page prompt area using either the **Actions** pane or the Actions Diagram. However, you cannot create actions between objects in the page prompt area and objects on the page using the Actions Diagram. For more information, see “Using the Actions Diagram”.

Here are some key points about actions:

- Actions are available only for objects on the same page.
- Report linking is a type of action. The page that is the target of a link is subset by the values selected in the linked object. For more information, see “Creating Links” on page 71.
- Tables and graphs can be the source of an action, with the exception of time series plots.
- Objects that use detail data cannot be the source of an action.
Controls can be the source of an action. Controls that are used as page prompts are treated as automatic filters.

Avoid using suppressed data in any object that is the source or target of a filter. Filters can sometimes make it possible to infer the values of suppressed data.

Hierarchical network analysis objects cannot be the source of an action.

You can add an action with an animated graph as its source. However, the action is disabled in the report viewer or mobile app.

Analytics objects cannot be the source of an action.

Only manual actions are propagated to page link targets.

**Using the Actions Diagram**

The Actions Diagram is an alternative to using the Actions pane.

**TIP** Click View Options to specify what you see in the Actions Diagram. For example, if you do not want to see page links in the Actions Diagram, then clear the Page links check box.

To create an action using the Actions Diagram:

1. Add the report objects that you want to use to the canvas. For example, you might have a bar chart, a line chart, and a list table.

2. Click View Diagram in the Actions pane to switch to the Actions Diagram.

3. In the Actions Diagram, do one of the following:
   - For a filter, make sure the icon is selected at the top of the diagram.
   - For a linked selection, click the icon at the top of the diagram.

4. Draw a connection from the source object to the target object. For a filter, the icon is displayed between the objects. For a linked selection, the icon is displayed between the objects.

**Note:** The source and target of an action should be based on the same data source. If you have multiple data sources, you are prompted to map the data sources to create the action. For more information, see “Map Data Sources for Actions and Links” on page 74.

Here is an example of a filter between a bar chart (the source object) and a list table (the target object):
5 (Optional) Modify the direction of the action or change it from a filter to a linked selection. Right-click the icon between the two objects, and select **Switch direction** or **Linked selection**.
Note: Derived actions are represented by dashed lines in the Actions Diagram.

6 (Optional) Add other actions. For example, if your report has multiple pages, you can add page links by drawing a connection from the source object to a page. The ∞ is displayed between the object and the page.

7 (Optional) Click View Options to specify what you see in the Actions Diagram. You can select Filters, Linked selection, Page links, Parameters, or Indirect filters. All of these actions are selected by default.

8 Click Close. The new action appears in the Actions pane.
TIP If you need to map data sources so that a page link works correctly, click ☐ that is displayed between the object and the page in the Actions Diagram, and then click Edit. The Edit Page Link Action window is displayed. Click ☑ beside Map data. The Map Data window is displayed. Map the Source and Target data items, and then click OK. For more information about using the Map Data window, see “Map Data Sources for Actions and Links” on page 74.

Create a Manual Filter

Here are some key points about manually creating filters:

- You cannot create actions from list tables or bubble plots that use detail data. However, any object that uses detail data can be the target of an action.
- Scatter plots cannot be the source of an action.
- Bubble plots can be the source of an action only if they have a Group role assigned.
- Sliders can be the target of an action. However, a slider that has the Set fixed range property set will not do anything when it is filtered because its data is fixed.
- Prompt containers enable you to delay the execution of actions to objects that are outside of the prompt container. However, actions between objects that are inside a prompt container are never delayed.
- You cannot have manual filters with automatic one-way filters.

1. Add the objects that you want to use to the canvas. For example, you might have a bar chart, a line chart, and a list table.

2. Select the object that you want to use as the source of the filter.

3. If the Actions pane is not already displayed, click ▶.

4. Expand the Object Links heading, if needed. Select the check box for the object that you want to filter.
Note: By default, object links are filters.

Create a Manual Linked Selection

A manual linked selection enables you to show the same data selected simultaneously in two or more tables, graphs, or controls.

Note: You cannot have manual linked selections with automatic one-way filters.

1. Add the objects that you want to use to the canvas. For example, you might have a bar chart, a line chart, and a list table.

2. Select the object that you want to use as the source of the linked selection.

3. If the Actions pane is not already displayed, click 📋.

4. Expand the Object Links heading, if needed. Select the check box for the object that you want to link to.

5. Click ✉️ to change the type of object link to a linked selection.

Using Automatic Actions

SAS Visual Analytics can automatically add linked selections and filters to objects. This means that you do not have to manually add actions to objects. Automatic actions work only on objects that use the same data source or on objects that have sufficient data source mappings. SAS Visual Analytics does not prompt you to map data sources for automatic actions. You need to use the Data pane to globally map data sources. For more information, see “Map Data Sources Using the Data Pane” on page 6.

Note: Report summaries do not support automatic actions.

About Automatic One-Way Filters

You can have automatic one-way filters on a page in a report. Here are some key points about one-way filters:

- Only objects that support manual filters can have automatic one-way filters.
- As you add objects to the canvas, a one-way filter is automatically applied to all other objects that are not selected.
- Automatic one-way filters are applied in the order in which you select the objects.
- If you change a selection, then all downstream filter, selections, and drills are removed.
- Tokens for the automatic one-way filters are displayed below the page prompt area. The filters are displayed in the order in which they are added. You can remove a filter by clicking on the related token.
- You cannot have manual linked selections and manual filters with automatic one-way filters.
- To deselected the last row in a list table or a crosstab, press Ctrl, and then click the last row.

Note: If automatic actions are enabled for a page, you will have to disable them before you can use the Actions Diagram.

For information about adding automatic one-way filters, see “Enable Automatic Actions” on page 70.

About Automatic Two-Way Filters

You can have automatic two-way filters on a page in a report. Here are some key points about automatic two-way filters:

- Only objects that support manual filters can have automatic two-way filters.
As you add objects to the canvas, two-way filters are automatically applied to all other objects that are not selected.

When the object that initially had focus loses its focus, the same filter is applied to it as is applied to all of the other objects.

Deleting a filter does not impact the other filters because there is not a chain of filters such as in automatic two-way filters.

Tokens for the automatic two-way filters are displayed in the page prompt area. You cannot control the visibility of the tokens.

You cannot have manual linked selections and manual filters with automatic two-way filters.

You should not use required prompts with automatic two-way filters.

To deselect the last row in a list table or a crosstab, press Ctrl, and then click the last row.

For information about adding automatic two-way filters, see “Enable Automatic Actions” on page 70.

About Automatic Linked Selection Page Actions

Automatic linked selection actions enable you to show the same data selected simultaneously in two or more tables, graphs, or controls on a page. The linked selection has the same appearance in each object, which makes the data easily apparent to users who are viewing the report.

Here are some key points about automatic linked selection actions:

- When an object is selected, all other objects on the page will have linked selections.
- When another object is selected, the previous selection is removed, and all other objects on the page will have linked selections.
- Only objects that support manual linked selections can have automatic linked selection actions for the page.
- All objects on the page participate in automatic linked selection actions for the page.
- When you drill-down on a hierarchy when linked selection actions are enabled, the drill-down will propagate to the other objects on the page.
- You cannot have manual linked selections and manual filters with automatic linked selection actions for the page.
- To deselect the last row in a list table or a crosstab, press Ctrl, and then click the last row.

For information about adding automatic linked selection actions, see “Enable Automatic Actions”.

Enable Automatic Actions

1. If the Actions pane is not already displayed, click 📊.
2 Do one of the following:

- For a page, make sure that the page name is selected in the drop-down list at the top of the Actions pane.
- For an object, make sure that the object name is selected in the drop-down list at the top of the Actions pane.

3 Select the Automatic actions on all objects check box.

**Note:** Any existing manual linked selections and manual filters are removed when you select this option.

4 Specify the type of automatic action using the drop-down list. You can specify One-way filters (default), Two-way filters, or Linked selection.

If you select One-way filters, then you can clear the selection for Display filter breadcrumb if you do not want to see the list of filters displayed at the top of the canvas.

SAS Visual Analytics provides an **Action mode for new pages** setting, which enables you to specify your preference for the type of actions you use for new pages in your new reports. For more information about settings, see “Modify SAS Visual Analytics Settings” in *SAS Visual Analytics: Designing Reports*.

### Creating Links

#### Overview of Links

Links enable single-step access to a report or web page that is related to a report that you are currently viewing. For example, you might be looking at a bar chart that has sales information for each geographical region of your company. If you double-click the bar for the Northeast region, then a report link associated with the graph could take you to a different report that provides information about employees in each region. You can click ⚡ in the top left corner of a destination report to return to the previous report.

Using SAS Visual Analytics, you can add a link from an object to another report, to a specific page or a hidden page in the current report, or to an external URL. If a destination report contains multiple pages, then you are
able (when defining the link) to choose the initial page of the destination report that you want to open first. For more information, see “Overview of Pages” in SAS Visual Analytics: Designing Reports.

If you click a page link to go to another page in a report, use the in the upper left corner of the workspace to return to the original page.

You can synchronize prompt values and parameters across linked reports. For example, suppose that you have two reports, Report 1 and Report 2. When you follow a link from Report 1 to Report 2, all of the prompts and their values are displayed in Report 2, and their states are synchronized. The same is true when you move from Report 2 to Report 1.

Note: Report links do not let you map joined data sources or aggregated data sources. If a source data source has a joined or aggregated data source, it can be used in a report link as long as it does not target another joined or aggregated data source.

Create a Manual Link to a Page, Another Report, or a URL

Note: The following steps do not apply to text objects. For more information, see “Create a Link from a Text Object” on page 73.

To add a link from an object or image to a specific page in the same report, another report, or a URL:

1. Add the objects and pages that you want to use to the canvas.
2. Select the object or image that you want as the source for the link.
3. If the Actions pane is not already displayed, click .
4. Do one of the following:
   - Select the Object Links heading, and then select the check box for the object that you want to link to.
     Note: By default, object links are filters. Click to change the type to a linked selection.
   - Select the Page Links heading, and then select the check box for the page that you want to link to.
     (Optional) Click , and select Set prompt bar values of target page. This action indicates whether the objects on the target page are filtered or whether the prompts on the target page have their values selected. If this action is not selected, then the objects on the target page are filtered based on the context from the source page. (All objects on the page or in the page prompt area are filtered in that context.) Selecting this action indicates that you want the controls in the page prompt area to have their values selected based on the context.
     Note: The control must use a data item that is part of the context.
   - Select the Report Links heading, and then select New Report Link. The Open window is displayed. Select the report that you want to link to, and click Open.
     In the Add Report Link Action window, use the Open page field to indicate which page should be displayed when the report opens.
     Select Set prompt bar values of target report. This action indicates whether the objects in the target report are filtered or whether the prompts in the target report have their values selected. If this action is not selected, then the objects in the target report are filtered based on the context from the source report. (All objects in the report or in the report prompt area are filtered in that context.) Selecting this action indicates that you want the controls in the report prompt area to have their values selected based on the context.
     Note: The control must use a data item that is part of the context.
   - Select the URL Links heading, and then click New URL Link. Using the Add URL Link Action window, enter a Name and the URL.
     Note: UTF-8 is supported for URL links.
Do not add parameters to the URL field. Click + to specify additional parameters, such as a Target. These additional parameters are automatically added to the URL.

(Optional) Add one or more Parameters.

5 Click OK. The new link is displayed in the Actions pane.

Note: You cannot test report links from within SAS Visual Analytics. You must save the report, and then switch to SAS Report Viewer (the report viewer). You can test report links in the report viewer.

Edit Links
You can edit report links and URL links using the Actions pane. This feature is not available for page links or object links.

1 Click beside the link name, and select Edit.
2 Make changes to the link.
3 Click OK to save your changes.

Create a Link from a Text Object
You can add a link from a text object to a URL, to a page, or to a report.

1 Double-click inside a text object on the canvas, and enter the text.
2 Select some or all of the text, and then click one of the following:

creates a link to a URL.

creates a link to a page within the current report.

creates a link to another report.

The Add Report Link Action window is displayed.

Note: After you add a page link or a report link, you need to add a space after the link. Then, you can press Enter to go to a new line.

3 Specify the link options:

- For URL links, specify the Name and the URL for the link. You can add Parameters for the URL.
  Note: UTF-8 is supported for URL links.

- For page links, select the target page for the link. You can select Set prompt bar values of target page to pass your current prompt selections to the target page.

- For report links, select the target report and the Open page. You can select Set the value for controls in the target report prompt bar to pass your current prompt selections to the target report.

4 Click OK. The text that you selected is a link in the text object.

Note: Text links are not displayed in the Actions pane.
Map Data Sources for Actions and Links

The source and target of an action or link should be based on the same data source. If they are not based on the same data source, you might be prompted to map data sources so that an action or link works properly in these situations:

- When you try to create an action or link between an object that uses one data source and another object that uses a different data source.
- When you try to create a link between an object that uses one data source and a report section that uses a different data source.
- When you try to create a link between an object that uses one data source and a report that uses a different data source.

Here are some key points about mapping columns in data sources:

- A column in one data source can be mapped only once to another data source. If you need to map a column more than once, then the column needs to be duplicated in the data source.
- Mapped columns must share the same format for filters to work. For example, if the format of the source column is MMDDYYYY and the format of the target column is DDMMYYYY, then a filter will not work.
- Data items in a hidden data role can participate in the mapping of data sources.
- You cannot map a column to a custom category data item or to a calculated data item.

**TIP** You can use the Data pane to globally map data sources. This can save you time because you are not prompted to map data sources for individual reports. For more information, see “Map Data Sources Using the Data Pane” on page 6.

To map data sources using the Map Data window:

1. Use the **Source** drop-down list to select a column from the first data source.
2. Use the **Target** drop-down list to select a corresponding column from the second data source.

Here is an example of the Map Data Sources window for an action between two list tables that have different data sources:
**TIP** If there are multiple data sources, and you do not want to link to all of them, you can select the Enable data source mapping check box.

For page links, you are not required to map the data sources. If you choose not to map the data sources, then the filters are not carried over.

3 Map additional data items. Click +.

**Note:** If you create actions between multiple objects using the same data source, but on different columns in that data source, then you must map each and every column in a Map Data window. If you do not do this, then a subsequent mapping for the data source overrides a previous mapping.

4 Click OK.

**Delete a Report Action**

Do one of the following:

- To delete a report action, click  beside the action name in the Actions pane.
- To delete object links and page links, clear the check box beside the link name in the Actions pane.
- To delete report links and URL links using the Actions pane, click  beside the link name, and select Delete.

**Ranking Values in Reports**

**About Ranks**

Using SAS Visual Analytics, you can rank the data in an object to show the top (greatest) count or percent or the bottom (least) count or percent for a category that is based on a measure. For a list table, you can also rank across a set of categories for the top value or bottom value in the set. A rank filters the values of a category based on the aggregated measure by the top or bottom of the values. A rank greatly reduces the visible categories to make it easier to focus on the top value or bottom value that interests a user.

For example, you might create a rank of the top 10 countries by frequency to select the 10 countries that are most represented in your report. As another example, you might create a rank of the top 10 countries by population to select the 10 countries with the greatest populations.

Here are some key points about ranks:

- Controls and gauges support ranks.
- Ranks can accept parameters. For more information, see “Working with Parameters in Reports” on page 35.
- Ranks can be added to an object before the data roles are assigned.

**Add a New Rank**

You can use the Ranks pane to create ranks to subset the data in your reports.

1 If it is not already selected, select the object on the canvas that you want to update.

2 If the Ranks pane is not already displayed, click .

3 Click Add.
Select a data item. You can select any category or geography data item, regardless of whether it is assigned to the current object. The new rank is displayed in the Ranks pane.

For list tables only, you can select All visible categories, which ranks across the intersection. The top or bottom combination of the visible categories is displayed. For example, you select the region and product data items. You rank on the top 10 by profit. The top 10 region and product combinations are displayed. In this case, the column is no longer considered a single column, it is considered the crossing of the columns.

Note: If a list table has a rank for All visible categories, then that is the only rank that it can have.

The Detail Rank option is available for list tables, bubble plots, and scatter plots that show detail data. If there is an aggregated filter in the data definition, you cannot have a detail rank. If the object has a detail rank, then it is the only rank that it can have. Otherwise, objects can have multiple ranks.

(Optional) Select the type of rank from the drop-down list. These types are available:

- **Top count** specifies that the rank selects the greatest values.
- **Bottom count** specifies that the rank selects the least values.
- **Top percent** specifies that the rank selects the greatest percentages.
- **Bottom percent** specifies that the rank selects the least percentages.

If you selected Top count or Bottom count, use the Count field to specify a number for the rank. For example, if you select 5, then the rank selects the five greatest values. The Count field also lets you add a parameter.

Click ▼ to select a count or enter a number in the Count field.

To add a parameter:

a. Click ▼ and select Add parameter.

b. Use the Add Parameter window to specify the Name, Type, Minimum value, Maximum value, Format, and Current value.

c. Click OK to save your changes. For more information, see “Working with Parameters in Reports” on page 35.

If you selected Top percent or Bottom percent, use the Percent field to enter a number between 1 and 99. The Percent field also lets you add a parameter.

To add a parameter:

a. Click ▼ and select Add parameter.

b. Use the Add Parameter window to specify the Name, Type, Minimum value, Maximum value, Format, and Current value.

c. Click OK to save your changes. For more information, see “Working with Parameters in Reports” on page 35.

From the By drop-down list, select the measure that is used to create the rank. You can select any measure.

(Optional) Select the Ties check box to include ties in the rank.

If you select Ties, then the rank selects as many values as necessary to include all of the ties. If you do not select Ties, then the rank selects only the number of values that are specified by the rank parameters.

For example, if your rank selects the top three values, but there are five values tied for the greatest value, then the number of values that are selected by the rank depends on the Ties option. If you select Ties, then the rank includes all five of the tied values. If you do not select Ties, then the rank includes only three of the tied values.
10 (Optional) For category-specific ranks, you can select the **All Other** check box to show the measurements for the categories that did not qualify as a top or bottom value. This option is not available if the object is showing only detail values.

Here are some key points about the **All Other** option:

- The option is available when you are ranking visible categories in certain types of objects.
- The option applies only to the category that is being ranked. For example, suppose that you have **Region** and **Product** categories assigned to a list table. Then, you apply a **Region** rank with the **All Other** option set, so the “All Other” value might appear as a **Region** value, but not as a **Product** value.

If you want to combine category values that are excluded by rank into “All Other”, then you need to use the **All Other** option. For more information, see “Use the Combine Excluded into “All Other” Option” in [SAS Visual Analytics: Working with Report Content](#).

- The option is not available if the rank is on a prompt control, geo bubble map, geo coordinate map, or geo region map.
- When the option is specified for an object, the total, subtotal, and percent of total show values with respect to all of the data, rather than data just relative to data qualifying under the rank. The data that does not fit into the top or bottom of the rank is aggregated in the **All Other** category.
- You can use this option with a ranking to reduce the number of slices in a pie chart. However, this means the “Other” slice must be removed from the pie chart. (You can remove the “Other” slice by clearing the “Other” slice check box under the **Pie** heading in the **Options** pane.)
- If this option is selected, then any **All Other** value that appears in a table or graph cannot be selected. This means that the **All Other** value cannot be the source value for an action.
- If you do not select **All Other**, then the rank shows only the data as filtered by the category values that qualify as the top or bottom value.

By default, your new rank is applied automatically to the object.

You can add more than one rank to an object, as long as the first rank is not a **Detail Rank** or an **All visible categories** rank.

Here is an example of a pie chart that shows the profit for multiple product lines before a rank is applied:
Here is the same pie chart after a rank of the top five product lines is added. The All Other option was selected, so the “Other” slice is not displayed.

Delete a Rank
To delete a rank, click beside the rank name in the Ranks pane.

Exporting Data and Saving Images from Objects

Overview of Exporting
You can export data or save an image from a report object using SAS Visual Analytics.

Users can export data from objects to Microsoft Excel format for future viewing or printing. This exported output can be saved locally on disk, and then opened in Excel. Or, you can choose to create a data file. The data file can be a tab-separated values (TSV) file or a comma-separated values (CSV) file.

Here are some key points about exporting data:

- When you export a graph from SAS Visual Analytics, you are exporting the data, not the visual graph representation.
- Not all objects support the export feature. If the export feature is not available for a particular object, the Export data menu item does not appear on the options menu for the object.
- SAS Visual Analytics does not preserve leading blanks in displayed or exported data. However, you can filter for values that contain leading blanks.
- SAS Visual Analytics does not support exporting supplemental characters (for example, emojis).
- When you export detailed data from a crosstab or a list table to Excel, totals are not exported.
- SAS Visual Analytics uses the browser locale when exporting data.
- Time or datetime values that are exported to Excel will have the display value truncated to the format precision rather than being rounded, which happens in SAS Visual Analytics and SAS Report Viewer (the report viewer). For example, a time value of 1:52:43 is displayed with hours and minutes formatting as 1:53 in both SAS Visual Analytics and the report viewer. The time value is displayed as 1:52 when it is exported to Excel with a cell format (in the en_US locale) of [§-409] [h]:mm. However, the underlying precision of the time or datetime value (for example, 1:52:43) is retained upon export.

- Quarter time values (for example, Year, Quarter) do not export correctly from SAS Visual Analytics because Excel does not have any built-in quarter-type formats. However, you can format the values in Excel by adding conditional formatting rules with formulas that reference custom number formats that are applied to a range of cells (for example, all of the cells in a column).

- When you export formatted data from some objects, it might involve exporting multiple sets of tabular data. In these cases, you are limited to exporting all or none of the data to Excel. (For example, when a heat map with more than two data items assigned to the Axis Items data role is exported, the exported data will have a worksheet for each data item pairing that can be formed from the data items in the Axis Items data role.)

### Save an Image

You can save an image for any list table, crosstab, graph, or gauge in a report. This is useful if you want to include the image of a report object in a presentation, such as in Microsoft PowerPoint. Images are saved as PNG files.

Here are key points about exporting an image:

- An exported image does not show ranks or filters that are associated with the report object.
- The image defaults to the size of the report object in the report.
- The following characters in an image name are converted to a hyphen (−) when the image is exported: / \ : * ? " < > |
- You cannot save an image for controls, prompt containers, web content, or data-driven content.

To export an image:

1. If the list table, crosstab, graph, or gauge that you want to export is not already selected on the canvas, select it.
2. Right-click in the object, and select **Save image**. The image is saved to your Downloads folder (or the browser’s default download folder).

   The name of the PNG file is assigned using the following format: `Snapshot of <object title or objectname> <date> at <time>.png`. For example, an image name might be `Snapshot of Sales by Department 10-25-2017 at 10.45.20 AM.png`.

### Export Data from a Table or a Graph

1. If the table or graph that you want to export data from is not already selected, then select it.
2. Click ⌃ for the table or graph, and then select **Export data**. The Export Data window is displayed.

   Here is an example of the Export Data window for a list table:
Choose the **Rows** to export. This option is always available for tables, and when the **Detailed data** option is selected for other graph objects.

The number of rows that you can export is the smaller of these two amounts:

- The range from zero up to the system row limit for the selected export type and the range.
- The range from zero up to the number of rows actually displayed by the object (where the displayed rows might have been truncated due to limits associated with a particular object type).

Choose **Columns** to export. If you choose individual columns, select the check box (or check boxes) to the left of the column (or columns) that you want to export. At least one column is required.

Specify the data **Options**:

- Either select or clear the **Formatted data** check box. This check box is selected by default.
- Either select or clear the **Detailed data** check box. When you select this option, all of the columns in the data set are selected.

This option must be selected if you want to choose the **Rows** to export from the graph objects and the analytic objects.
Note: This option is not available when a post-aggregate filter is applied or a rank with “All Other” is applied.

6 For **File type**, select **Excel workbook (*.xlsx)** to create a Microsoft Excel workbook, or either **Tab-separated values (*.tsv)** or **Comma-separated values (*.csv)** to create a data file.

   Note: The contents in an exported CSV file can display differently depending on the application that opens the file.

7 Click **OK**.

8 When you are prompted, choose either to open the file or to save it.

---

**Export Data from a SAS Visual Statistics or SAS Visual Data Mining and Machine Learning Object**

To use analytic objects, your site must have a SAS Visual Statistics license or a SAS Visual Data Mining and Machine Learning license. If you are using analytic objects, follow these steps to export data:

1 Click for the analytic object, and then select **Export data**. The Export Data window is displayed. Here is an Export Data window for a decision tree with formatted data:

![Export Data Window](image)

2 Specify the data **Options**:

   - Either select or clear the **Formatted data** check box. This check box is selected by default. When this option is selected for analytic objects, the summary tables are exported as separate Excel worksheets.

   - Either select or clear the **Detailed data** check box. When you select this option, all of the columns in the data set are selected. The Export Data window content changes, so you can select the **Rows** and the **Columns** that you want to export.

3 For **File type**, select **Excel workbook (*.xlsx)** to create a Microsoft Excel workbook, or either **Tab-separated values (*.tsv)** or **Comma-separated values (*.csv)** to create a data file.

   Note: The contents in an exported CSV file can display differently depending on the application that opens the file.

4 Click **OK**.
When you are prompted, choose either to open the file or to save it.

---

**Reference: Editing a Data Expression in Text Mode**

**Overview of Text Mode**

In SAS Visual Analytics, you create and edit filters, calculated items, and aggregated items by using an expression editor. The **Text** mode of the expression editor enables you to edit the expression as text.

You can add operators and data items to your expression by dragging and dropping them onto the expression or by entering the names of the operators or data items.

When you make changes to your expression, it is automatically evaluated to determine whether it is valid. If the expression is not valid, then an error appears on the **Messages** tab, and the **OK** button is disabled. There might be a brief delay as your expression is evaluated.

**Specifying Operator Parameters**

When you add an operator to the expression, any parameters that are required by the operator are represented between braces { }. For example, if you add the \( x - y \) operator, then your expression appears as \{Number\} — \{Number\}.

Each parameter value that you enter should replace the entire string between the braces, including the brace characters. For example, you might replace \{Number\} with 12 or with a data item such as Expenses.

You can automatically select the next operator in the expression by pressing Ctrl + Shift + spacebar.

**Specifying Data Item Names and Parameter Names**

Data item names and report parameter names can be entered as plain text and are not case sensitive. You can enter names formally by using the format ‘\texttt{data-item-name\}'n for a data item, or ‘\texttt{parameter-name\}'p for a parameter. If you switch to **Visual** mode, then all of your names are converted to the formal format.

Note: If a name contains quotation marks, then you must use the \ character to escape the quotes.

Note: If a name contains spaces, then you must use the formal format.

Note: If a data item or report parameter has the same name as an operator, then you must use the formal format. For example, if you have a category named Year, then enter the name as ‘\texttt{Year\}'n to avoid conflict with the **Year** operator.

**Using Formatted and Unformatted Values**

By default, category values and discrete numeric and date values are evaluated as formatted values. Continuous numeric values are evaluated as unformatted values.

To override this default behavior, you can add [raw] (to use unformatted values) or [formatted] (to use formatted values) to the right of the data item.

For example, ‘\texttt{Expenses\}'n[formatted] specifies that the Expenses measure is evaluated as a formatted value.
Specifying String Values

To enter a string value, you can enter the string between single quotes or double quotes. If your value contains a quotation mark, use the \ character to escape the quote. If you use double quotes to enclose the string, then you do not need to escape the single quotes. If you use single quotes to enclose the string, then you do not need to escape the double quotes. For example, "O'Reilly", 'O\'Reilly', and "Hello" are all valid.

To enter a string that contains a newline character, use \r, \n, or both to specify the newline character.

Specifying Date and Datetime Values

For date and datetime values, specify a formatted value in quotes, followed by the letter "d" for a date value or the letters "dt" for a datetime value.

Here are some examples of date and datetime values:

<table>
<thead>
<tr>
<th>Table 6</th>
<th>Example Date and Datetime Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>'23JUN2013'd</td>
</tr>
<tr>
<td></td>
<td>'JUN2013'd</td>
</tr>
<tr>
<td></td>
<td>'2013'd</td>
</tr>
<tr>
<td></td>
<td>'q32013'd</td>
</tr>
<tr>
<td>Datetime</td>
<td>'23JUN2013_5:23:55'dt</td>
</tr>
<tr>
<td></td>
<td>'23JUN2013_5:23'dt</td>
</tr>
<tr>
<td></td>
<td>'23JUN2013'dt</td>
</tr>
</tbody>
</table>

Specifying Aggregated Values

For aggregated values, specify the format, aggregation-type [context] (value), where context specifies one of the following aggregation contexts:

ByGroup
calculates the aggregation for each subset of the data item that is used in an object. For example, in a bar chart, an aggregated measure with the ByGroup context calculates a separate aggregated value for each bar in the chart.

ForAll
calculates the aggregation for the entire data item (after filtering). For example, in a bar chart, an aggregated measure with the ForAll context uses the same aggregated value (calculated for the entire data item) for each bar in the chart.

See “Aggregated (Simple) Operators” on page 93 for a list of the aggregation types that are available.

For example, sum [bygroup] ('cost'n) aggregates the sum of the measure COST for each BY-group value.

Specifying a Missing Value

Use a period character (.) to specify a missing numeric or date value. Use empty quotes (") to specify a missing string value.
Reference: Aggregations for Measures

The aggregation that is assigned to a measure determines how its values are summarized in an object. For example, in a bar chart of Sales by Quarter, each bar represents the aggregated values of the Sales measure for a specific quarter. If the aggregation for Sales is Sum, then the bars represent the sum (total) of sales for each quarter. If the aggregation for Sales is Average, then the bars represent the average sales for each quarter.

Note: Some aggregation types can override the data format that is used to display values in a visualization or object. For example, if a measure has the Currency format with zero decimal places of precision, and you apply the Variance aggregation, then the values are displayed using the Comma format with two decimal places of precision instead.

You can specify the following aggregations for your measures:

**Sum**
- calculates the sum (total) of the values of a measure.

**Average**
- calculates the average (mean) value of a measure.

**Standard Deviation**
- calculates the standard deviation of a measure.

**Standard Error**
- calculates the standard error of the mean of a measure.

**Variance**
- calculates the variance of a measure.

**Count**
- calculates the total number of nonmissing values of a measure.

**Number Missing**
- calculates the number of missing values in a measure.

**Minimum**
- calculates the smallest value of a measure.

**First Quartile**
- calculates the first quartile of a measure.

**Median**
- calculates the median value of a measure.

**Third Quartile**
- calculates the third quartile of a measure.

**Maximum**
- calculates the largest value of a measure.

**Skewness**
- calculates the skewness of a measure. Skewness indicates the distribution of values. A positive value indicates that the distribution is heavier for values greater than the mean. A negative value indicates that the distribution is heavier for values less than the mean.

**Kurtosis**
- calculates the kurtosis of a measure. The kurtosis value indicates how peaked the distribution is. A larger value indicates a more sharply peaked distribution. A smaller value indicates a flatter distribution.
Coefficient of Variation

calculates the coefficient of variation of a measure. The coefficient of variation is the ratio of the standard deviation to the mean.

Uncorrected Sum of Squares

calculates the uncorrected sum of squares of a measure. The uncorrected sum of squares is the sum of the squared values.

Corrected Sum of Squares

calculates the corrected sum of squares of a measure. The corrected sum of squares is the sum of the squared deviations from the mean.

T-statistic (for Average = 0)

calculates the Student’s t statistic for a measure, assuming a mean value of zero.

P-value (for T-statistic)

calculates the probability of observing the t statistic value or a more extreme value. A small value indicates that the mean is likely not equal to zero.

---

Reference: Operators for Data Expressions

Overview of Operators for Data Expressions

In SAS Visual Analytics, you can calculate data items and create filters by using expressions that contain operators.

Numeric (Simple) Operators

-x
returns a value with the opposite sign of the input value.

For example, --1 returns 1 and -1 returns -1.

-x
subtracts the second value from the first value.

For example, 2 – 1 returns 1.

x * y
multiplies the first and second values together.

For example, 2 * 3 returns 6.

x / y
divides the first value by the second value.

For example, 6 / 2 returns 3.

x + y
adds the first and second values together.

For example, 1 + 2 returns 3.

Comparison Operators

BetweenExclusive
returns true if the first value is within the range defined by the second and third values (excluding the bounding values).
For example, \( X \text{ BetweenExclusive}(50, 100) \) returns true if \( X \) is greater than 50 and less than 100.

BetweenInclusive returns true if the first value is within the range defined by the second and third values (including the bounding values).

For example, \( X \text{ BetweenInclusive}(50, 100) \) returns true if \( X \) is greater than or equal to 50 and less than or equal to 100.

In returns true if the first value is in the list specified by the second parameter. Select your list by choosing the values from the drop-down list or the selector window.

For example, \( X \text{ In ('A', 'B', 'C')} \) returns true when the value of \( X \) is either A, B, or C.

Note: This operator cannot be used to compare measures.

IsSet returns true if the specified parameter has a value.

For example, \( 'MyParameter'\text{p IsSet} \) returns true if the parameter MyParameter has a value.

Missing returns true if the value is a missing value.

For example, \( X \text{ Missing} \) returns true if the value of \( X \) is missing.

NotBetweenExclusive returns true if the first value is outside the range defined by the second and third values (excluding the bounding values).

For example, \( X \text{ NotBetweenExclusive}(50, 100) \) returns true if \( X \) is less than 50 or greater than 100.

Note: The NotBetweenExclusive operator has the same effect as \( \text{Not (BetweenInclusive)} \).

NotBetweenInclusive returns true if the first value is outside the range defined by the second and third values (including the bounding values).

For example, \( X \text{ NotBetweenInclusive}(50, 100) \) returns true if \( X \) is less than or equal to 50 or greater than or equal to 100.

Note: The NotBetweenInclusive operator has the same effect as \( \text{Not (BetweenExclusive)} \).

NotIn returns true if the first value is not in the list specified by the second parameter. Select your list by choosing the values from the drop-down list or the selector window.

For example, \( X \text{ NotIn ('A', 'B', 'C')} \) returns true when the value of \( X \) is not A, B, or C.

Note: This operator cannot be used to compare measures.

NotMissing returns true if the value is not a missing value.

For example, \( X \text{ NotMissing} \) returns true if the value of \( X \) is not missing.

\( x < y \) returns true if the first value is less than the second value.

\( x <= y \) returns true if the first value is less than or equal to the second value.

\( x <> y \) returns true if the first value is not equal to the second value.

\( x = y \) returns true if the first value is equal to the second value.
\( x > y \)
returns true if the first value is greater than the second value.

\( x \geq y \)
returns true if the first value is greater than or equal to the second value.

**Boolean Operators**

**AND**

joins two conditions and returns true if both conditions are true.

For example, \((1 = 1) \text{ AND } (2 = 2)\) returns true, and \((1 = 1) \text{ AND } (2 = 1)\) returns false.

**IF... ELSE**

returns different values, depending on whether the condition is true. The first parameter specifies the condition. The second parameter specifies the value to return if the condition is true. The third parameter specifies the value to return if the condition is false.

For example, \(\text{if } (X > Y) \text{ return } X \text{ else } Y\) returns the value of \(X\) if \(X\) is greater than \(Y\), but returns the value of \(Y\) otherwise.

**Note:** The IF... ELSE operator can also be used in report filters.

**NOT**

returns true if the condition is false.

For example, \(\text{not } (1 = 2)\) returns true.

**OR**

joins two conditions and returns true if either condition is true.

For example, \((1 = 1) \text{ OR } (2 = 2)\) returns true, and \((1 = 1) \text{ OR } (2 = 1)\) returns true.

**Numeric (Advanced) Operators**

**Abs**

returns the absolute value of the input value.

For example, \(\text{Abs}(-3)\) returns 3.

**Ceil**

rounds the input value up to the nearest integer.

For example, \(\text{Ceil}(4.2)\) returns 5 and \(\text{Ceil}(-4.8)\) returns -4.

**Exp**

raises the constant \(e\) to the power specified by the input value.

For example, \(\text{Exp}(5)\) returns \(e\) to the 5th power (148.41).

**Floor**

rounds the input value down to the nearest integer.

For example, \(\text{Floor}(4.8)\) returns 4 and \(\text{Floor}(-4.2)\) returns -5.

**Ln**

returns the natural logarithm (base \(e\)) of the input value.

For example, \(\text{Ln}(10)\) returns the \(e\)th root of 10 (2.30...).

**Log**

returns the logarithm of the first value, where the second value specifies the base.

For example, \(64 \text{ Log } 8\) returns the base 8 logarithm of 64 (2).
Mod
returns the remainder after dividing the first value by the second value.
For example, 5 Mod 2 returns 1.

Power
raises the first value to the power of the second value.
For example, 5 Power 2 returns 5 to the 2nd power (25).

Root
returns the $n$th root of the first value, where the second value specifies $n$ (the base of the root).
For example, 27 Root 3 returns the third (cube) root of 27 (3).

Round
rounds the first value to the number of decimal places that is specified by the second value. Select the second value from the drop-down list.
For example, 7.354 Round 2 returns 7.35.

Note: If you select 0 decimal places, then the values are rounded to the nearest integer.

TreatAs
allows a numeric, date, or datetime value to be used as a different data type within other operators. Select one of the following:

_Date_
allows the value to be used as a date.

_Datetime_
allows the value to be used as a datetime value.

_Number_
allows the value to be used as a number.

The value is treated as a raw value instead of being converted. Date values are the number of days since 01JAN1960. Datetime values are the number of seconds since 01JAN1960.
For example, TreatAs(_Date_, 19600) returns 30AUG2013 as a date value.

Note: The TreatAs operator is useful for calculating elapsed time between two datetime values. For example, (TreatAs(_Number_, '23OCT2013'd) — TreatAs(_Number_, '15JAN2013'd)) calculates the number of days between 15JAN and 23OCT, which is 281.

Trunc
truncates the input value to an integer.
For example, Trunc(8.9) returns 8 and Trunc(-8.9) returns -8.

**Date and Time Operators**

Note: Date and time operators are not supported for aggregated items.

DateFromMDY
creates a date value from separate month, day, and year values. The first value specifies the month as a number from 1–12. The second value specifies the day as a number from 1–31. The third value specifies the year as a four-digit number.
For example, DateFromMDY(1, 15, 2013) returns 15JAN2013.

DateFromYQ
creates a date value from separate year and quarter values. The first value specifies the year as a four-digit number. The second value specifies the quarter as a number from 1–4.
For example, DateFromYQ(2013, 1) returns 01JAN2013.
Note: The date is generated using the first day of each quarter.

**DatePart**
converts a datetime value to a date value.

For example, `DatePart('15JAN2013_17:15'dt) returns 15JAN2013.`

**DateTimeFromDateHMS**
creates a datetime value from a date value and separate hour, minute, and second values. The first value specifies the date. The second value specifies the hour as a number from 0–23. The third value specifies the minute as a number from 0–59. The fourth value specifies the second as a number from 0–59.

For example, `DateTimeFromDateHMS('15JAN2013'd, 17, 15, 23) returns January 15, 2013 05:15:23 PM`

**DateTimeFromTimeMDY**
creates a datetime value from a time value and separate month, day, and year values. The first value specifies the time. The second value specifies the month as a number from 1–12. The third value specifies the day as a number from 1–31. The fourth value specifies the year as a four-digit number.

For example, `DateTimeFromTimeMDY('01JAN1960_17:15:23'dt, 1, 15, 2013) returns January 15, 2013 05:15:23 PM.`

**TIP** You can use the TimePart or TimeFromHMS operators to create a time value for the first parameter.

**DayOfMonth**
returns the day of the month from a date value as a number from 1–31.

For example, `DayOfMonth('15JAN2013'd) returns 15`.

**DayOfWeek**
returns the day of the week from a date value as a number from 1–7 (1 is Sunday).

For example, `DayOfWeek('15JAN2013'd) returns 3 (Tuesday)`.

**DayOfYear**
returns the day of the year from a date value as a number from 1–366.

For example, `DayOfYear('15FEB2013'd) returns 46`.

**Hour**
returns the hour from a datetime value as a number from 0–23.

For example, `Hour('15JAN2013_17:15:23'dt) returns 17`.

**Minute**
returns the minute from a datetime value as a number from 0–59.

For example, `Minute('15JAN2013_17:15:23'dt) returns 15`.

**Month**
returns the month from a date value as a number from 1–12.

For example, `Month('15JAN2013'd) returns 1`.

**Now**
creates a datetime value from the current date and time.

For example, `Now() returns the current date and time.`

**Quarter**
returns the quarter from a date value as a number from 1–4.

For example, `Quarter('15AUG2013'd) returns 3`. 
Second returns the second from a datetime value as a number from 0–59.

For example, `Second('15JAN2013_17:15:23'dt)` returns 23.

TimeFromHMS creates a time value from separate hour, minute, and second values. The first value specifies the hour as a number from 0–23. The second value specifies the minute as a number from 0–59. The third value specifies the second as a number from 0–59.

For example, `TimeFromHMS(17, 15, 23)` returns January 1, 1960 05:15:23 PM.

Note: Time values are expressed as datetime values where the date is January 1, 1960.

**TIP** You can use the Time format to hide the date portion of a datetime value.

TimePart converts a datetime value to a time value.

For example, `TimePart('15JAN2013_17:15:23'dt)` returns January 1, 1960 05:15:23 PM.

Note: Time values are expressed as datetime values where the date is January 1, 1960.

**TIP** You can use the Time format to hide the date portion of a datetime value.

WeekNumber returns the week of the year as a number from 0–53, where week 1 begins on the first Sunday of the year. Dates before the first Sunday of the year return 0.

For example, `WeekNumber('04AUG2013'd)` returns 31.

Year returns the year from a date value as a four-digit number.

For example, `Year('15JAN2013'd)` returns 2013.

**Text (Simple) Operators**

Note: All text operators are case sensitive.

Note: Text operators are not supported for aggregated items.

Concatenate appends the second input string to the first input string.

For example, `Concatenate('A', 'B')` returns `AB`.

Contains specifies that a matching value must contain the specified string.

For example, `'Catcher' Contains 'Cat'` returns `true`.

EndsWith specifies that a matching value must contain the specified string at the end of the value.

For example, `'Catcher' EndsWith 'her'` returns `true`.

Format applies a SAS format to the input value. Click the format field to select the format that you want to apply. The output from the Format operator is a string.

For example, `Format(1015.35, 'DOLLAR6.2')` returns `$1,015.35` as a string value.
Note: Standard date formats in SAS Visual Analytics display date and datetime values in the locale of your browser. You can display date and datetime values in the locale of the data source by using national language formats. The names of national language formats begin with "NL." For example, the NLDATETIME format displays date values by using the locale of the data source.

LowerCase
changes all of the characters in a text string to lowercase.

For example, LowerCase('SAS INSTITUTE') returns sas institute.

NotContains
specifies that a matching value must not contain the specified string.

For example, 'Catcher' NotContains 'Dog' returns true.

Parse
interprets a numeric or datetime value from the input string. Click the format field to select the format that is used to interpret the string. The output from the Parse operator is either a number or a datetime value, depending on the format that you select.

For example, Parse('15JAN2013', 'DATE9.') returns 15JAN2013 as a date value.

StartsWith
specifies that a matching value must contain the specified string at the start of the value.

For example, 'Catcher' StartsWith 'Cat' returns true.

UpCase
changes all of the characters in the text string to uppercase.

For example, UpCase('sas institute') returns SAS INSTITUTE.

Text (Advanced) Operators

Note: All text operators are case sensitive.

Note: Text operators are not supported for aggregated items.

FindChar
finds the position of a character or any of a set of characters within a text string. The position of the first match is returned as a numeric value. If no matches are found, then 0 is returned. The first input string specifies the value to search within. The second input string specifies the list of characters to search for.

For example, FindChar('mystring', 'sz') returns 3.

FindString
finds the position of a string within another string. The position of the first match is returned as a numeric value. If no matches are found, then 0 is returned. The first input string specifies the value to search within. The second input string specifies the string to search for.

For example, FindString('mystring', 'st') returns 3.

GetLength
returns the length of an input string as a numeric value.

For example, GetLength('mystring') returns 8.

GetWord
returns a word from an input string where the words are separated by spaces, periods, or other special characters. The first parameter specifies the input string. The second parameter specifies the number of the word to return where 1 is the first word.

For example, GetWord('my test string', 2) returns test.
Note: In addition to spaces, the following characters are used as delimiters in the input string: . < ( ) + & ! $ *; ^ / , % | '

RemoveBlanks
removes space characters from the input string. The first parameter specifies the input string. The second
parameter specifies which space characters to remove. Select one of the following:

_All_
removes all spaces from the string.

_Leading_
removes spaces at the beginning of the string.

_LeadingAndTrailing_
removes spaces at the beginning and end of the string.

_Trailing_
removes spaces at the end of the string.

For example, RemoveBlanks('my test string', '_ALL_') returns myteststring.

RemoveChars
removes all instances of a set of characters from the input string. The first parameter specifies the input
string. The second parameter specifies the list of characters to remove.

For example, RemoveChars('my_test_string', '_') returns myteststring.

RemoveWord
removes a word from an input string where the words are separated by spaces or special characters. The
first parameter specifies the input string. The second parameter specifies the number of the word to remove
where 1 is the first word.

For example, RemoveWord('my test string', 2) returns my string.

Note: In addition to spaces, the following characters are used as delimiters in the input string: . < ( ) + & ! $ *; ^ / , % | '

Replace
replaces a substring within the input string with a replacement string. The first parameter specifies the input
string. The second parameter specifies the substring to replace. The third parameter specifies the
replacement string. The fourth parameter specifies which instances of the substring to replace. Select one of
the following:

_ALL_
replaces every instance.

_FIRST_
replaces the first instance only.

_LAST_
replaces the last instance only.

For example, Replace('my test string test', 'test', 'new', '_ALL_') returns my new string new.

ReplaceWord
replaces a word from an input string where the words are separated by spaces, periods, or other special
characters. The first parameter specifies the input string. The second parameter specifies the number of the
word to replace where 1 is the first word. The third parameter specifies the replacement string.

For example, ReplaceWord('my test string', 2, 'new') returns my new string.

Note: In addition to spaces, the following characters are used as delimiters in the input string: . < ( ) + & ! $ *; ^ / , % | '
Reverse
reverses the order of the characters in the input string.
For example, Reverse('A B C') returns C B A.

Substring
returns a substring from the input string based on the position of the characters. The first parameter specifies
the input string. The second parameter specifies the position of the first character to return. The third
parameter specifies the number of characters to return.
For example, Substring('my test string', 4, 3) returns tes.

Update
replaces a substring from the input string based on the position of the characters. The first parameter
specifies the input string. The second parameter specifies the position of the first character to replace. The
third parameter specifies the number of characters to replace. The fourth parameter specifies the
replacement string.
For example, Update('my test string', 4, 3, 'nex') returns my next string.

URLDecode
removes URL encoding from the input string. URL encoding replaces some characters with a % character
followed by a two-digit hexadecimal code.
For example, URLDecode('support.sas.com%2Fmy%20string') returns support.sas.com/my
string.

URLEncode
applies URL encoding to the input string. URL encoding replaces some characters with a % character
followed by a two-digit hexadecimal code.
For example, URLEncode('support.sas.com/my string') returns support.sas.com%2Fmy
%20string.

**Aggregated (Simple) Operators**

Avg
calculates the average (mean) value of a measure.

Count
calculates the total number of nonmissing values of a measure or a category.

Distinct
calculates the number of distinct values in a data item. By default, if the data item contains missing values,
then “missing” increases the distinct count by one. This behavior can be changed by an administrator.

Max
calculates the largest value of a measure.

Median
calculates the median value of a measure.

Min
calculates the smallest value of a measure.

NumMiss
calculates the number of missing values in a data item.

Q1
calculates the first quartile of a measure.

Q3
calculates the third quartile of a measure.
StdDev
  calculates the standard deviation of a measure.

StdErr
  calculates the standard error of the mean of a measure.

Sum
  calculates the sum (total) of the values of a measure.

Var
  calculates the variance of a measure.

### Aggregated (Periodic) Operators

**About Periodic Operators**

Periodic operators aggregate values over a period of time.

If you assign a periodic aggregated item to an object that contains dates, the aggregated item displays the aggregated values for each time period in the object.

In an object that does not contain dates, the aggregated item displays values that use today's date as a reference. If the date data item for the operator does not contain data for the interval that contains today's date, then the operator returns missing values.

Periodic operators are evaluated using time intervals. Intervals specify whether the aggregation is applied on a monthly basis, a quarterly basis, and so on. You can specify a specific interval, or you can specify that the interval is inferred. For an inferred interval, the aggregation is evaluated based on its context in the object. For example, if your report contains a bar chart of sales by month, then the inferred interval is monthly.

**TIP** Periodic operators support weekly and daily intervals.

**Note:** Periodic operators return a missing value in the following scenarios:

- Data does not exist for the specified time period.
- The date data item for the period calculation does not match the date data item in the object. You must use the same date data item or a duplicate data item that is based on the same data item.
- The interval for the operator is smaller than the interval of the date format in the object (for example, if your interval is by month, but the date format is Year).
- For operators that use inner and outer intervals, the inner interval is larger than the outer interval.
- The inferred interval is by an interval smaller than a day.
- If a rank is applied to the data, the All Other value for that rank is missing for any aggregated item that includes a periodic operator.

The following periodic operators are available:

*Table 7  Periodic Operators*

<table>
<thead>
<tr>
<th>Periodic Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CumulativePeriod</td>
<td>returns the aggregated value for a period of time and all of the previous periods of time within a larger period of time (for example, the year-to-date total of monthly values).</td>
</tr>
<tr>
<td>ParallelPeriod</td>
<td>returns the aggregated value for a period of time that is parallel to the current period of time (for example, the value for the same month of the previous year).</td>
</tr>
</tbody>
</table>
Period returns the aggregated value for a period of time (for example, the value for the current month).

PeriodWithDate returns the aggregated value for a specific, constant period of time (for example, the value for the month that includes 15OCT2013).

RelativePeriod returns the aggregated value for a period of time that is relative to the current period (for example, the value for the previous month of the same year).

## Intervals for Periodic Operators

You can select the following intervals for periodic operators:

- **_ByDay_** specifies a daily interval.
- **_ByMonth_** specifies a monthly interval.
- **_ByQuarter_** specifies a quarterly interval.
- **_ByWeek_** specifies a weekly interval.
- **_ByYear_** specifies a yearly interval.
- **_Inferred_** specifies that the interval is determined automatically from the object that displays the aggregated item.

## CumulativePeriod

The CumulativePeriod operator returns aggregated values for a period of time and all of the previous periods within a larger period of time (for example, the year-to-date total of monthly values).

**TIP** You can specify the starting point for the outer period to calculate year-to-date based on fiscal year and other intervals that are offset from the standard calendar.

Specify the following parameters:
Figure 2  Parameters for the CumulativePeriod Operator

1. The aggregation that is applied to the measure.
2. The measure to aggregate over time.
3. Which time filters should be applied before processing the aggregated measure. Select one of the following:
   - _ApplyAllFilters_ applies all filters before processing the aggregated measure.
   - _IgnoreAllTimeFrameFilters_ ignores all filters that are based on the same date data item as the periodic operator.
   - _IgnoreInteractiveTimeFrameFilters_ ignores all interactive filters (from prompts and actions) that are based on the same date data item as the periodic operator.
4. The date data item for the period calculation. Only data items whose formats specify year are available.
5. The inner interval (smaller time period) for which the values are aggregated. For example, specify _ByMonth_ as the inner interval and _ByYear_ as the outer interval to aggregate the year-to-date values for each month.
   For details about the intervals that you can select, “Intervals for Periodic Operators” on page 95.
6. The outer interval (larger time period) that provides the context for the cumulative aggregation. For example, specify _ByMonth_ as the inner interval and _ByYear_ as the outer interval to aggregate the year-to-date values for each month.
   For details about the intervals that you can select, “Intervals for Periodic Operators” on page 95.
The number of outer intervals to offset from the current period. 0 specifies that the period from the current outer interval is used. A negative value indicates a previous interval.

For example, if your inner interval is by month and your outer interval is by year, then -1 specifies the year-to-date monthly values for the previous year.

The starting point for each new outer period. For example, if your inner interval is by month and your outer interval is by year, then 3 specifies that each year begins in the third month.

Note: If the outer interval is inferred or by year, then the value must be an interval between 1 and 12. If the outer interval is by quarter, then the value must be an interval between 1 and 4.

The scope for the period. The scope specifies how much of each period is aggregated.

Select one of the following:

- **_Full_**  
  aggregates the values for the entire period.

- **_ToDate_**  
  aggregates only the values up to a specific day of the outer interval.

- **_ToToday_**  
  aggregates only the values up to the equivalent of today's position in the outer interval. For example, if the outer interval is by quarter and today is the 40th day of the quarter, then only the values up to the 40th day of each quarter are used.

  The value for today is evaluated dynamically whenever the aggregated item is viewed in an object.

If you select _ToDate_ as the scope, then select the date that is used to subset each period.

Note: The year part of the selected date is not used.

For example, if you select 09NOV2013, and the outer interval is by year, then only the values up to November 9 of each year are used in the aggregation.

For example, `CumulativePeriod(_Sum_, 'Expenses'n, _ApplyAllFilters_, 'Date'n, _ByMonth_, _ByYear_, 0, 1, _Full_)` aggregates the sum of year-to-date monthly values for the Expenses measure using date values from the Date data item. Each year begins at the first month of the year.

**ParallelPeriod**

The ParallelPeriod operator returns aggregated values for a period of time that is parallel to the current period (for example, the value for the same month of the previous year).

Specify the following parameters:
Figure 3  Parameters for the ParallelPeriod Operator

1. The aggregation that is applied to the measure.
2. The measure to aggregate over time.
3. Which time filters should be applied before processing the aggregated measure. Select one of the following:
   - _ApplyAllFilters_  
     applies all filters before processing the aggregated measure.
   - _IgnoreAllTimeFrameFilters_  
     ignores all filters that are based on the same date data item as the periodic operator.
   - _IgnoreInteractiveTimeFrameFilters_  
     ignores all interactive filters (from prompts and actions) that are based on the same date data item as the periodic operator.
4. The date data item for the period calculation. Only data items whose formats specify year are available.
5. The inner interval (smaller time period) for which the values are aggregated. For example, specify _ByMonth_ as the inner interval to aggregate the values for each month.
   For details about the intervals that you can select, “Intervals for Periodic Operators” on page 95.
6. The outer interval (larger time period) that provides the context for the parallel period aggregation. For example, specify _ByMonth_ as the inner interval and _ByYear_ as the outer interval to aggregate the monthly values for a different year.
   For details about the intervals that you can select, “Intervals for Periodic Operators” on page 95.
7. The number of outer intervals to offset from the current period. 0 specifies that the period from the current outer interval is used. A negative value indicates a previous interval.
   For example, if your inner interval is by month and your outer interval is by year, then -1 specifies the corresponding monthly values for the previous year.
The scope for the period. The scope specifies how much of each period is aggregated.

Select one of the following:

- **_Full_**
  - aggregates the values for the entire period.

- **_ToDate_**
  - aggregates only the values up to a specific day of the outer interval.

- **_ToToday_**
  - aggregates only the values up to the equivalent of today’s position in the outer interval. For example, if the outer interval is by quarter and today is the 40th day of the quarter, then only the values up to the 40th day of each quarter are used.

  The value for today is evaluated dynamically whenever the aggregated item is viewed in an object.

If you select **_ToDate_** as the scope, then select the date that is used to subset each period.

**Note:** The year part of the selected date is not used.

For example, if you select 09NOV2013, and the outer interval is by year, then only the values up to November 9 of each year are used in the aggregation.

For example, `ParallelPeriod(_Sum_, 'Expenses'n, _ApplyAllFilters_, 'Date'n, _ByMonth_, _ByYear_, -1, _Full_)` aggregates the sum of monthly values for the Expenses measure for the previous year using date values from the Date data item.

**Period**

The Period operator returns aggregated values for a period of time (for example, the value for the current month).

Specify the following parameters:

**Figure 4  Parameters for the Period Operator**

1. The aggregation that is applied to the measure.
2. The measure to aggregate over time.
3. Which time filters should be applied before processing the aggregated measure. Select one of the following:
   - **_ApplyAllFilters_**
     - applies all filters before processing the aggregated measure.
   - **_IgnoreAllTimeFrameFilters_**
     - ignores all filters that are based on the same date data item as the periodic operator.
_IgnoreInteractiveTimeFrameFilters_
ignores all interactive filters (from prompts and actions) that are based on the same date data item as the periodic operator.

4 The date data item for the period calculation. Only data items whose formats specify year are available.

5 The interval for which the values are aggregated. For example, specify _ByMonth_ as the interval to aggregate the values for each month.

For details about the intervals that you can select, "Intervals for Periodic Operators” on page 95.

For example, Period(_Sum_, 'Expenses'n, _ApplyAllFilters_, 'Date'n, _ByMonth_) aggregates the sum of monthly values for the Expenses measure using date values from the Date data item.

**PeriodWithDate**
The PeriodWithDate operator returns aggregated values for a specific, constant period of time (for example, the value for the month that includes 15OCT2013).

Specify the following parameters:

**Figure 5 Parameters for the PeriodWithDate Operator**

1 The aggregation that is applied to the measure.

2 The measure to aggregate over time.

3 Which time filters should be applied before processing the aggregated measure. Select one of the following:
   - _ApplyAllFilters_ applies all filters before processing the aggregated measure.
   - _IgnoreAllTimeFrameFilters_ ignores all filters that are based on the same date data item as the periodic operator.
   - _IgnoreInteractiveTimeFrameFilters_ ignores all interactive filters (from prompts and actions) that are based on the same date data item as the periodic operator.

4 The date data item for the period calculation. Only data items whose formats specify year are available.

5 The interval for which the values are aggregated. For example, specify _ByMonth_ as the interval to aggregate the values for each month.
For details about the intervals that you can select, “Intervals for Periodic Operators” on page 95.

6 The reference date for the period aggregation.

For example, PeriodWithDate(_Sum_, 'Expenses'n, _ApplyAllFilters_, 'Date'n, _ByMonth_, '15OCT2013'd) aggregates the sum of monthly values for the Expenses measure using date values from the Date data item.

RelativePeriod

The RelativePeriod operator returns aggregated values for a period of time that is relative to the current period (for example, the previous month of the same year).

Specify the following parameters:

Figure 6 Parameters for the RelativePeriod Operator

1 The aggregation that is applied to the measure.

2 The measure to aggregate over time.

3 Which time filters should be applied before processing the aggregated measure. Select one of the following:
   - _ApplyAllFilters_ applies all filters before processing the aggregated measure.
   - _IgnoreAllTimeFrameFilters_ ignores all filters that are based on the same date data item as the periodic operator.
   - _IgnoreInteractiveTimeFrameFilters_ ignores all interactive filters (from prompts and actions) that are based on the same date data item as the periodic operator.

4 The date data item for the period calculation. Only data items whose formats specify year are available.

5 The interval for which the values are aggregated. For example, specify _ByMonth_ as the interval to aggregate the year-to-date values for each month.
For details about the intervals that you can select, “Intervals for Periodic Operators” on page 95.

6 The number of intervals to offset from the current period. 0 specifies that the period from the current interval is used. A negative value indicates a previous interval.

For example, if your interval is by month, then -1 specifies the monthly values for the previous month.

7 The scope for the period. The scope specifies how much of each period is aggregated.

Select one of the following:

- **_Full_**
  - aggregates the values for the entire period.

- **_ToDate_**
  - aggregates only the values up to a specific day of the interval.

- **_ToToday_**
  - aggregates only the values up to the equivalent of today’s position in the outer interval. For example, if the outer interval is by quarter and today is the 40th day of the quarter, then only the values up to the 40th day of each quarter are used.

  The value for today is evaluated dynamically whenever the aggregated item is viewed in an object.

8 If you select _ToDate_ as the scope, then select the date that is used to subset each period.

  **Note:** The year part of the selected date is not used.

  For example, if you select 09NOV2013 and the outer interval is by quarter, then only the values up to the 40th day of each quarter are used in the aggregation.

For example, `RelativePeriod(_Sum_, 'Expenses'n, _ApplyAllFilters_, 'Date'n, _ByMonth_, -1, _Full_)` aggregates the sum of monthly values for the Expenses measure for the previous month using date values from the Date data item.

### Aggregated (Advanced) Operators

**CoefVar**
- calculates the coefficient of variation of a measure. The coefficient of variation is the ratio of the standard deviation to the mean.

**CSS**
- calculates the corrected sum of squares of a measure. The corrected sum of squares is the sum of the squared deviations from the mean.

**First**
- calculates the first value of a measure based on chronological order. The first parameter specifies the measure. The second parameter specifies the sequence data item that is used to determine the chronological order. The sequence data item can be either a date or datetime data item or a numeric data item. The third parameter specifies whether missing values are included. Select _IncludeMissing_ to include missing values or select _ExcludeMissing_ to exclude missing values.

  **Note:** If there are multiple measure values for the first value of the sequence data item, then the minimum measure value is selected.

  **Note:** The First aggregation always calculates measure values by using the sequence data item that you specify. If your object uses a different date or datetime data item, then the results might be misleading to viewers who do not know the expression for the aggregated data item.

**Kurtosis**
- calculates the kurtosis of a measure. The kurtosis value indicates how peaked the distribution is. A larger value indicates a more sharply peaked distribution. A smaller value indicates a flatter distribution.
Last
calculates the last value of a measure based on chronological order. The first parameter specifies the
measure. The second parameter specifies the sequence data item that is used to determine the
chronological order. The sequence data item can be either a date or datetime data item or a numeric data
item. The third parameter specifies whether missing values are included. Select _IncludeMissing_ to include
missing values or select _ExcludeMissing_ to exclude missing values.

**Note:** If there are multiple measure values for the last value of the sequence data item, then the minimum
measure value is selected.

**Note:** The Last aggregation always calculates measure values by using the sequence data item that you
specify. If your object uses a different date or datetime data item, then the results might be misleading to
viewers who do not know the expression for the aggregated data item.

Percentile
calculates the specified percentile of a measure. Specify a number between 0 and 100. For example, 85
specifies the 85th percentile, the value for which 85% of the values are lower.

PvalT
calculates the probability of observing the $t$ statistic value or a more extreme value. A small value indicates
that the mean is likely not equal to zero.

Skewness
calculates the skewness of a measure. Skewness indicates the distribution of values. A positive value
indicates that the distribution is heavier for values greater than the mean. A negative value indicates that the
distribution is heavier for values less than the mean.

Suppress
hides aggregated values if the specified condition is true. Hidden values are displayed as an asterisk (*)
character within crosstabs and other objects. Hidden values are evaluated as normal for the purposes of
calculating totals and subtotals.

Specify a condition and a measure, and then select whether data suppression is applied to complementary
values as needed (withComplement) or not (withoutComplement).

If you select withComplement, additional values might be hidden when a single value is hidden for a group
or subgroup. In this case, the hidden value might otherwise be easily inferred by using totals, subtotals, or
other cell values.

For example, `Suppress(( Count [_ByGroup_] ('Weight'n) BetweenExclusive(0, 5) ),
Sum [_ByGroup_] ('Weight'n), withComplement)` suppresses the value of Weight when the
aggregated value represents fewer than five rows of detail data.

When you use suppressed data, be sure to follow these best practices:
- Never use the unsuppressed version of the data item in your report, even in filters and ranks. Consider
  hiding the unsuppressed version in the Data pane.
- Avoid using suppressed data in any object that is the source or target of a filter action. Filter actions can
  sometimes make it possible to infer the values of suppressed data.
- Avoid assigning hierarchies to objects that contain suppressed data. Expanding or drilling down on a
  hierarchy can make it possible to infer the values of suppressed data.

TStat
calculates the Student’s $t$ statistic for a measure, assuming a mean value of zero.

USS
calculates the uncorrected sum of squares of a measure. The uncorrected sum of squares is the sum of the
squared values.
Aggregated (Tabular) Operators

*AggregateCells*

aggregates the values of a specific set of cells in the detail data table for an object.

Specify the following parameters:

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>Sum</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>default</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>current</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>current</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Table 8  Parameters for the AggregateCells Operator*

1. the aggregation that is applied to the measure.

2. the measure to aggregate.

3. the direction in which the values should be aggregated. Select one of the following:
   - *default* specifies that the direction is selected automatically based on the contents of each object. For example, list tables are always aggregated by column.
   - *column* specifies that the values are aggregated for each column that contains the aggregated measure.
   - *row* specifies that the values are aggregated for each row that contains the aggregated measure.

4. the starting point for the aggregation (that can be an offset from that point). Specify one of the following:
   - *start* specifies the first value in the row or column.
   - *current* specifies the current cell in the row or column.
   - *end* specifies the last value in the row or column.

5. the ending point for the aggregation (that can be an offset from that point). Specify one of the following:
   - *start* specifies the first value in the row or column.
   - *current* specifies the current cell in the row or column.
   - *end* specifies the last value in the row or column.
For example, `AggregateCells(_Sum_, 'Expenses', column, start, 0, current, 0)` creates a running total for the column that the Expenses measure is in. For each cell, it calculates the sum of all the values from the first value to the current value.

**AggregateTable**

performs aggregations on data crossings that are independent of (or changed from) the data in your objects.

Specify the following parameters:

<table>
<thead>
<tr>
<th>1</th>
<th><em>Sum</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td><em>Sum</em></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3</th>
<th>Fixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>number</td>
</tr>
</tbody>
</table>

**Table 9  Parameters for the AggregateTable Operator**

1. the aggregation that is applied to the aggregated item when it is used in an object that displays fewer group-by crossings than the table in your expression.

2. the aggregation that is used in the inner table context.
3. the type of aggregation that is performed. Select one of the following:

**Fixed**
aggregates the values for a specified set of categories (the group-by context). If you select **Fixed**, then the aggregation is independent of the data crossings in your object.

For example, in the following table, the aggregated item Average of MPG by Type has a fixed data crossing of MPG by Type. This enables you to compare the MPG of each car model to the average MPG for its type.

<table>
<thead>
<tr>
<th>Make</th>
<th>Model</th>
<th>Type</th>
<th>MPG (Highway)</th>
<th>Average of MPG by Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acura</td>
<td>3.5L 4dr</td>
<td>Sedan</td>
<td>24</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>3.5L w/navigation 4dr</td>
<td>Sedan</td>
<td>24</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>MDX</td>
<td>SUV</td>
<td>23</td>
<td>21.68</td>
</tr>
<tr>
<td>Honda</td>
<td>NSX coupe 2dr/3dr manual 5</td>
<td>Sports</td>
<td>24</td>
<td>26.65</td>
</tr>
<tr>
<td></td>
<td>RSX Type S 2dr</td>
<td>Sedan</td>
<td>31</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>TL 4dr</td>
<td>Sedan</td>
<td>29</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>TSX 4dr</td>
<td>Sedan</td>
<td>29</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Accord EX 2dr</td>
<td>Sedan</td>
<td>34</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Accord EX V6 2dr</td>
<td>Sedan</td>
<td>30</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Accord LX 2dr</td>
<td>Sedan</td>
<td>34</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Accord LX V6 4dr</td>
<td>Sedan</td>
<td>30</td>
<td>29.97</td>
</tr>
</tbody>
</table>

**Add**
adds one or more categories to the data crossings (group-by context) in your object.

For example, in the following table, the aggregated item Average Revenue per City adds City to the data crossing. Each value contains the average revenue per city within each state.

<table>
<thead>
<tr>
<th>Facility State</th>
<th>Revenue</th>
<th>Average Revenue per City</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>103,126,664</td>
<td>51,563,332.23</td>
</tr>
<tr>
<td>CA</td>
<td>775,723,022</td>
<td>258,574,340.73</td>
</tr>
<tr>
<td>OH</td>
<td>137,899,612</td>
<td>68,949,806.16</td>
</tr>
<tr>
<td>TX</td>
<td>631,247,216</td>
<td>210,415,738.81</td>
</tr>
</tbody>
</table>

**Remove**
removes categories from the data crossings (group-by context) in your object.

For example, if your AggregateTable expression removes the category State from the data crossings in your object, then the values for the aggregated item ignore State in their data crossings.

For example, in the following table, the aggregated item removes Make from the data crossing. This enables you to compare the MPG for each manufacturer to the average MPG for all manufacturers.

<table>
<thead>
<tr>
<th>Type</th>
<th>Make</th>
<th>MPG (Highway)</th>
<th>Average MPG for All Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid</td>
<td>Honda</td>
<td>58.50</td>
<td>56.00</td>
</tr>
<tr>
<td></td>
<td>Toyota</td>
<td>51.00</td>
<td>56.00</td>
</tr>
<tr>
<td></td>
<td>Acura</td>
<td>27.20</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Honda</td>
<td>33.18</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Hyundai</td>
<td>30.70</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Infiniti</td>
<td>25.00</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Kia</td>
<td>29.44</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Lexus</td>
<td>25.17</td>
<td>29.97</td>
</tr>
<tr>
<td>Sedan</td>
<td>Mazda</td>
<td>30.50</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Mitsubishi</td>
<td>29.00</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Nissan</td>
<td>26.56</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Scion</td>
<td>38.00</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Subaru</td>
<td>27.17</td>
<td>29.97</td>
</tr>
<tr>
<td></td>
<td>Suzuki</td>
<td>30.00</td>
<td>29.97</td>
</tr>
</tbody>
</table>
the list of categories that are used to alter the data crossing for the aggregation.

the measure that is aggregated. You can add a Table expression to perform a nested aggregation.

**Note:** If your object contains a hierarchy that is expanded unevenly, then the aggregated values for each level are calculated using only the values at the same level of expansion or greater.

**Table**

Specifies a table aggregation that is nested within an AggregateTable expression.

For details, see the AggregateTable operator.

### Calculating Compound Annual Growth Rate

Compound annual growth rate (CAGR) is an investing and business term for the effective constant year-over-year rate of return that produces a target result value at the end of multiple years, assuming that the CAGR is compounded at the end of each year. For example, you might use CAGR to compare trends over multiple years in revenue or in the number of units sold. For SAS Visual Analytics, you can calculate the yearly CAGR using the expression builder.

This example compares trends in the growth rate for yearly sales amounts between different product types or regions.

The basic data items are:

* sales
  - This is a numeric measure with a currency format and a default aggregation of Sum.

* ProductType
  - This is a string category data item.

* RegionName
  - This is a string category data item.

* TransactionDate
  - This is a date data item with a format of Month, Day, Year (MMDDYYYY).

The duplicate data item is:

* TransactionDateYear
  - This data item is a duplicate of the TransactionDate data item, but with the Year format.

The calculated data items are:

* BeginningYearNum
  - This data item should be a numeric type with a Float4.0 format and an aggregation of Minimum.

    BeginningYearNum = Year('31DEC2010'd)

* EndingYearNum
  - This data item should be a numeric type with a Float4.0 format and an aggregation of Minimum.

    EndingYearNum = Year('transactionDate'n)

The aggregated measure data items are:

* NumYears
  - This data item has a Float4.0 format.

    NumYears = Min [_ByGroup_] ('EndingYearNum'n) - Min [_ByGroup_] ('BeginningYearNum'n)
BeginningValue
This data item needs to be set to the same currency format as the sales data item.
BeginningValue = PeriodWithDate(_Sum_, 'sales', 'transactionDate', _ByYear_, '31DEC2010'd)

EndingValue
This data item needs to be set to the same currency format as the sales data item.
EndingValue = Period(_Sum_, 'sales', 'transactionDate', _ByYear_)

NormalizedRatio
This data item has a Float12.2 format.
NormalizedRatio = 'EndingValue' / 'BeginningValue'

CAGR
This data item has a Percent format.
CAGR = (NormalizedRatio^ (1 / 'NumYears')) - 1

To use the CAGR, you should add TransactionDateYear, CAGR, and any other categories of interest (for example, RegionName, ProductType, and so on) to a list table, a crosstab, or a graph.

Reference: Conditions for Filters

SAS Visual Analytics, filters are based on expressions that contain operators. Conditions enable you to easily add the most common operators to your expression. Depending on the type of data that is used by the filter, you can select from the following categories of filter conditions:

Table 10  Conditions for Character Data

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>=</td>
<td>Specifies that a matching value must match one of the filter values exactly.</td>
</tr>
<tr>
<td>Contains</td>
<td>Specifies that a matching value must contain the filter value.</td>
</tr>
<tr>
<td>EndsWith</td>
<td>Specifies that a matching value must contain the filter value at the end of the value.</td>
</tr>
<tr>
<td>In</td>
<td>Specifies that a matching value is in the list that you select. To select your list, choose the values from the drop-down list.</td>
</tr>
<tr>
<td>Missing</td>
<td>Specifies that a missing value matches the filter.</td>
</tr>
<tr>
<td>NotContains</td>
<td>Specifies that a matching value must not contain the filter value.</td>
</tr>
<tr>
<td>NotIn</td>
<td>Specifies that a matching value is not in the list that you select. To select your list, choose the values from the drop-down list.</td>
</tr>
<tr>
<td>NotMissing</td>
<td>Specifies that a nonmissing value matches the filter.</td>
</tr>
<tr>
<td>StartsWith</td>
<td>Specifies that a matching value must contain the filter value at the start of the value.</td>
</tr>
</tbody>
</table>

Table 11  Conditions for Numeric Data and Date and Time Data

<table>
<thead>
<tr>
<th>Operator</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;&gt;</td>
<td>Specifies that a matching value must not be equal to the filter value.</td>
</tr>
<tr>
<td>Condition</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>=</td>
<td>Specifies that a matching value must be equal to the filter value.</td>
</tr>
<tr>
<td>&lt;</td>
<td>Specifies that a matching value must be less than the filter value.</td>
</tr>
<tr>
<td>&lt;=</td>
<td>Specifies that a matching value must be less than or equal to the filter value.</td>
</tr>
<tr>
<td>&gt;</td>
<td>Specifies that a matching value must be greater than the filter value.</td>
</tr>
<tr>
<td>&gt;=</td>
<td>Specifies that a matching value must be greater than or equal to the filter value.</td>
</tr>
<tr>
<td>BetweenExclusive</td>
<td>Specifies that a matching value must be greater than the first filter value and less than the second filter value.</td>
</tr>
<tr>
<td>BetweenInclusive</td>
<td>Specifies that a matching value must be greater than or equal to the first filter value and less than or equal to the second filter value.</td>
</tr>
<tr>
<td>In</td>
<td>Specifies that a matching value is in the list that you select. To select your list, choose the values from the drop-down list.</td>
</tr>
<tr>
<td>Note:</td>
<td>This condition is not available for continuous numeric data.</td>
</tr>
<tr>
<td>Missing</td>
<td>Specifies that a missing value matches the filter.</td>
</tr>
<tr>
<td>NotBetweenExclusive</td>
<td>Specifies that a matching value must be less than the first filter value or greater than the second filter value.</td>
</tr>
<tr>
<td>NotBetweenInclusive</td>
<td>Specifies that a matching value must be less than or equal to the first filter value or less than or equal to the second filter value.</td>
</tr>
<tr>
<td>NotIn</td>
<td>Specifies that a matching value is not in the list that you select. To select your list, choose the values from the drop-down list.</td>
</tr>
<tr>
<td>Note:</td>
<td>This condition is not available for continuous numeric data.</td>
</tr>
<tr>
<td>NotMissing</td>
<td>Specifies that a nonmissing value matches the filter.</td>
</tr>
</tbody>
</table>

**Table 12  Conditions for Date and Time Data**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last 30 days</td>
<td>Specifies that a matching value is within thirty days of today's date.</td>
</tr>
<tr>
<td>Current month</td>
<td>Specifies that a matching value is within the current month.</td>
</tr>
<tr>
<td>Current year</td>
<td>Specifies that a matching value is within the current year.</td>
</tr>
</tbody>
</table>