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What’s New in the SAS Graphics Accelerator

4.7 (May 2020)

Enhancements for Graph Creation

You can do the following tasks related to graph creation in the accelerator:
- create heat maps
- specify the range of the Y axis
See “Create a Graph” on page 46.

Enhancements for Maps

You can do the following tasks related to maps:
- import Keyhole Markup Language (KML) files.
  KML files are geographic data files from applications such as Google Maps (mymaps.google.com) and Google Earth (earth.google.com/web).
  To import a KML file, from the Laboratory page, activate the Import Table button. For more information, see “Import a Data Table from the File System” on page 36.
  For a free webinar about using the accelerator with Google Maps, see SAS Accessibility Webinars.
- find out where you are in a map.
  When you navigate a map, you can press the forward slash (/) to obtain information about your current whereabouts. If you use a game controller, you can click the right thumbstick. See “Navigation, Pan, and Zoom Commands” on page 25.
- access auditory and visual settings from a game controller.
  If you are using a game controller, you can use the controller buttons to access the settings for options such as speech and sound.
For a list of game controller buttons and their functions, press the H key to access the Help page. See “Configure Auditory and Visual Settings for Maps” on page 27.

- use the metric system for distance units in maps. Press the U key to specify imperial or metric distance units.
- explore table variables and automatically generated maps. On the Table page, activate the column header for the column that you want to explore. For more information, see “Explore Table Variables and Automatically Generated Graphs and Maps” on page 48.

When you open an automatically generated map, the map is displayed in the map view. In the map view, you can specify a variable that provides a label for each point on the map. To do this, press the L key repeatedly until you reach the variable that you want.

---

Enhanced Support for Graphs That Can Be Accelerated

Additional graphs can be accelerated to some extent. The following graph types can be described but cannot be explored using sonification:

- block
- drop line
- ellipse
- fringe
- polygon
- scatter plot matrix
- surface
- text
- vector
- waterfall

For more information about supported graphs, see SAS Graphics Accelerator: Supported Types of Data Visualizations.
What Is the SAS Graphics Accelerator?

The SAS Graphics Accelerator (accelerator) enables users with visual impairments or blindness to create, explore, and share data visualizations such as graphs and geographic maps.

The accelerator provides text descriptions, tabular data, a visualization of a graph, and interactive sonification. Sonification uses non-speech, musical audio to convey important information about a graph, such as the graph's overall shape and specific contours. Data is represented through musical notes and other sounds, enabling you to hear the data points. You can interact with the accelerator by itself or in conjunction with a screen reader such as JAWS or NVDA. Whether you want to quickly grasp the basic shape of the graph or examine the graph in more detail, the accelerator makes the full graph accessible.

The accelerator includes a laboratory in which you can create accessible graphs of your own data. The graphs can be sonified, visualized, and downloaded. You can explore table variables and access automatically generated sample graphs. For more information, see Chapter 6, “Creating Your Own Graphs and Maps,” on page 33.

You can also create geospatial maps of your data. The accelerator supports maps with a single layer of data points that identify items of interest, such as cities, restaurants, other types of buildings, and so on. The maps can be explored using sonification. See Chapter 4, “Exploring Maps Visually and by Sound,” on page 21.
Installing the Accelerator on Your Browser

The accelerator is supported on the Google Chrome browser. You can install the accelerator extension on Chrome from the browser’s Extension page. For an installation link, see SAS Graphics Accelerator on the SAS support site.

Access the Accelerator Menu

You use the accelerator’s menu to access a number of features. For example, you can access the Laboratory and Options pages from the menu.

Complete these steps to access the accelerator’s menu:

1. In the browser toolbar, navigate to the SAS Graphics Accelerator icon (§). The icon is to the right of the website address field.

2. Activate the icon and then select the menu item that you want.

The menu contains the following items:

<table>
<thead>
<tr>
<th>Menu Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extract Tables from This Page</td>
<td>Extracts data from one or more tables that reside on the current web page.</td>
</tr>
<tr>
<td>Laboratory</td>
<td>Displays the Laboratory page. On this page you can import data tables and generate graphs or maps of the data.</td>
</tr>
<tr>
<td>Options</td>
<td>Displays the Options page. On this page you can specify browser-specific options. Options include text color, background color, font size, focus indicator color, and more.</td>
</tr>
<tr>
<td>Resources</td>
<td>Displays the SAS Graphics Accelerator page on the SAS support site. On this page you can find supported browsers, related documentation, sample graphs, and more.</td>
</tr>
<tr>
<td>About</td>
<td>Displays release and legal information about the accelerator.</td>
</tr>
</tbody>
</table>
What Is an Accessible Graph?

An accessible graph is a graph that can be opened and interpreted by the accelerator. To be accessible, a graph must meet the following conditions:

- contain a plot that is one of the supported plot types. For a list of supported plot types, see SAS Graphics Accelerator on the SAS Support site.

For more information about supported plot types, see SAS Graphics Accelerator: Supported Types of Data Visualizations.

Note: The graph can contain only one cell. Multi-cell graphs are not supported.

- contain the SAS information required to be interpreted by the accelerator. The following types of graphs satisfy this requirement:
  - graphs that you create manually within the accelerator’s laboratory.
  - graphs that the accelerator creates automatically as you explore data within the laboratory.
  - graphs that you create in one of the SAS products that create accessible graphs. Graph accessibility must be enabled.
  - graphs that you encounter on the web that have been created to be accessible. For more information, see Creating Accessible SAS Output Using ODS and ODS Graphics.

Get Started Using the Accelerator

Here are the main steps to use the accelerator:

1. Open an accessible graph in a web browser on which the accelerator has been installed.

   **TIP** The accelerator provides sample accessible graphs that you can use to explore the accelerator. See Chapter 2, “Quick Start Example: Exploring a Graph,” on page 7.

The accelerator scans the HTML page when the graph is opened or refreshed in the browser. The accelerator sounds a chime and displays an Accelerate button near the graph.

Note: If you are accessing the graph in one of the SAS products that create accessible graphs, your method of accessing the graph varies with the product. For more information, see the product’s documentation.
Activate the **Accelerate** button. The accelerator opens a new browser tab and displays the graph in the **graph view**. In that view, you can explore a graph visually and through sound.

3 To see the graph, activate **View, download, and share a visualization of this plot-type**. (The text **plot-type** is replaced with the type of plot you are viewing.) The graph is displayed in the **visualization view**. The graph has been optimized for users with low vision. In the visualization view, you can download the graph and share it with others.

When you are finished viewing the graph, use the browser’s back button to return to the graph view.

4 You can also **create graphs for your own data** in the laboratory. The laboratory enables you to import, create, and manage data.

For a complete list of tasks that you can perform, see “**Guide for Using the Accelerator**” on page 4.

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**See Also**

Chapter 2, “Quick Start Example: Exploring a Graph,” on page 7

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**Guide for Using the Accelerator**

The accelerator enables you to explore an accessible graph and an accessible map audibly and visually. You can also work with data tables in the accelerator’s laboratory and create graphs and maps for the data. The following tables list the tasks that you can perform.

**Table 1.1 Exploring Graphs**

<table>
<thead>
<tr>
<th>Goal</th>
<th>Related Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hear and see the graph</td>
<td>Hear the graph and see graph data in the <strong>graph view</strong>. This view also provides the following information:</td>
</tr>
<tr>
<td></td>
<td>a brief description of the graph</td>
</tr>
<tr>
<td></td>
<td>the graph’s data table</td>
</tr>
<tr>
<td></td>
<td><strong>Change auditory settings</strong>.</td>
</tr>
<tr>
<td></td>
<td>See the graph in the <strong>visualization view</strong>.</td>
</tr>
<tr>
<td>Download the graph</td>
<td>From the visualization view, you can <strong>download the graph</strong> as an HTML file and as a PNG image file.</td>
</tr>
<tr>
<td>Save graph data</td>
<td><strong>Save graph data</strong> to the laboratory.</td>
</tr>
<tr>
<td></td>
<td><strong>Download graph data</strong> to your file system.</td>
</tr>
</tbody>
</table>
### Table 1.2 Exploring Maps

<table>
<thead>
<tr>
<th>Goal</th>
<th>Related Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hear and see the map</td>
<td>Hear the map and see map data in the map view.</td>
</tr>
<tr>
<td>Download the map</td>
<td>From the map view, you can download the map as an HTML file.</td>
</tr>
</tbody>
</table>

### Table 1.3 Working with Data Tables in the Laboratory

<table>
<thead>
<tr>
<th>Goal</th>
<th>Related Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add a data table to the laboratory</td>
<td>Import a data table from your file system.</td>
</tr>
<tr>
<td></td>
<td>Manually create a data table in the laboratory.</td>
</tr>
<tr>
<td></td>
<td>While accessing a graph in the graph view, save the graph data to the laboratory.</td>
</tr>
<tr>
<td></td>
<td>Extract data from one or more tables that reside on a web page. After extracting the tables, you can add them to the laboratory.</td>
</tr>
<tr>
<td>Modify a table</td>
<td>Change table properties, such as the table's name.</td>
</tr>
<tr>
<td></td>
<td>Change a column’s properties, including the data type.</td>
</tr>
<tr>
<td></td>
<td>Apply one or more filters to the data.</td>
</tr>
<tr>
<td>Download a table</td>
<td>Download the table in several formats:</td>
</tr>
<tr>
<td></td>
<td>■ comma-separated value (CSV) file</td>
</tr>
<tr>
<td></td>
<td>■ HTML file</td>
</tr>
<tr>
<td></td>
<td>■ SAS program that generates a SAS data set</td>
</tr>
<tr>
<td>Graph or map the table data</td>
<td>Create one or more graphs of your data.</td>
</tr>
<tr>
<td></td>
<td>Access graphs that are created automatically for your data.</td>
</tr>
<tr>
<td></td>
<td>Create one or more maps of your data.</td>
</tr>
<tr>
<td>Explore the data for a table</td>
<td>Explore table variables in detail. You can compare variables using sample graphs that are generated automatically.</td>
</tr>
</tbody>
</table>

### SAS Products That Create Accessible Graphs

Several SAS products can create accessible graphs. For some of these products, a graph accessibility option must be enabled in order to create the accessible graphs.
The accelerator works with the following SAS products:

- **SAS Studio 3.6 or later and SAS University Edition.**
  
  To enable accessible graphs in SAS Studio, in Preferences, select **Enable accessible graph option.**

  **TIP** SAS University Edition has a quick start guide for students with visual impairments.

- SAS Visual Analytics 8.3 or later, SAS Report Viewer 8.2, and SAS Visual Analytics Viewer 7.4 or later (the modern viewer only). With these products, accessibility is enabled for the graph objects that support the accelerator.

  For more information, see the [SAS Visual Analytics Documentation](#) on the SAS Support site.

- **SAS Enterprise Guide 7.13 or later.** See the online Help for information about enabling accessible graphs.
Quick Start Example: Exploring a Graph

About This Example

The accelerator provides text descriptions, tabular data, a visualization of the graph, and interactive sonification. This example walks you through the steps to examine each of those features.

The following image shows the graph to be explored in this example:
The example graph contains a line chart that shows the increase in international air travel over a period of time. Miles traveled are measured in units of a thousand.

Accelerate the Graph for the Example

Make sure that you are using a Chrome web browser on which the accelerator has been installed.

1 To access the samples web page, point your browser to http://support.sas.com/software/products/graphics-accelerator/samples/index.html.

A web page containing sample graphs is displayed.

The accelerator detects the accessible graphs and sounds a chime. Each graph includes an Accelerate button.

2 Navigate to the series plot showing international air travel. If you are using JAWS, you can press the G key repeatedly to move to the plot.

3 In the graph, activate the Accelerate button. The accelerator opens a new browser tab and displays the graph view.
Hear and See the Graph Data

In this step, you explore the graph using musical sound. As you navigate the X axis, the accelerator’s sonification feature represents the corresponding Y values using pitch. High Y values are represented by high-pitch notes, and low Y values are represented by low-pitch notes.

When you access the graph view, the keyboard focus is on the graph, enabling you to immediately begin navigating the graph.

Note: If you are using a screen reader such as JAWS, you must enter Forms Mode before you can interactively explore the graph using keyboard commands.

1. Listen to the shape of the graph as a whole. Press Shift+right arrow to play all data items starting at the current position and moving left to right. You can hear the rise and fall of the pitch, corresponding to the increasing and decreasing Y values. Although the graph contains peaks and valleys, you can hear that overall the data trends upward.

TIP For a list of keyboard commands available for the graph, press H.

2. Now that you have an idea of the graph’s overall trend, explore each data point interactively.

   a. To return to the far left side of the X axis, press Ctrl+left arrow (Option+left arrow on a macOS).

   b. Press the right arrow key to move along the X axis one data point at a time. As you do so, listen to the audio feedback. Also, the data values are displayed on the right side of the screen.

Hear and See a Description of the Graph

In this step, you access descriptive information about the graph. You can use your screen reader to hear a description of the graph. In addition, the graph view has been optimized so that users with low vision can see the description.

The description area is directly beneath the graph that you sonified in the previous step. This area includes the following items:

- (left side of the page) the graph’s title “International Air Travel.”
- a summary of the graph, including the graph’s type, a description of the axes, and the number of data points.
a link that displays a visualization of the graph. The visualization has been optimized for users with low vision. To see the graph, activate View, download, and share a visualization of this series plot, which appears under the Visualization heading. The graph is displayed in the visualization view. In that view, you can download the graph and share it with others.

When you are finished viewing the graph, use the browser’s back button to return to the graph view.

(right side of the page) up to the first 20 rows of the graph data in tabular format.

buttons that enable you to do the following tasks:

- save the graph and data to your laboratory. In the laboratory, you can create your own graphs for the data.

- download the data. The data file is downloaded to your file system. This file can be opened in another application such as Microsoft Excel.

This example provided a quick look at the accelerator and showed how you can use sound to visualize a graph.
Exploring Graphs Visually and by Sound

About Visual and Auditory Exploration

When you open a graph in the accelerator, the graph view is displayed. In the graph view, you can explore a graph audibly and visually. You can also save the graph data to your laboratory and download the data.

The graph view contains the following panes:

- Sonification (top pane)
  Sonification enables you to explore a graph using audio feedback. Data is represented through musical notes and other sounds, enabling you to hear the data points. This feature also provides a visual presentation of the data that has been optimized for users with low vision.

Note: Some graphs can be described but cannot be sonified. In those cases, the sonification pane is not displayed. Only the graph summary and data table are displayed (as described later in this topic).

The sonification pane contains the following three regions:

- The menu bar (top of pane) enables you to configure settings and get help.
  - The Settings menu enables you to adjust the auditory feedback settings. You can use keyboard shortcuts to quickly cycle through those settings.
  - The Help menu displays keyboard commands and other context-sensitive help that is relevant to the type of graph currently being displayed.
Alternatively, when the keyboard focus is on the graph, you can press the H key to display the Help.

- The graph (left side of pane) provides the audio feedback as you navigate the graph. A large cursor tracks the progression through the graph.

You navigate in a graph using the arrow keys and various modifier keys such as Ctrl and Shift. For example, you can press the Shift+right arrow to play all data items starting at the current position and moving left to right.

**TIP**  
For a list of keyboard commands available for the graph, press H.

For more information, see the following topics:
- "What You Hear, and What It Means" on page 13
- “Navigation” on page 14

- The visual details (right side of pane) show the data point values as you move through the graph. This presentation has been optimized for users with low vision.

**Note:** Graphs that have a horizontal orientation, such as a horizontal bar chart, are transformed to vertical for purposes of sonification. This adjustment provides a consistent user experience. Regardless of the graph’s orientation, you can navigate along the X axis using the left or right arrow keys.

For more information about sonification, see “Working with Graph Sonification” on page 13.

**graph summary (lower left pane)**

The graph summary pane contains the following information:

- the type of plot that the graph contains.
- the graph’s title if one has been provided.
- information about the axes, including the label, range, type, scale, and more. For a categorical plot, the categories are listed. If a summary statistic is used in the graph, that information is provided as well.
- summary of the graph layout, such as the number of columns and rows or the number of data points.

You can activate the View, download, and share a visualization of this plot-type link that appears in the pane. The accelerator displays a visualization of the graph that you can explore. The visualization has been optimized for users with low vision. In the visualization view, you can download the graph and share it with others.

The graph summary contains two buttons:

- **Save to Laboratory** saves the graph data to the accelerator’s laboratory.
- **Download Data as CSV** downloads the data as a comma-separated value (CSV) file to your file system.

**data table (lower right pane)**

The **Data** pane displays up to the first 20 rows of the graph data in tabular format.
Save the Graph Data to the Laboratory

When a graph is open in the graph view, you can save the graph’s data to the laboratory.

1. In the graph view, activate the **Save to Laboratory** button.
   Depending on the table’s size, all or part of the table is displayed on the Prepare Table page. To display the full table, activate the **Show Full Table** button at the bottom of the table. You can later restore the partial view by activating the **Show Partial Table** button.

2. On the Prepare Table page, make changes as needed. You can change the table name and specify whether the table has column headers, row headers, or both. (You can change the name and specify row headers after you have saved the data.)

3. When you are satisfied with the information that is on the Prepare Table page, activate the **Save to Laboratory** button. The table is saved to your laboratory. Depending on the table’s size, all or part of the table is displayed on the Table page. On that page, you can change information about the table, such as the table’s name or the data type that is associated with a column.

After you have saved the data, you can create one or more graphs of the data. For more information about working in the laboratory, see Chapter 6, “Creating Your Own Graphs and Maps,” on page 33.

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Working with Graph Sonification

The **graph view** enables you to explore a graph using the keyboard, audio feedback, and a visual presentation that has been optimized for users with low vision.

**What You Hear, and What It Means**

In the **sonification pane of the graph view**, you use arrow and modifier keys such as Ctrl and Shift to **navigate along the X and Y axis**. For some charts, such as computed bar charts, you can navigate along only the categorical X axis.

The X axis is mapped to your left and right speakers. Data points on the left side of the axis are heard with your left speaker, and data points on the right side are heard with your right speaker.

Moving from left to right along the X axis, you can trace the curve and shape of the graph through a series of piano-like, musical notes. Pitch is a key component of sonification and is defined as the degree of highness or lowness of a tone. The accelerator uses other sounds as well.

Here are the sounds that are used by the accelerator:
Y value
musical note that uses pitch to represent changes to the Y value. The pitch increases with an increase in the Y value, and decreases with each decrease in the Y value. This is a very logical and ordered way to hear and visualize the shape of a graph.

Z value
white-noise sound whose frequency increases with an increase in the Z value. The Z value is used in some graphs, such as heat maps and scatter plots, to quantify a third-dimensional value.

missing value
a low thud that sounds like tapping on a wooden table.

end of data
a mid-frequency sound indicates that there are no more data points in the specified direction, or the dimension is not supported in the graph being viewed.

TIP It is recommended that you use headphones to hear these different sounds with greater fidelity.

You can adjust the auditory feedback using the Settings menu. You can use keyboard shortcuts to quickly cycle through those settings.

Navigation

Overview of Navigation

In the sonification pane of the graph view, you navigate in a graph using the arrow keys and various modifier keys such as Ctrl and Shift. The keyboard focus is on the graph when the graph view is displayed. This focus is indicated by a musical note of fixed pitch. If you move the focus to some other area of the screen, you must return focus to the graph area before you can navigate in the graph.

Note: If you are using a screen reader such as JAWS, you must enter Forms Mode before you can interactively explore the graph using keyboard commands.

The combination of keyboard commands and navigation keys was designed for efficiency. You can quickly access the navigation commands by pressing the arrow keys with your right hand and pressing modifier keys if needed with your left hand. Also, you can change auditory settings by pressing the corresponding keyboard shortcuts with your left hand and cycling through the available options while your right hand rests over the arrow keys.

TIP For complete keyboard commands for a graph, press the H key to see the Help page. Some of the commonly used navigation commands are described here.

The keys behave differently depending on whether you are using the explore mode or the scan mode.
Explore Mode versus Scan Mode

You select a navigation mode from the Settings menu. There are two modes for navigating a graph:

Explore
enables you to explore the graph using the arrow keys by themselves or with various modifier keys such as Ctrl and Shift. For example, you might listen to the shape of the graph as a whole or explore each data point interactively.

Explore mode is the default. If you change the mode, then the new mode remains in effect until you change it again.

Scan
enables you to play all items or cells in the corresponding direction from beginning to end without first having to navigate to the starting point. For example, you can repeatedly sonify the graph from left to right without repositioning the cursor.

This feature is useful when you need to hear the overall shape of the graph several times repeatedly. The feature is also useful when the graph contains grouped data. You can play the entire graph for one group, change to a different group, and replay the entire graph using just the arrow key.

Navigation Commands for the Explore Mode

The explore mode is on by default. If you have changed to the scan mode, to access the explore mode, press the V key until the Explore menu item is selected.

Here are the main keyboard commands:

- **spacebar**
  plays the item at the current position.

- **arrow key**
  moves the cursor and plays one item in the corresponding direction.

- **Ctrl+arrow key**
  moves the cursor to the far end of the axis in the corresponding direction.

- **Ctrl+Shift+arrow key**
  moves the cursor one segment of items or cells in the corresponding direction starting at the current position.

- **Shift+arrow key**
  plays all items or cells in the corresponding direction starting at the current position. This navigation feature includes aggregated data played by melody or by chord. In that case, all the melodies or chords are played in the corresponding direction.

  You can interrupt the progression by pressing an arrow key while the sonification is playing. You can then initiate another play in the same or a different direction. If the arrow key that interrupts the progression differs from the original direction, the sonification is interrupted and the cursor moves in the new direction.

  Other keys that interrupt the progression include the Ctrl key and the spacebar.

- **Ctrl**
  cancels a navigation command or pauses the speech.
Note: It is not possible to navigate along the Z axis.

Navigation Commands for the Scan Mode

To access the scan mode, press the V key until the Scan menu item is selected.

Here are the main keyboard commands:

arrow key
  plays all items or cells from beginning to end in the corresponding direction. You can interrupt the progression and change the direction by pressing a different arrow key.

spacebar
  plays the item at the current position.

Ctrl
  cancels a navigation command or pauses the speech.

Navigation for Dendrograms

About Dendrograms

A dendrogram is a diagram that has a tree-like structure of clusters. Clusters represent the hierarchical relationships among data items. The height of the vertical tree stems reflects the distances between clusters and is expressed as Y-axis values.

Figure 3.1 Sample Dendrogram with 15 Nodes

Nodes represent the initial data along the X axis as well as the clusters to which the data belong. The root node is the highest node in the dendrogram tree. The leaf nodes are the lowest nodes and are the data points on the X axis. In the space between the root node and the leaf nodes are the clusters to which the data belong. Nodes are specified as children, siblings, and parents depending on their relationship to each other. A cluster node has two children descending from the node, one on the left and one on the right. The node can have four grandchildren, eight great grandchildren, and so on.
Levels denote the proximity of nodes from the root node. The root node is designated as level zero. Children of the root node are designated as level one, grandchildren of the root node are level two, and so on, until the leaf nodes are reached.

Both horizontal and vertical dendrograms are represented vertically in the graph view. (This orientation is also used for bar charts and box plots.) Although clusters might be represented as bars or points in your graph, clusters are always represented as points in the graph view.

Dendrogram Navigation

Here are the main keyboard commands:

- **spacebar**
  - plays the current node.

- **arrow key**
  - moves the cursor as follows:
    - The up arrow moves the cursor up to the parent node.
    - The down arrow key moves the cursor down to the left child node.
    - The left and right arrows move the cursor to the next sibling in the corresponding direction.

- **Ctrl+arrow key**
  - moves the cursor as follows:
    - The Ctrl+up arrow moves the cursor to the root node (Level 0).
    - The Ctrl+down arrow moves the cursor to the leftmost leaf node.
    - The Ctrl+left or right arrows move the cursor to the farthest sibling in the corresponding direction.

Configure Auditory Settings for Graph Sonification

The **Settings** menu enables you to modify the auditory feedback and interaction of the graph in the **sonification pane of the graph view**. For example, for graphs that contain Z values, you can listen to the Y values or the Z values, or you can listen to both values played together.

**TIP** Keyboard shortcuts enable you to quickly modify settings when keyboard focus is on the graph area. To access the shortcuts, press one of the keys defined in the **Settings** menu. The shortcuts are also listed on the Help page. You can cycle through the values of a specific setting by pressing the shortcut key repeatedly. For example, press the C key to cycle through the available speech settings, press the S key to cycle through the available sound options, and so on. The shortcut keys are indicated in the following list of settings.

The shortcut keys are not case-sensitive. You can use uppercase or lowercase keys.
Speech (C)
controls how much text that your screen reader reads. This text appears in the
lower right corner of the visual display.

Here are the options:

Terse
provides the data values for the X and Y variables. If the graph contains a Z
variable or a group variable, those values are provided as well.

Verbose
provides the data labels and values for the X and Y variables. If the graph
contains a Z variable or a group variable, those labels and values are provided
as well.

Off
The X, Y, and Z values are not displayed.

Sound (S)
controls what you hear. For most graphs, the available options are Off and On.
When you select Off, the sonification is disabled for the graph. You can navigate
in the graph but there is no sound.

Exception: Sound is always enabled when you use the Shift+arrow keys to
sonify the full graph. In addition, sound is always enabled when you sonify the
graph in scan mode.

Some graphs, such as heat maps and scatter plots, contain individual cells or
data points arranged in columns and rows. These graphs have the following
options:

Cell by cell
sonifies each cell individually in a row or column. If you navigate left or right
along the X axis, you hear the cells in the row. If you navigate up or down along
the Y axis, you hear the cells in the column.

Row or column by melody
sonifies the string of data points for each row or column, depending on your
direction of movement. The feature is useful for visualizing the data in a
horizontal or vertical portion of the plot.

Row or column by chord
sonifies the combined data points for each row or column, depending on your
direction of movement. The feature is useful for comparing the aggregated data
between rows or between columns.

Speed (D)
controls the navigation speed, from slowest to fastest. The speed takes effect
when you do either of the following:

- play all items or cells by pressing the Shift+arrow key while in the explore
  mode or an arrow key while in the scan mode
sonify a row or a column by melody or by chord

**TIP** You might begin exploring a graph with the fastest setting to obtain a quick overview of the graph’s shape. Then, to examine the data in more detail, you might use a slower speed when navigating the graph.

Response (R)
sonifies the Y values alone, the Z values alone, or both values played together. This option is available when a graph contains Z values.

Group (G)
sonifies the values for the group that you select. This menu is available when a graph contains grouped data.

With two-dimensional graphs, you can sonify all group values simultaneously. When you select the **All Groups** option, the sound plays the notes for all groups at each X position as a melody or chord, whichever is selected in the **Sound** menu.

Statistic (T)
cycles through statistics.

Plots such as box plots use settings to enable sound for the various statistics that are part of the plot. For example, with box plots you can specify the following statistics: minimum, first quartile, mean, median, third quartile, and maximum. You can play the chord for either the box, the whiskers, the outliers, or the extreme outliers. The chord for the box includes these statistics: minimum, first quartile, median, third quartile, and maximum. Whiskers include both upper and lower whiskers. Outliers include both upper and lower outliers. Extreme outliers include both upper and lower extreme outliers.

Navigation (V)
specifies which navigation mode to use. You can choose either **Explore** or **Scan**.

Get Help
In the **graph view**, the **Help** menu displays keyboard commands and other helpful information. Alternatively, when the keyboard focus is on the graph, you can press H to display the Help. The help information is displayed in a new tab in the browser.

In addition, you can access information about the accelerator on the **SAS Graphics Accelerator** product page on the SAS support site. On the product page, you can find videos, sample graphs, documentation, a blog, and more.

**Working in the Visualization View**

When you open a graph in the accelerator, the graph view is displayed. From that view, you can activate the **View, download, and share a visualization of this plot-type** link to display the graph in the visualization view.

In the visualization view, you can do the following:
- see a visualization of the graph. The visualization has been optimized for users with low vision.
- download the graph to your file system.

Note: Some graphs do not support visualization in the accelerator. In those cases, the link to launch the visualization view is not available.
About Visual and Auditory Exploration of Maps

The accelerator supports visual and auditory access to accessible maps with geospatial data. Geospatial data includes the location of data elements on the surface of the earth. Data elements can be cities, buildings, restaurants, and so on. For example, your data might contain variables such as the type of a real estate property or the current tax value of that property.

When you open an accessible map in the accelerator, the map view is displayed. The map view displays a low-resolution visual representation of the map that is optimized for users with low vision.

In the map view, you can explore the map’s geospatial data from anywhere on Earth. Using the keyboard to move to different points on a map, you explore the map through the auditory and visual feedback that it provides. You can zoom in or out to decrease or increase the map area being explored. You can also move to other parts of the map.
What Is an Accessible Map?

An accessible map is a map that you create in the accelerator. Map creation is a two-step process:

1. **Provide map data to the laboratory.**

   Note: Map data has specific requirements.

2. **Create the map.** You can create a single layer of data points that identify items of interest on the map.

How Map Sonification Works

About the Lens

When you open an accessible map in the map view, the entire map is contained within a circular area called the lens. The lens provides auditory feedback as you encounter data points of interest on the map. Your virtual position is in the geographic center of the lens. That virtual position might align with your actual physical location.

Within the circular lens, the earth’s sphere is flattened onto a two-dimensional plane. Distances between your position and data points of interest are computed as the shortest possible straight route. Bearing values are calculated by the clockwise offset of data points from due north. These can be presented as degrees or as hours, such as three o’clock.

About the Virtual Cane

The lens contains a virtual cane that is represented by a line extending from your position at the center of the lens to the edge of the lens.

If you are blind, you probably learned to navigate the world safely using a long cane. While walking, you might use the cane to feel the ground and detect potential obstacles by moving the cane from side to side as you travel. You can perceive your surroundings in 360 degrees using the cane and your sense of hearing.

Similarly, when you explore a map within the map view, you can perceive your surroundings by moving the virtual cane. As you touch map objects with the virtual cane, the map view provides feedback about the objects using sonification and computer-generated speech. Within the map lens, you can rotate the virtual cane up...
to 360 degrees around the center as you navigate the map. Keyboard commands enable you to rotate the virtual cane clockwise or counter-clockwise. You can also move to a new location to continue your exploration.

The maximum viewable radius of the lens is a fourth of the circumference of the earth (about 6,225 miles). The maximum viewable diameter of the lens is twice that amount. This range enables you to explore an entire hemisphere with one 360-degree sweep of your virtual cane.

Sonification Details

Here are more details about how sonification works:

- As you rotate the virtual cane, the accelerator plays sounds for the objects that the cane detects. Nearby objects are indicated using high pitch. The pitch decrease as an object’s distance from your position increases. For more information, see “What You Hear and What It Means” on page 25.

  Sound is panned between the left and right speakers based on the bearing of the object. Objects to your right (at three o’clock) are played in the right speaker. Objects to your left (at nine o’clock) are played in the left speaker. Objects in front of you at twelve o’clock and behind you at six o’clock are perfectly balanced between the left and right speakers.

- Your default position is in the geographic center of the lens. You can move your position in these ways:
  - move directly to a point on the map. For example, you might move to a coffee shop, a convention center, or a particular town.
  - move to the left, right, up, or down by panning. For example, if you detect a group of stores or buildings of interest, you might pan toward the buildings.
  - return to your original position in the geographic center of the lens.

- You can zoom in or out to decrease or increase the area being explored. The zoom feature enables you to view the entire map or a portion of the map within the lens.

For the keyboard commands that accomplish these actions, see “Navigation, Pan, and Zoom Commands” on page 25.
About the Map View

Figure 4.1  Map View

The map view contains the following items:

- The **lens** (left side of window) is a circular area in which the map resides. The lens contains a **virtual cane** positioned at the center that can rotate up to 360 degrees around the center as you navigate the map. The lens provides the auditory feedback as you encounter data points of interest on the map.

  For more information, see the following topics:
  - “How Map Sonification Works” on page 22
  - “What You Hear and What It Means” on page 25
  - “Navigation, Pan, and Zoom Commands” on page 25
  - “Configure Auditory and Visual Settings for Maps” on page 27

- The visual details (right side of window) show the data point values as you move through the map. This presentation has been optimized for users with low vision.

- The **Download as HTML** button downloads the map as an HTML file to your file system’s download directory. After you have downloaded the map, you can open the HTML file in the browser and accelerate the map using the **Accelerate** button. You can email the HTML file or make the HTML page available in a file location that others can access.

- The **Help** button displays keyboard commands and other help for the map currently being displayed.

**TIP**  Alternatively, when the keyboard focus is on the map, you can press the H key to display the Help.
Map Sonification

What You Hear and What It Means

The relative distance of an object is indicated using pitch (frequency). Nearby objects are indicated using high pitch. The pitch decrease as an object's distance from your position increases.

A specific timbre is used for objects to your north while a different timbre is used for objects to your south. Timbre refers to the tone color or quality. Objects to your south (at six o'clock) have a more metallic tone than objects to your north (at twelve o'clock).

Sound is panned between the left and right speakers based on the bearing of the object. Objects to your right (at three o'clock) are played in the right speaker. Objects to your left (at nine o'clock) are played in the left speaker. Objects in front of you at twelve o'clock and behind you at six o'clock are perfectly balanced between the left and right speakers.

**TIP** It is recommended that you use headphones to hear these different sounds with greater fidelity.

You can adjust the auditory feedback.

Navigation, Pan, and Zoom Commands

Here are the main keyboard commands:

/  
provides information about your current whereabouts (called **where am I** in the online Help).

spacebar  
repeats the sound for the item that has focus.

Page Up, Page Down  
rotates the **virtual cane** to locate and play the next intersecting data item.

- Page Up moves the cane counter-clockwise.
- Page Down moves the cane clockwise.

arrow key  
moves your position one fifth (20%) of the current radius in the corresponding direction. For example, pressing the right arrow moves your position to the east, pressing the up arrow moves you to the north, and so on.
= (equal sign key)
zooms in on the map. This action decreases the area being explored and enables you to focus on a smaller geographic area.

– (hyphen key)
zooms out from the map. This action increases the area being explored.

Enter
moves your position directly to the current object that is highlighted on the map.

0 (zero key)
returns you to your default position in the center of the map. The zero key also returns to the default zoom level in which the entire map is fitted to the lens.

J
enables you to jump to a particular data object on the map. The J key displays a Jump window in which you can search for a data object of interest. By default, the window lists all of the data objects in the map. As you enter characters in the Search text box, the list narrows to those objects that match what you have entered. When you find the data object that you want, select the object in the list and activate the OK button.

TIP  Press the H key to see the Help page, which contains these commands.

As an alternative to keyboard navigation, you can use a game pad controller.

Game Controller Usage and Navigation

If you have a game controller, such as an Xbox controller, you can use the controller to navigate the map view. This device provides an intuitive way for users with visual impairments or blindness to interact with maps.

IMPORTANT  In order to use the game controller, you must connect the game controller to your computer before you launch Google Chrome.
The following figure shows an example game controller:

![Example Game Controller](image)

The example controller has two thumbsticks, a cluster of buttons on the right (face buttons), and a directional pad (D-pad) with four arrows. On the back of the controller (not shown here) near the bottom of the controller are left and right triggers.

Not all game controllers are alike. Your controller might look different from the one pictured here.

In the following list, added a command for the "where am I" feature for defect S1564835.

The following list can help you navigate a map using a game controller:

- The right thumbstick sweeps the virtual cane around your virtual position in any direction within 360 degrees.
- When clicked, the right thumbstick provides information about your current whereabouts (called where am I in the online Help).
- The D-pad moves your position on the map in the direction that corresponds to the activated arrow.
- The right trigger moves your position directly to the current object that is highlighted on the map.

Configure Auditory and Visual Settings for Maps

Shortcut keys enable you to modify the auditory and visual feedback of the map in the map view. For example, press the C key to cycle through the available speech settings. Press the S key to cycle through the available sound options. The shortcut keys are not case-sensitive. You can use uppercase or lowercase keys.

This cycling aspect of the settings is called the settings rotor. If you are using a game controller, use the controller buttons to access and cycle through the settings rotors.

The following list describes the settings and indicates the shortcut key for each setting. The descriptions apply also to game controllers. In addition, game controllers have a settings rotor for the zoom in and zoom out feature.
For a list of game controller buttons that access and cycle through the settings rotors, press the H key to access the Help page.

**Speech (C)**
controls how much text that is displayed and that your screen reader reads.

Here are the options:

Terse
provides the data values for the map variables. For example: *Charlotte, 181 miles at 10 o’clock*

Verbose
provides the data labels and values for the map variables. For example: *Label = Charlotte, Direction = 181 miles at 10 o’clock*

Label
provides only the data labels. For example: *Charlotte*

Off
The map values are not displayed.

**Sound (S)**
controls what you hear. The available options are **Off** and **On**. When you select **Off**, the sonification is disabled for the map. You can navigate in the map but there is no sound.

**Distance units (U)**
controls the unit of measure used for distances.

Here are the options:

Imperial
provides the distance in Imperial units, such as miles.

Metric
provides the distance in metric units, such as kilometers.

**Direction (I)**
provides options for displaying the direction of data points.

Here are the options:

Clock
provides the direction of data items in hours. For example, a city might be located at three o’clock from your position.

Cardinal
provides the direction of data items as points on a compass. For example, a city might be located northeast of your position.

Bearing
provides the direction of data items in degrees.
Download a Graph’s Table Data

When you open a graph in the accelerator, the graph view is displayed. In that view, you can download the data as a comma-separated value (CSV) file.

To download the data, activate the Download Data as CSV button. The button appears beneath the data table. The CSV file is downloaded to your file system’s
download directory. This file can be opened in another application such as Microsoft Excel.

Download a Graph

While accessing a graph in the visualization view, you can download the graph in two formats.

The graph download feature enables you to share the graph with other people. To download the graph, you can activate the following buttons:

- **Download Graph as HTML**. The HTML file is downloaded to your file system’s download directory. After you have downloaded the graph, you can open the HTML file in the browser. You can email the HTML file or make the HTML page available in a file location that others can access.

- **Download Graph as PNG**. The image is downloaded as a Portable Network Graphic (PNG) file to your file system’s download directory. After you have downloaded the graph, you can open the PNG file in a graphics editor. You can also import or copy and paste the image into another application such as Microsoft Word or Microsoft PowerPoint.

The graph’s title is used as the file name for the downloaded HTML or PNG file.

Download a Table in Various Formats

The Table page is displayed when you select the name of an existing table on the Laboratory page. The Table page is also displayed after you save the table for an accelerated graph to the laboratory.

When you view a table on the Table page, you can download the table as described in the following steps:

1. Activate the Download button.

2. From the File type list box, select one of the following items:

   - **Comma-separated values (*.csv)**
     downloads the data as a comma-separated value (CSV) file. The CSV file is downloaded to your file system’s download directory. You can then share the data with others or import the CSV file into your laboratory.

   - **SAS program (*.sas)**
     downloads a SAS program in a SAS file. The program contains a SAS DATA step that, when executed in SAS, generates a SAS data set. The generated data set is added to the WORK library in the current SAS session. The data set maintains the labels and formats that were specified in the laboratory.

   - **Web page (*.html)**
     downloads the table as an HTML file. You can then make the web page available to others. For example, other people might want to extract the data from the HTML page.
3 (Optional) In the **Filename** text box, you can change the file name.

When you download a SAS program file, the file name is used for the name of the data set that the program creates. Changes are made to the data set name if necessary to comply with SAS naming requirements. If you later download and execute the same file using the same file name, the original data set is overwritten.

4 Activate the **Download** button.
About Creating Your Own Graphs and Maps

The accelerator provides a laboratory in which you can create accessible graphs and geographic maps of your own data. These graphs and maps can be visualized, downloaded, and explored in the graph view and map view, respectively.

Here are the main aspects of working with data:
You provide the data tables that you want to use for your graphs and maps. You have several options for providing data.

You can change the table’s properties. You can change the table name and specify whether the table has row headers.

You can change a column’s properties, including the data type.

You can apply one or more filters to the data.

You can explore table variables and access automatically generated sample graphs.

Here are the main aspects of creating graphs and maps:

For each table that you have in the laboratory, you can create one or more graphs or maps. Every graph is associated with a particular data table.

In addition, as mentioned previously, the accelerator can generate sample graphs automatically for exploration.

**IMPORTANT** To create maps, your table must contain geographic data, that is latitude and longitude data. See “Data Requirements for Maps” on page 40.

The graphs can be viewed, described, and sonified in the accelerator. They can be downloaded and shared with others.

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**Note:** The graphing feature enables users with visual impairments to quickly discover insights and relationships within their data. The feature is useful for students and casual users. Users who need to analyze data in an industrial or commercial context should use a fully featured SAS product in conjunction with the accelerator.

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**Access Your Laboratory**

The laboratory is where you can create accessible graphs of your data.

1. **Access the accelerator’s menu.**
2. **Activate the Laboratory menu item.**

The Laboratory page lists any data tables that have been created or imported. The page also lists sample tables that are included with the accelerator.
You can do the following on the Laboratory page:

- activate the link for any table that is listed. Information about the table is displayed on the Table page. From the Table page, you can create one or more graphs of the data.
- delete one or more tables. Activate the Manage Tables button and select the tables that you want to delete. Activate the Delete button when you are ready to delete the selected tables.
- create a new table.
- import a table from your file system.

Providing Data to the Laboratory

Options for Providing Data to Your Laboratory

You have several options for providing data:

- You can import data tables that exist on the file system. If you later change the data for a table, you must re-import that table.
- You can manually create data tables in your laboratory.
- While accessing a graph in the graph view, you can save the graph data to your laboratory.
- You can extract data from tables that reside on web pages. After extracting the table, you can add it to your laboratory.
Import a Data Table from the File System

Types of Data Files That You Can Import

- comma-separated-value (CSV or TXT)
- tab-separated-value (TSV, TXT or TAB)
- Microsoft Excel workbooks (XLSX)

An Excel XLSX file can contain data or objects that the accelerator does not import. For example, review comments and clip art in the Excel file are not imported into the accelerator. The accelerator imports only the displayed cell values, including formulas. In addition, merged cells and header cells are honored.

- Keyhole Markup Language (KML)

KML files are geographic data files used by applications, such as Google Maps (mymaps.google.com) and Google Earth (earth.google.com/web). The accelerator imports the geographic points, which are also called placemarks. The accelerator does not import paths or polygons that the map might contain. Compressed KMZ files are not supported.

Import a Table

Data can be imported from the file system. See "Requirements for the Data Tables That You Import" on page 36.

1. From the Laboratory page, activate the **Import Table** button.

2. Browse for and select the file, and then activate **Open**. You can browse the local file system, mapped network drives, and public folders on a network.

   Depending on the table's size, all or part of the table is displayed on the Prepare Table page. To display the full table, activate the **Show Full Table** button at the bottom of the table. You can later restore the partial view by activating the **Show Partial Table** button.

3. On the Prepare Table page, make changes as needed. You can change the table name and specify whether the table has column headers, row headers, or both.

4. When you are satisfied with the information that is on the Prepare Table page, activate the **Save to Laboratory** button. Depending on the table's size, all or part of the table is displayed on the **Table page**.

   If you later change the data for a table, you must re-import the table. However, you can change table properties and change column properties.

Requirements for the Data Tables That You Import

The following list contains requirements for the table file.
Note: For requirements about the data contained in the table and the valid formats for that data, see “Valid Input Data Types and Formats” on page 49.

- The following file extensions are acceptable: CSV, TSV, TXT, TAB, XLSX, KML
- The table must contain at least two rows.
- The table should have a single row of column headers. This must be the first row in the table. If a table does not have column headers, the accelerator creates headers with generic names, such as VAR1, VAR2, and so on. You can change the labels of the headers that are created.
- The table file can contain comments. However, comments are ignored by the accelerator. Any line that starts with a hash tag (#) is considered a comment. Comments typically reside above or below the rows and columns. Here is an example:

  # Source: http://support.sas.com/training/

Note: Comments in Excel files are not supported.

- The maximum file size for a data table is one megabyte (1 MB).
- The accelerator does not provide any way to prepare or clean the data. The data table must be clean and ready to graph. For example:
  - The table should not contain extraneous comments.
  - A table cannot have empty rows unless the empty rows are at the bottom of the table. Similarly, a table cannot have empty columns unless the empty columns are at the end of the table.

Create a Table Manually

You can create a table in the accelerator and add data to the table. This feature is most useful when you have a relatively small amount of data that does not require updates. If you need more robust data management, you can instead enter the data in a spreadsheet application and then import the data into the laboratory.

Note:

For requirements about the data that can be contained in the table and the valid formats for that data, see “Valid Input Data Types and Formats” on page 49.

1. From the Laboratory page, activate the Create Table button.
2. On the Create Table page, enter the number of columns. The default number is 2.
3. Enter the number of data rows. The default number is 2.
4. Activate the Next button. A table appears with the specified number of columns and rows. The table also contains a header row.
   In addition, Add Column and Add Row buttons appear on the page.
5 Enter the appropriate header in each column of the header row. The header can contain spaces and special characters, such as the underscore and period characters. You can change the headers later.

6 In each subsequent row, enter the data for each column.

7 (Optional) To add a column or row, activate the Add Column or Add Row button. New columns are added to the right of the existing columns, and new rows are added beneath the existing rows.

Enter the data for each new column or row.

8 When you have entered all of your data, activate the Save button. Information about the table is displayed on the Prepare Table page.

9 On the Prepare Table page, enter the table name. You can also specify whether the table has column headers, row headers, or both by selecting the appropriate check box. Column headers are selected by default.

10 When you are satisfied with the information that is on the Prepare Table page, activate the Save to Laboratory button. The table is displayed on the Table page.

If you later want to change the data in the table, you must re-create the table.

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### Extract External Table Data from a Web Page

#### Extract Table Data

You can extract data from one or more tables that reside on a web page. After extracting the table, you can add it to your laboratory.

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**Note:** The table must be accessed using a web browser that is supported and that has the accelerator installed.

---

1 Open the web page that contains the table or tables whose data you want to extract.

2 From the accelerator’s menu, select the Extract Tables from This Page menu item.

The accelerator scans the web page. If the table meets the necessary conditions, the table is extracted and displayed on the Prepare Table page. That page contains information about the table. If you extracted more than one table, all the extracted tables are displayed on the page.

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**TIP** If you are extracting data for a single table, you can bypass the Prepare Table page. See “Expeditied Extraction” on page 39.

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If the accelerator does not detect any tables on the web page, a pop-up box displays a message to that effect.
3 On the Prepare Table page, make changes as needed. You can change the table name and specify whether the table has column headers, row headers, or both.

When a table extracted from Wikipedia contains footnote citation numbers, the citation numbers are removed from the table. To restore the citation numbers, clear the Remove Wikipedia citations check box.

Depending on the size of the table, only the first few rows might be displayed. To display the full table, activate the Show Full Table button at the bottom of the table. You can later restore the partial view by activating the Show Partial Table button.

4 When you are satisfied with the information that is on the Prepare Table page, you can save the table or tables to your laboratory. Do either of the following:

- If you extracted one table, activate the Save to Laboratory button. Depending on the table’s size, all or part of the table is displayed on the Table page. On that page, you can change the table’s name and column properties.
- If you extracted more than one table, a check box appears above each table. All the check boxes that appear are selected by default.
  - To save more than one table, make sure that the check box is selected for each table that you want to save. Then activate the Save to Laboratory button. The tables are displayed on the Laboratory page.

**TIP** You can toggle the Select All button above the tables to select or deselect all the tables. This is useful when you want to customize the list of extracted tables that you want to save.

**Note:** When you deselect a table, the contents of that table disappear from the window. To restore the contents, select the table’s check box.

- To save a single table, toggle the Select All button to deselect all extracted tables, select the table that you want to extract, and activate the Save to Laboratory button. All or part of the table is displayed on the Table page. On that page, you can change the table’s name and column properties.

**Expedited Extraction**

Expedited table extraction enables you to extract a single table without stopping at the Prepare Table page. If there is one table, the table is extracted and displayed immediately on the Table page. If there are more than one table, the tables are displayed on the Prepare Table page.

1 Open the web page that contains the table whose data you want to extract.

2 Access the accelerator’s menu.

3 Press and hold the Shift key while you select the Extract Tables from This Page menu item. The table is displayed on the Table page. On that page, you can change the table’s name and column properties.
Requirements for Tables to Be Extracted

The following list contains some of the requirements for the tables that you want to extract. This list does not include all possible cases where tables can or cannot be extracted. However, in most cases an error message is displayed when a table cannot be extracted.

Note: For requirements about the data contained in the tables and the valid formats for that data, see “Valid Input Data Types and Formats” on page 49.

- Tables can be extracted only from English web pages. The web page must be a page in which the HTML LANG attribute is “EN”. LANG is a language attribute of the HTML element in a web page. If HTML LANG is not specified in the web page, then the page is considered to be “EN”.

- The table must reside on a web page that provides access to the Chrome Extensions toolbar. (You can use Ctrl+Shift+Enter to open a link to a table in a new browser tab.)

- The table must be rectangular—that is, every row must contain the same number of columns. This determination takes into consideration ROWSPAN and COLSPAN attributes.

- The maximum file size for a data table is one megabyte (1 MB).

- The table must contain at least three columns and two rows of valid data, or it must contain at least two columns and three rows of valid data. All empty rows and empty columns are removed during extraction.

- The table must be visible. For example, a table that has the following HTML coding would be rendered invisible and cannot be extracted: `<table style="display:none">. . .</table>.

- The table cannot contain any nested tables.

- The table cannot be a presentation table. A presentation table is one that is used only for creating a visual layout on the page. A table that has the following HTML coding cannot be extracted: `<table role="presentation">. . .</table>.

- Only visible content within tables is extracted. Rows and individual cells that are marked hidden are not extracted as part of the table.

**TIP** The table can contain images and hypertext URL links. For images, the ALT text is extracted. For URL links, the URL string is extracted but is not linked.

Data Requirements for Maps

When you import map data or extract map data from a web page, the data tables must meet certain requirements as described in “Providing Data to the Laboratory” on page 35.
In addition, map tables must include columns with latitude and longitude values that meet the following requirements:

- The values must conform to the numerical formats described in “Valid Numeric Formats” on page 50.
- The values must be between -90 and 90 for latitude, and between -180 and 180 for longitude. Both ranges are inclusive.
- A column is determined to be latitude or longitude if the column label is one of the following:

  **Table 6.1 Valid Latitude and Longitude Column Labels**

<table>
<thead>
<tr>
<th>Column</th>
<th>Valid Labels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latitude</td>
<td>Latitude</td>
</tr>
<tr>
<td></td>
<td>Lat</td>
</tr>
<tr>
<td></td>
<td>Lat.</td>
</tr>
<tr>
<td>Longitude</td>
<td>Longitude</td>
</tr>
<tr>
<td></td>
<td>Long</td>
</tr>
<tr>
<td></td>
<td>Long.</td>
</tr>
<tr>
<td></td>
<td>Lon</td>
</tr>
<tr>
<td></td>
<td>Lon.</td>
</tr>
</tbody>
</table>

Note: The column label is not case-sensitive. For example, all of the following are valid labels for latitude: lat, Lat, LAT.

You can create a map even if the column label differs from what is listed in the previous table. However, you first need to change the data type. You can change the label name and the data type in the **Column Properties window**.

## Working with the Table Page

The Table page is displayed when you select the name of an existing table on the Laboratory page. The Table page is also displayed after you save the table for an accelerated graph to the laboratory.

The Table page contains the following elements:

- **name of the table**
  - You can **rename the table** and change other table properties.

- **menu bar**
  - You can perform a number of tasks using the buttons in the menu bar. For example, you can create and delete graphs and maps. You can also **download the table** as a CSV file, an HTML file, or a SAS program.

- any graphs or maps that have been created for the table
  - You can do the following tasks with graphs and maps:
    - Select a graph to open the graph in the graph view.
Select a map to open the map in the map view.

- Create a new graph.
- Create a new map.
- Delete any of the graphs or maps that have been created for the table. Activate the Manage Graphs and Maps button and select the graphs that you want to delete. Activate the Delete button when you are ready to delete the selected graphs.

Note: Manage Graphs and Maps is available only after you have created a graph or map.

table data
Under each column header of the table, a button shows the data type that is assigned to the column. For example, the data type might be character, number, date, or currency.

For more information about a column, or to change the data type and other properties, see “View and Change Column Properties” on page 43.

TIP  A column might include an exclamation mark (!). The mark indicates a possible data assignment issue. That issue is described when you view the column properties, where you can change the data type. See also “Overview of Data Types” on page 49.

Depending on the size of the table, only the first few rows might be displayed. To display the full table, activate the Show Full Table button at the bottom of the table. You can later restore the partial view by activating the Show Partial Table button.

You can do the following:

- filter the table
- explore table variables and access automatically generated sample graphs

Change the Table Name and Specify Row Headers

The Table page is displayed when you select the name of an existing table on the Laboratory page. You can view the table data and change the table properties shown here.

1 On the Table page, activate the Table Properties button.

2 In the Table name text box, enter the name that you want.

3 To specify row headers, select the First column contains row headers check box.

4 Activate the OK button.

Note: If the table has been extracted from the web, the web URL is displayed at the bottom of the window above the OK button. If the table has been imported, the
View and Change Column Properties

The Table page is displayed when you select the name of an existing table on the Laboratory page. You can view and change the column properties shown here.

1. In the table, activate the data type button for the column that you want to change.

   The Column Properties window is displayed in which you can change the following column properties:
   - To change the column header label, select the Column label text box and enter the new label.
   - To change the column type, select the appropriate type from the Type list box.

   Note: A column might be assigned a character data type even though it contains numeric or other data. This occurs when the accelerator detects a possible data assignment issue. That issue is noted in the window. See “Overview of Data Types” on page 49.

   - If the column type is number, then you can specify whether commas are displayed in the table. Select or deselect the Show Commas check box. By default, commas are displayed regardless of whether the original numbers contain commas. The use of commas provides a better experience for screen reader users.
   - To specify whether a column is considered categorical, select or clear This column contains categorical data. When you select this option, the term Categorical appears along with the column type on the Table page. Categorical columns represent types of data that can be grouped into categories, such as age, gender, country, product type, and so on.
   - For a numeric or date column, select This column contains series data if the data in the column should be treated as series data. For example, if the column contains consecutive years, then select this option.

     A series is a sequence of measurements of the same variable collected over time. Most often, a series variable is a date, and the measurements are made at regular time intervals.

     To change the format, select the format from the Format list box. This list box is available only when a format has been applied to the column data, and more than one format is available. The selected format affects the display in pages such as the Table page and the graph view.

2. To filter the data based on the values of this column, select a filter from the Filter Type list box. Then specify the filter criteria.

3. When you are finished changing properties, activate the OK button.
Filtering Table Data

About Filtering Data

While accessing table data on the Table page, you can define and apply one or more filters to the data. Filters enable you to subset your data.

You can filter based on one or more columns. If you apply a filter for two or more columns, the accelerator displays only the rows that meet the criteria specified for all filtered columns.

The following table shows which types of data can be filtered:

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Usage Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characters</td>
<td>The filter can match values that contain, start with, or end with a set of characters.</td>
</tr>
<tr>
<td>Numbers</td>
<td>The filter can match values that are greater than, less than, or equal to a number.</td>
</tr>
<tr>
<td></td>
<td>Note: A numeric filter can be applied to latitude and longitude data types.</td>
</tr>
</tbody>
</table>

If a column is designated as categorical, then you can filter the data that matches a category value. This ability applies to all the data types. You can also filter the table to display only those rows that have or do not have missing data for a column.

You can show or hide matching rows. For example, if you filter on cars that originate in Japan, you can either show or hide the rows containing those cars. If you hide the rows, the accelerator shows the cars that do not originate in Japan.

Define and Apply One or More Filters

1. On the Table page, activate the data type button for the column that you want to filter. The Column Properties window is displayed.

2. Select the type of filter you want to use from the Filter Type list box.

   The available filter types depend on whether you are filtering characters, numbers, and so on. The following options are generally available:

   - **None** turns off filtering for the column. This is the default value, and it is always available.
- **Category** enables you to specify the category for the filter. The accelerator filters the data to show or hide rows that match the category. This option is available only when the **This column contains categorical data** check box is selected.

- **Missing data** filters the table to show or hide only those rows that have missing data for the column. This filter is always available.

- For character data, filter types enable you to match values that contain, start with, or end with a set of characters.

- For numeric data, filter types enable you to match values that are greater than, less than, or equal to a number.

Depending on the filter type that you specify, a list box or a text box might be displayed.

3 If applicable, do either of the following steps:
   - specify a category value in the **Select category** list box.
   - enter a character or numeric value in the **Value** text box. If you are entering a character value, you can specify whether the filter is case-sensitive. When case sensitivity is specified, the filter matches only those characters that have the exact same capitalization as the specified value.

4 Select either **Show filter results** or **Hide filter results**. This selection determines whether to show or hide the rows that match your filter criteria. The default is **Show filter results**.

5 Activate the **OK** button to apply the filter and close the window.

6 To define and apply a filter for a different column, repeat the previous steps.

---

**Remove One or More Filters**

1 On the Table page, activate the data type button for the column that contains the filter that you want to remove. The Column Properties window is displayed.

2 From the **Filter Type** list box, select **None**.

3 Activate the **OK** button.

4 To remove the filter for a different column, repeat the previous steps.

To remove all filters that are applied to a table, activate the **Remove All Filters** button on the Table page.
Creating Graphs and Maps

Graphs That You Can Create in the Laboratory

- bar chart
- box plot
- bubble plot
- heat map
- histogram
- line chart
- pie chart
- scatter plot
- series plot

Create a Graph

1. From the Table page, activate the Create Graph button or the Create Graph from Filtered Data button.

2. Select the type of graph from the Chart Type list.
   
   A description of the chart type is displayed to the right of the selection list. In addition, data entry fields are displayed for the selected chart.

3. Specify the axis variables, labels, summary statistic, or other aspects of the graph. The available options vary with the type of graph.
   
   Here is information about some chart options:
   
   - With bar charts, you can sort the bars. The sort action is not case sensitive. For example, sedan and SEDAN are sorted in the same order.
   
   - You can specify a group variable for the chart. Only character variables can be used as group variables.
     
     To help minimize clutter in the graph output, the maximum number of groups that are created by the group variable is 10. Variables with a cardinality higher than 10 are disabled in the group list.

4. Specify a title in the Title text box. As you enter data for the graph, the accelerator provides a brief description of the graph to be used for the title. You can use this default title or specify your own title. You can enter a maximum of 250 characters. The title identifies the graph in the accelerator.
Note: The graph must have a title before the Submit button can become available.

5 (Optional) Enter a footnote in the Footnote text box. In the output, the footnote appears in the bottom left corner of the graph. Long text strings are wrapped as needed. You can enter a maximum of 250 characters for the footnote.

You can provide a URL as a footnote. However, the URL is not hyper-linked in the output.

The footnote is also displayed when the graph is viewed in the visualization view.

By default, the Footnote text box is empty unless one or more filters have been applied to the table. In that case, the applied filters are listed in the text box.

6 Activate the Submit button. The graph is listed on the Table page.

On the Table page, you can open the new graph in the graph view of the accelerator.

Create a Map

The accelerator supports maps with a single layer of data points that identify items of interest on the map. To create a map, your data table must meet the requirements described in “Data Requirements for Maps” on page 40.

1 From the Table page, activate the Create Map button or the Create Map from Filtered Data button.

2 Specify the latitude variable and the longitude variable from their respective list boxes.

3 (Optional) Specify a variable to be used for the markers.

4 Specify a title in the Title text box. By default, the accelerator provides a brief description of the map to be used for the title. You can use this default title or specify your own title. You can enter a maximum of 250 characters. The title identifies the map in the accelerator.

Note: The map must have a title before the Submit button can become available.

5 (Optional) Enter a footnote in the Footnote text box. In the output, the footnote appears on the map view. Long text strings are wrapped as needed. You can enter a maximum of 250 characters for the footnote.

You can provide a URL as a footnote. However, the URL is not hyper-linked in the output.

By default, the Footnote text box is empty unless one or more filters have been applied to the table. In that case, the applied filters are listed in the text box.

6 Activate the Submit button. The map is listed on the Table page.
From the Table page, you can click the map to open it in the map view of the accelerator. In that view, you can explore and sonify the map. For more information, see Chapter 4, “Exploring Maps Visually and by Sound,” on page 21.

Explore Table Variables and Automatically Generated Graphs and Maps

The accelerator provides an easy way to understand, explore, and analyze the data in a table. This feature provides insights about table variables along with automatically generated graphs or maps that you can use for analysis.

The feature enables you to do the following tasks:

- view information about and descriptive statistics for a variable. For category variables, the information includes a pie chart based on the category variable.
- compare two variables using sample graphs that are generated automatically.
- compare latitude and longitude variables using sample maps that are generated automatically.

To explore table data:

1. Open the table that you want to explore. This can be a table that was extracted, imported, or created in the accelerator. If you have applied a filter to the table, then the filtered data is used in the analysis.

2. On the Table page, activate the column header for the column that you want to explore. The Variable page is displayed in a new tab and contains the following areas:

   **Summary** (left)
   summarizes information about the variable. The information that is displayed depends on the type of variable. For example, for character variables, the frequency count and number of unique values are displayed. For numbers, the display includes the minimum and maximum values along with other statistics.

   If the variable is categorical, the **Summary** area contains information about the categories. The page also contains a link to a pie chart, which shows the frequency of the category variables.

   **Comparison** (right)
   contains the names of the other variables in the graph. To the right of some or all of the variable names are links to one or more graphs. Each graph shows the relationship of a variable to the main variable that you are exploring. The list of graphs that are available depends on the types of variables that are being compared.

3. To open any of the graphs that are listed on the page, activate the link for the graph. The graph opens in the graph view of the accelerator. You can then sonify the graph and perform other tasks.

4. To open a map that is listed on the page, activate the link for the map. The map opens in the map view of the accelerator. You can then sonify the map and perform other tasks. You can also specify a variable for the label.
To explore a different variable, activate the variable name in the Comparison area. The Variable page refreshes and shows the information for the new variable.

Valid Input Data Types and Formats

Overview of Data Types

A data type is a column attribute that specifies the type of data that the column contains. When you create, import, or extract data, it is important to understand the requirements for input data and how the accelerator handles data that does not conform to the requirements.

Here are the valid data types:

- character
- number

Note: See “How the Accelerator Handles Very Large or Very Small Numbers”.

- currency
- date
- latitude and longitude

The latitude and longitude data types are unique examples of the number data type, and they must conform to the data formats for numbers. Map data has other requirements as well. For more information, see “Data Requirements for Maps” on page 40.

With the exception of character data, the data must have a valid format in order to be assigned to any of the data types. The data in a column can have different formats, but the data must all have valid formats in order to resolve to the same data type. If even one cell does not conform, the column is assigned a data type of character. In addition, ambiguous date formats are assigned a data type of character. For more information, see “Valid Date Formats” on page 51.

Note: When you import character data, all consecutive, internal whitespace characters are collapsed into a single space. All trailing and leading spaces are removed. This conversion process occurs whether the table is imported, extracted, or created in the laboratory.

After creating, importing, or extracting the table, you can change the data type that has been applied to a column. When you change the data type, any invalid cells are assigned as missing.

The following sections list the formats that are valid for the various data types.
Valid Numeric Formats

- number without commas (example: 2167034)
- number with commas (example: 2,167,034)
- decimal (example: 2167.75)
- negative number (example: –680)

The following example shows the first few rows of two numeric columns. In the example, the second column contains four invalid numbers: 9.2M, 82 percent, 3e2, and (680). Therefore, the accelerator associates that column with a data type of character. If you change the column type to numeric, the invalid data items are presented as missing.

<table>
<thead>
<tr>
<th>Valid Numbers</th>
<th>Four Invalid Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,740</td>
<td>6,735</td>
</tr>
<tr>
<td>2167.75</td>
<td>2,300.50</td>
</tr>
<tr>
<td>2167034.75</td>
<td>9.2M</td>
</tr>
<tr>
<td>78.0912</td>
<td>82 percent</td>
</tr>
<tr>
<td>300</td>
<td>3e2</td>
</tr>
<tr>
<td>–680</td>
<td>(680)</td>
</tr>
</tbody>
</table>

See Also

“How the Accelerator Handles Very Large or Very Small Numbers”

How the Accelerator Handles Very Large or Very Small Numbers

Extremely large positive or negative numbers (in the quadrillions) are not supported in the accelerator. When such numbers are detected, an error message is displayed.

Numbers can have a maximum of 14 decimal places to the right of the decimal. Numbers that exceed this limit are handled in the following ways:

- For numbers in graphs that are accelerated, the numbers are rounded to 14 decimal places.

  Numbers that are calculated in the accelerator are rounded to 14 decimal places.

- For numbers in tables that are imported, extracted, or created in the laboratory, the corresponding column is assigned a character data type. If you change the data type to numeric, the numbers are rounded to 14 decimal places.

In addition, numbers that are less than 0.000001 but greater than 0 are not interpreted as numbers in the accelerator. Although the column is assigned a
number type, the number is displayed as NaN in the table cell. If you change the column from a number type to a character type, the cell displays the correct number as a character string.

Valid Currency Formats

dollar (examples: $12,345,678.09, $-5,000.00)

Parentheses are supported by the accelerator to denote negative numbers when the currency value is formatted as $(number) or ($number). Examples: $(10.00) and ($10.00).

Valid Date Formats

Note: If a column of dates is ambiguous, the column is assigned a data type of character. For example, a column with some dates in the DD/MM/YYYY format and other dates in the MM/DD/YYYY is assigned a data type of character.

- DD-MM-YYYY (example: 31-10-2018)
- DD/MM/YYYY (example: 31/10/2018)
- MM-DD-YYYY (example: 10-31-2018)
- MM/DD/YYYY (example: 10/31/2018)
- YYYY-MM-DD (example: 2018-10-31)
- YYYY/MM/DD (example: 2018/10/31)
- DDMMMYY (example: 31Oct18) *
- DDMMMMYYY (example: 31Oct2018) *
- month DD, YYYY (example: October 31, 2018)
- weekday, month DD, YYYY (example: Wednesday, October 31, 2018)

* Although these formats are supported, after they are imported the dates are converted to DD-MM-YYYY (example: 31-Oct-2018).
Specify Accelerator Options

The accelerator has visual and auditory options that can be set in the browser. Options include text color, background color, font size, focus indicator color, and more.

1. Access the accelerator’s menu.
2. Activate the Options menu item.
3. Make your changes and activate the Save button.

**CAUTION**

Be careful when specifying options that affect how the accelerator looks or behaves. For example, you can disable stereo sound, which maps X values in the graph to your left and right speakers. You might disable that feature if you have a hearing impairment in one ear and want to disable the panning between speakers. Otherwise, it is recommended that you keep stereo sound enabled in order to take full advantage of sonification.

**TIP**

The option to invert the page colors is on by default. This setting results in white text on black background. To change to black text on white background, specify Off for Invert page colors.

In addition, if you specify Text color or Background color while the Invert page colors option is on, the inversion of the specified color is assigned to the foreground or background respectively.
Enable or Disable Accelerator Notification for Graphs

By default, the accelerator notifies you when it detects a graph that contains the necessary SAS metadata on an HTML page. The notification consists of sounding a chime and displaying an Accelerate button near the graph.

You can enable or disable the notification feature for graphs.

1. Access the accelerator’s menu.
2. Activate the Options menu item.
3. Under the Notifications heading, select On from the Show the Accelerate button for graphs in web pages list box to enable notification for graphs. Select Off to disable notification for graphs.
4. Activate the Save button.
Enable Chrome to Access Local Files

For security reasons, by default the Chrome browser does not allow extensions to access local files. If you want the accelerator to access local files (locations of “file://...”, instead of “http://” or “https://”), you must configure Chrome to allow the access. This setting is also useful for accessing email attachments.

1. In the Chrome search bar, enter `chrome://extensions` and press Enter.
2. Scroll the list of extensions until you find SAS Graphics Accelerator.
3. Activate the **Details** button for SAS Graphics Accelerator.
4. Select **Allow access to file URLs** to toggle the option on or off.

macOS Notes and Issues

- Due to a known issue, VoiceOver on macOS sometimes stops announcing information from the SAS Graphics Accelerator. If this happens, try turning VoiceOver off and back on again to correct the problem. You can use the Cmd +F5 shortcut key to quickly toggle VoiceOver off and on.
- When using Chrome on macOS High Sierra (10.13) or later with VoiceOver, system sounds (earcons) are sometimes introduced and are played when particular regions of the page are updated. The sounds can interfere with sonification. You can disable these additional earcons by selecting the VoiceOver option **Mute sound effects**. Another option is to use the Web Speech software instead of VoiceOver.
- On macOS with Chrome 69, the sonification pane of the graph view does not announce the position of the cursor correctly. This problem is resolved by upgrading to Chrome 70 or higher and macOS 10.14 or higher.