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ODS Graphics Designer

An Interactive Tool for Creating Batchable Graphs

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ABSTRACT

The SAS/GRAPH® ODS Graphics Designer provides an intuitive GUI interface for creating analytical graphs. The software provides a visual gallery of commonly used graphs. You can create your custom graph starting from the gallery, or from a blank graph. You can further build up the graph by dragging and dropping additional plots and graph features from the “Elements Panel”. Titles and footnotes can be added and edited directly on the graph. You can build complex graphs with multiple cells, building up layered graphs in each of cell. You can build classification panels using up to two class variables. The graphs can be saved in the extensible graph gallery to the file system. Saved graphs can be run in batch with different data using the SGDESIGN procedure.

INTRODUCTION

Effective graphs are an essential part of a data analysis or a report. A carefully constructed graph can reveal associations, clarify differences, and show patterns that are not apparent in the underlying data. The ODS Graphics system provides the ability to create modern analytical graphs using syntax-based tools such as the SAS/GRAPH Graph Template Language (GTL) and the SAS/GRAPH Statistical Graphics (SG) procedures. The GTL is also used to define the automatic graphs created by many analytical procedures.

Although these tools provide the SAS user powerful syntax to create complex graphs, often a user wants the ability to create graphs quickly to obtain various views of the data. Many users who are not familiar with the SAS/GRAPH procedure syntax would prefer to use an interactive tool to create their graphs. Even many experienced SAS/GRAPH programmers could use an interactive way to create the graph without having to resort the trial-and-error approach needed with syntax-based tools.

The new ODS Graphics Designer application (henceforth called “the Designer”) provides just such an interactive process to create your graphs. This tool provides a GUI-based, interactive interface to many of the same features that are available in GTL. This application uses the 80/20 rule to provide the 20% features from GTL needed to create 80% of the graphs. The application provides a gallery of commonly used graphs and a building-block approach to constructing many different types of graphs.

Audience: The audience for the Designer consists of SAS users who are knowledgeable in DATA step and STAT procedures and who need to create graphs to explore the data or to present the results of their analyses. These users might not be knowledgeable in SAS/GRAPH software and might use third-party software to do their graphics.

STARTING THE DESIGNER

Start SAS in DMS mode, and submit the following code in the program window:

```
%sgdesign; <submit>
```

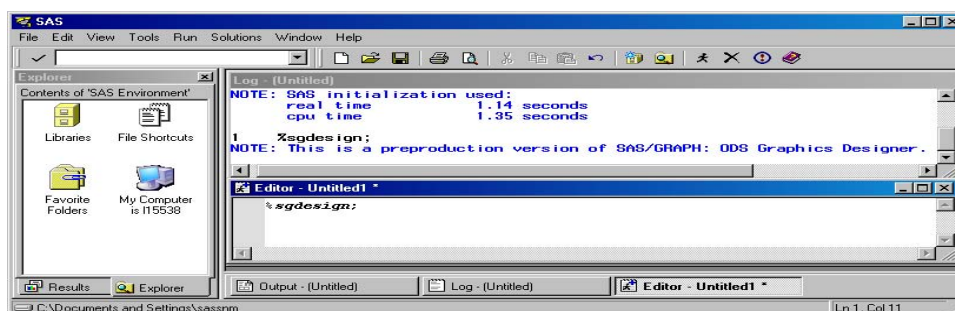


Figure 1. SAS Window

The Designer GUI window is launched. When the application starts, the following tasks are done:

- A new (internal) SAS session is launched and the Designer software connects to this session. Pertinent information about all assigned libraries and formats are sent to the Designer.
- Some sample data sets needed by Designer sample graphs are created.

If you assign new libraries or define new formats in the DMS session after the Designer is launched, the Designer will not know about these. Resubmit the macro with REFRESH=Y option to send this information to the Designer.

```
%sgdesign (refresh=y); <submit>
```

THE DESIGNER GUI

When the software starts, you see the Designer application in a separate window with the following features:

- the Menu Bar along the top
- the Toolbar with common items
- the Graph Gallery, a gallery of commonly used graphs organized in tabs
- a set of plots and insets on the left side, initially inactive

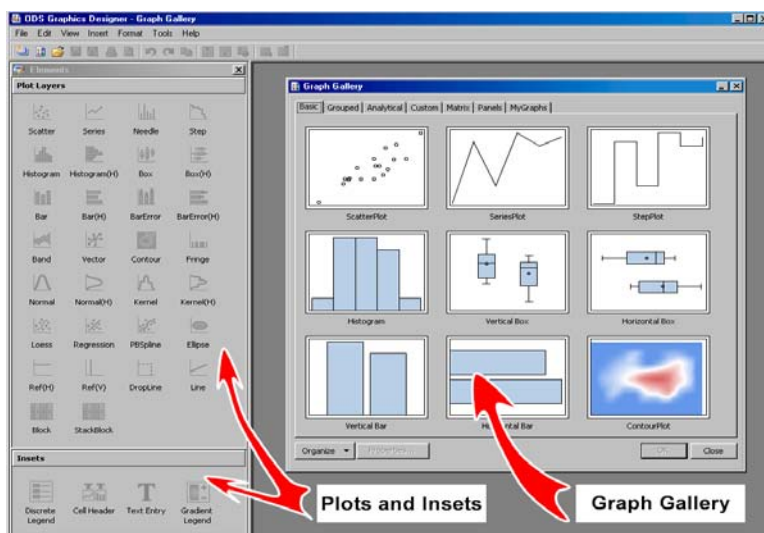


Figure 2. The Designer GUI

THE GRAPH GALLERY

The Graph Gallery contains a tabbed set of commonly used graphs, organized as follows:

- **Basic** – Common graphs
- **Grouped** – Graphs showing grouped data
- **Analytical** – Graphs commonly used for analysis of data
- **Custom** – A set of graphs showing the possible ways to combine the plots
- **Matrix** – A set of Scatter Plot Matrix graphs
- **Panels** – A set of Classification Panel Graphs
- **MyGraphs** – A user defined group

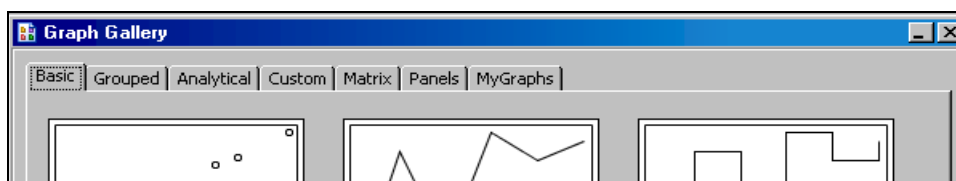


Figure 3. Graph Gallery Tabs

CREATING A NEW GRAPH FROM THE GRAPH GALLERY

You can create a new graph from the Graph Gallery as follows:

- Select a graph from the Graph Gallery, and select **OK**. For example, to create a histogram, select the **Histogram** from the **Basic** tab of the Graph Gallery, and click **OK**.
- A new histogram is created, and the Assign Data dialog box is launched. Note that the histogram has SASHELP.CLASS pre-assigned as a placeholder data set. Also, the X role is set to HEIGHT. This is done to show a visual representation of the selected graph type.

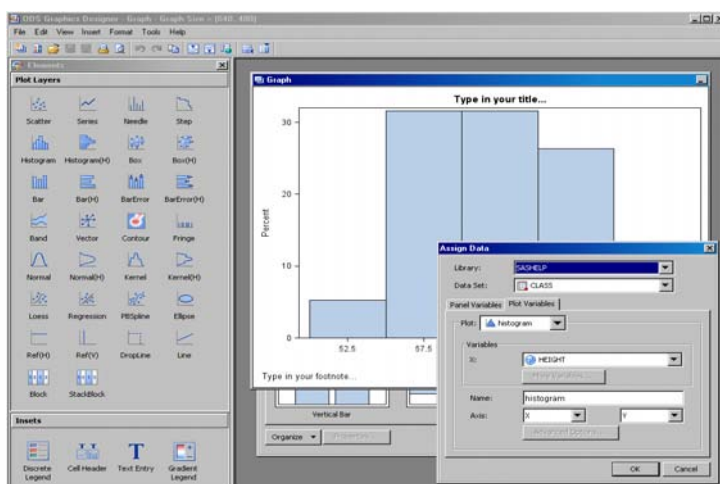


Figure 4. Selecting a Graph

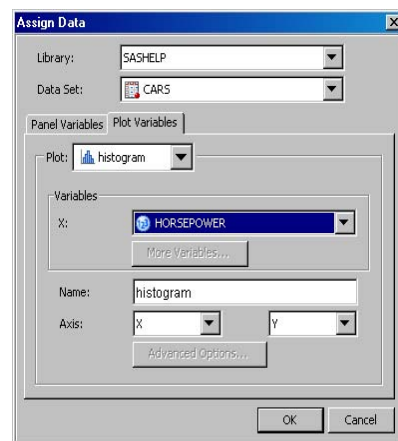


Figure 5. Assign Data Dialog Box

Figure 5 shows the Assign Data dialog box for setting the various roles for the histogram. You can select the desired library and data set, and also the desired X roles for the graph.

The default X axis is the lower axis, and the Y axis is the left-hand axis. You can change these settings.

- For this example, select the following settings:
 - Library = sashelp
 - Data set = Cars
 - X = Horsepower
- Press **OK** to create the histogram. After you click **OK**, the histogram is created, and the Graph Gallery is hidden. Note that the Plots and Insets panels at the left of the window are now enabled. Figure 6 shows the result.
- The graph has a title at the top, with the placeholder text "Type in your title..." and a footnote at the bottom "Type in your footnote..." You can click on these objects and customize them to your needs. To remove the title, click the right mouse button on the title and select **Remove Title**.

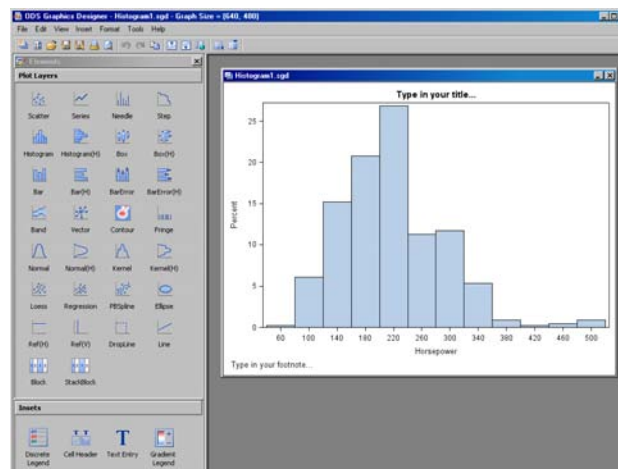


Figure 6 Histogram

ADDING PLOTS TO THE GRAPH

On the left side of the Designer window there are two panels of objects as shown in Figure 7 :

- A Plot Layers panel that contains a number of different plot types that can be added to most graphs. To add a plot to a cell of a graph, drag and drop the icon of the plot from the Plot Layers panel to the cell.
- An Insets panel that contains a number of inset objects that can be placed inside a cell.
- To add a new plot to the graph, click on the icon for the plot or inset, and then drag and drop it on the graph cell. Multiple plots from the Plot Layers panel can be added to a cell in a graph, as long as the data types are compatible.
- The following plot types can be mixed in a cell:
 - Scatter, Series, Band, Needle, Step, Vector, Regression, Loess, PBSpline, Ref Lines, Drop Lines, Contour Ellipse, Line
 - Bar, Series, Ref lines, Drop Lines
 - Histograms, Density, Fringe, Ref Lines
- The GUI provides an indication when a plot cannot be combined with existing plots in a cell.
- You can also drag and drop an inset from the Insets panel into a cell. Legends and entries can be placed in one of nine locations around the cell.

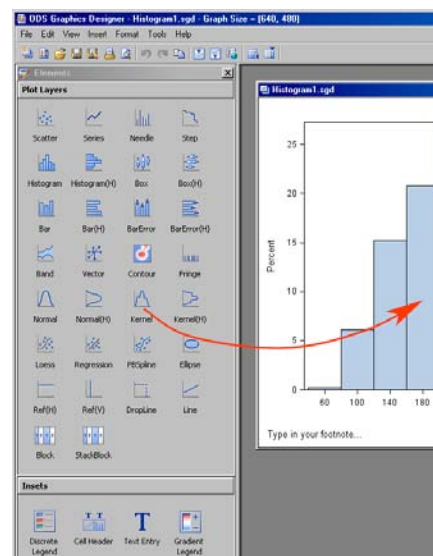


Figure 7. Plot Layers and Insets

ADD A KERNEL DENSITY PLOT

To add a kernel density plot to the histogram, drag and drop the **Kernel** icon on top of the histogram in the graph.

- An Assign Data dialog box is displayed, as shown in Figure 8.
- For convenience, the kernel density can be estimated for one of the existing plots in the cell listed in the drop-down box by using the **Fit an existing plot** option. In this case, there is only one existing histogram in this graph.
- If you wish, you can assign specific variables to the X role of the density plot. To do that, deselect the **Fit to existing plot** option to enable variables selection. Select **OK**.
- A kernel density plot is added to the graph on top of the histogram. We have previously updated the title and the footnote. The resulting graph is shown in Figure 9.

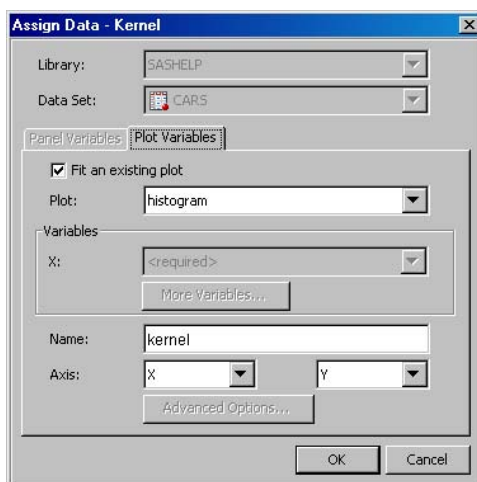


Figure 8. Assign Data Dialog Box

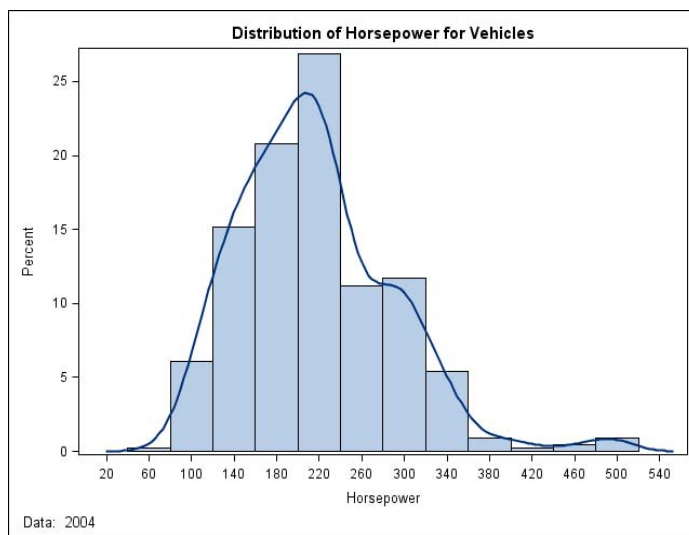


Figure 9. Graph with Kernel Density Plot

ADDING A NORMAL DENSITY PLOT

To add a normal density plot to the graph, drag and drop the **Normal** icon on top of the histogram plot in the graph.

- An Assign Data dialog box is displayed.
- Select **OK**.

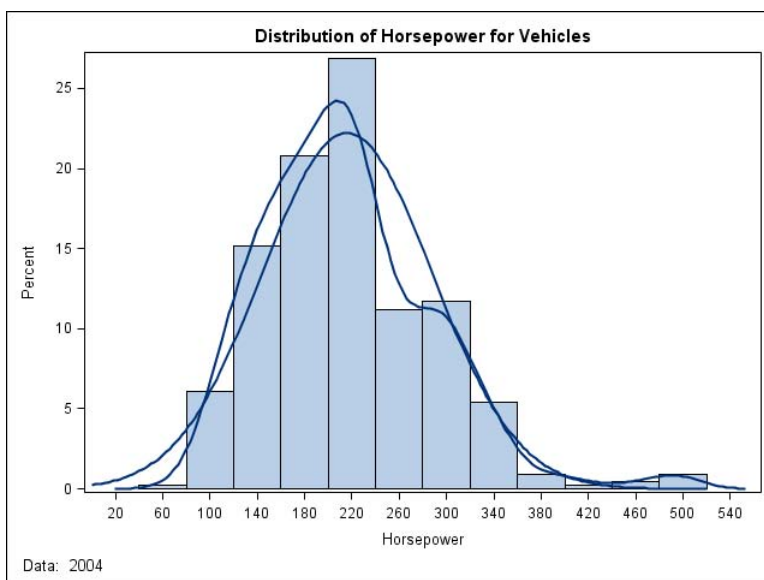


Figure 10. Graph with Kernel Density and Normal Density Plots

In Figure 10, both the kernel and normal density curves have the same visual properties. To address this, you can customize the visual properties of the plots in the graph. To do this, select one of the plots in the graph with the right mouse button, and select **Plot Properties** from the pop-up menu.

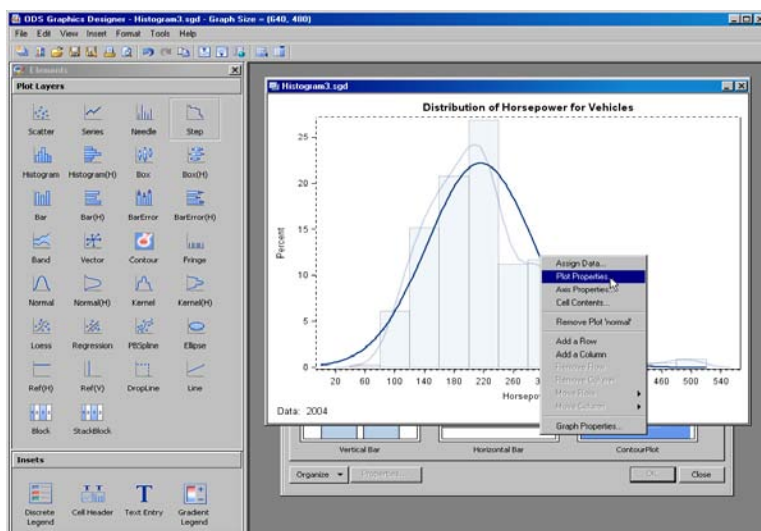


Figure 11. Assigning Plot Properties

SELECTING A PLOT

As you select different plots in the graph, the selected plot is displayed at full strength, while the other plots in the same cell of the graph are dimmed, as shown in Figure 11. The normal density plot is currently selected, and the other plots are dimmed. Select the **Plot Properties** menu. The Cell Properties dialog box is displayed.

SETTING PLOT PROPERTIES

The visual properties of a plot can be customized using the associated Cell Properties dialog box. Because we launched this from the normal density plot, the dialog box is displayed with the **Plots** tab selected. Within this, **normal** is preselected in the **Plot** field, as shown in Figure 12.

- The **Plots** tab of the dialog box is selected.
- The name of the plot being edited is shown in the **Plot** field. All plots in the cell of the graph are listed here, and you can change to any other plot if needed.
- In this case, we are editing the properties of the **normal** plot.
- Based on the plot type, the user can customize different visual attributes of the plot. For the normal density curve, you can change its color, pattern, thickness, and transparency.
- The **Legend Label** field shows the name that will be displayed in a legend if needed.
- The **Style Element** field at the top allows a user to select a named Style Element bundle from ODS Styles, which contains more than one attribute at a time.
- In this case, let us set a Dash pattern from the drop down list for **Pattern**. Select **OK**. The resulting graph is shown in Figure 13.

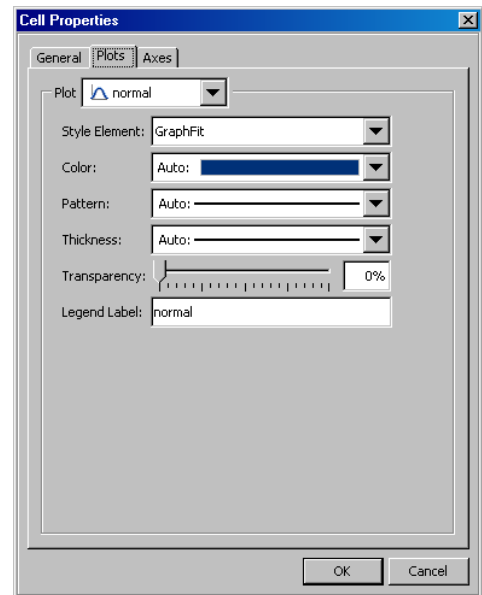


Figure 12. Cell Properties Dialog Box

ADDING A CELL LEGEND

Figure 13 also shows a discrete legend in the upper right corner of the cell. This is added by a simple drag and drop of the **Discrete Legend** icon from the Insets panel on the left to the desired location in the cell.

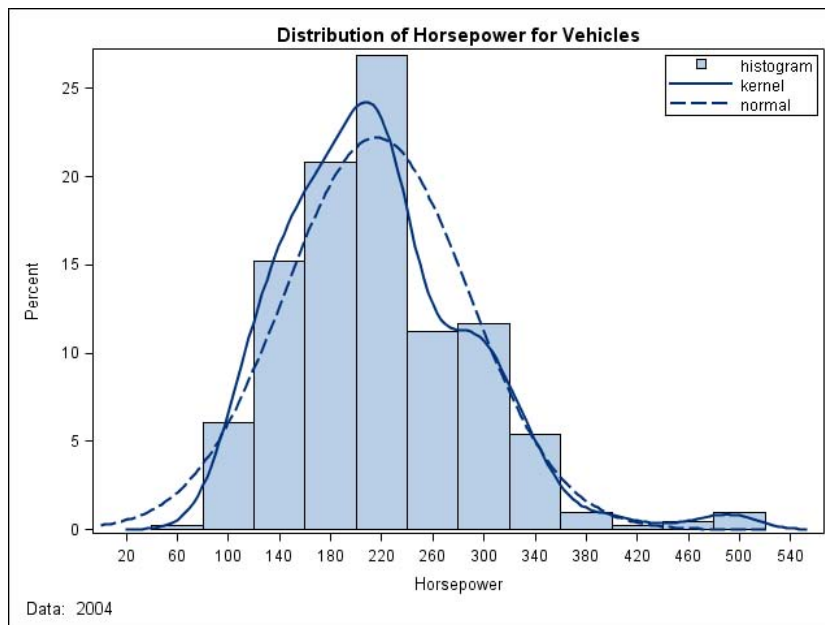


Figure 13. Graph with Dash Pattern for Normal Density Curve

When a discrete legend is placed in a cell, all the plots in the cell are represented in the legend by default. The Legend context menu can be displayed by clicking the right mouse button on the legend as shown in Figure 14. It has the following entries:

- Legend Contents
- Legend Properties
- Remove Legend

To customize the contents shown in the legend, select **Legend Contents** from the pop-up menu to launch the Legend Contents dialog box, as shown in Figure 15.

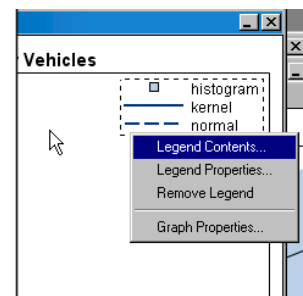


Figure 14

LEGEND CONTENTS

This dialog box displays the information on the contents of the legend. By default, all the plots in the cell are represented in the legend. The dialog box shows the following:

- names of all the plots that can be included in the legend.
- a check box indicating if the plot is included.
- the string that will be displayed in the legend to represent each plot. For grouped plots, these come from the data. For non-grouped plots, this string comes from the plot name and can be edited. Here we have capitalized the first letters for both Normal and Kernel.

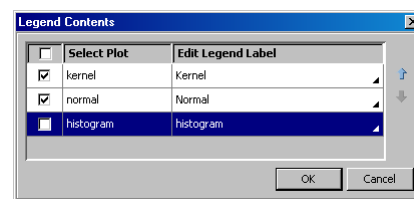


Figure 15. Legend Contents

We have also unchecked the histogram to exclude it from the legend. The resulting legend is shown in Figure 16.

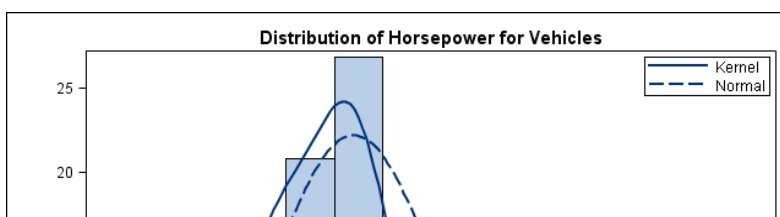


Figure 16. Legend for the Graph

LEGEND PROPERTIES

Figure 17 shows the Legend Properties dialog box that you can use to customize the appearance of the Legend. These include the following:

- the legend title and appearance properties for the title.
- the fill and outline colors for the background.
- the position of the legend. You can select one of the nine compass positions or **Automatic**, which will place the legend in the position of minimum overlap with data.
- the arrangement of the legend entries and wrapping.

GLOBAL LEGEND

If you prefer an exterior legend at the bottom of the graph, instead of the legend inside the cell, select **Insert > Global Legend**. Now you can customize it like the cell legend.

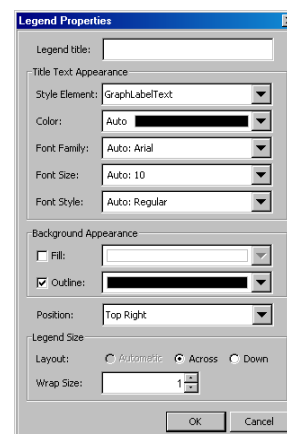


Figure 17. Legend Properties

ANATOMY OF A GRAPH

The Designer supports the creation of many different types of graphs. These can generally be classified into “single-cell” or “multi-cell” graphs. Although the terms “graph,” “plot,” and “chart” are often used loosely in the industry, we have assigned specific meaning to each term. It is useful to have a consistent terminology for the various components of graphs. For this topic, we use an example of a two-cell graph shown in Figure 18.

- **Graph:** The entity created by the Designer, individually saved as a file or image. A graph is generally made up of the following:
 - one or more titles at the top
 - one or more footnotes at the bottom
 - one or more legends
 - one or more cells that contain the visuals representing the data
- **Cell:** An independent rectangular subregion in the graph. Each cell can contain one or more plots and other text entries and legends. A graph can have one or more cells. The graph in Figure 13 has only one cell.
- **Plot:** The visual element that represents the data, such as a scatter plot, a series plot, a box plot, a histogram, a bar chart, and so on. All of these are referred to by the generic term “plot.” Plots that share the same type of data per axis can be placed in layers.
- **Axes:** Each cell has a set of axes that are shared by all the plots in the cell. The axes are not controlled by the plot. In case of multi-cell plots, each cell can have its own axes, or columns and rows of cells may share common external axes.

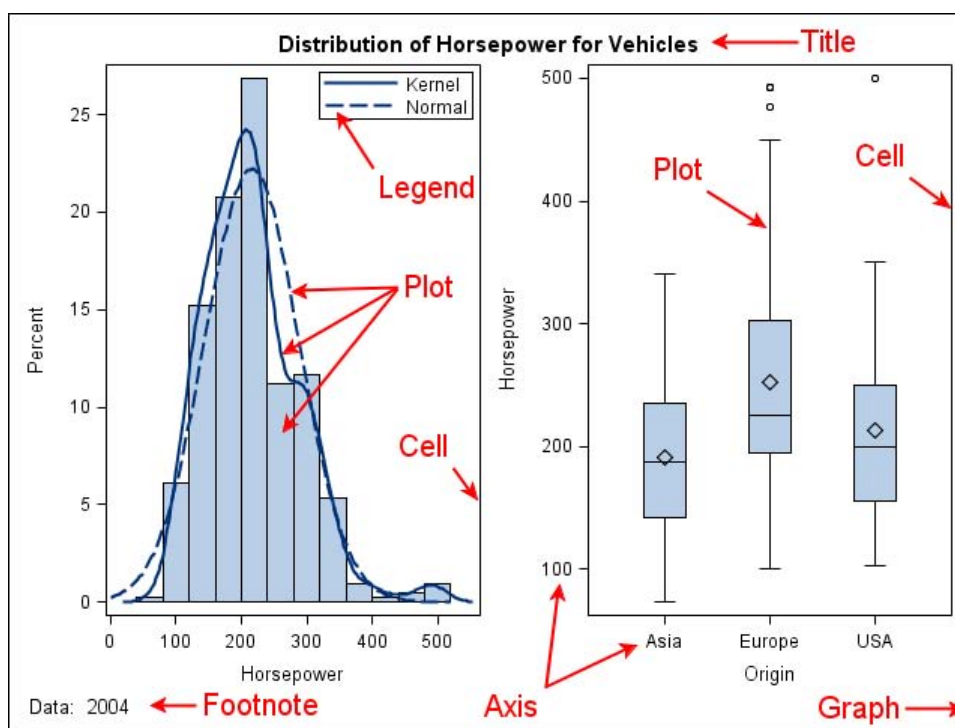


Figure 18. Example of a Two-Cell Graph

CONTEXT MENUS

Various actions on the graph components can be done by using the context menus. These are displayed by clicking the right mouse button on different parts of the graph. You can use the context menus to perform the following actions:

- assign data for individual plots in the graph
- set plot properties for individual plots in the graph
- set axis properties, including label, ticks, and tick values
- set legend properties, including legend contents
- set graph properties, which are the settings for the whole graph in one image
- adjust cell contents
- set properties for titles and footnotes

ASSIGN DATA

This dialog box is first displayed when a new graph is created from the Graph Gallery, or when a new plot is added to a graph using the drag-and-drop method. When first displayed for a new plot, the dialog box can assign data only for that particular plot. This dialog box can also be displayed by selecting one of the plots in the graph with the right mouse button, and selecting the **Assign Data** menu entry.

- Click on the histogram with right mouse, and select **Assign Data** to display the Assign Data dialog box for the histogram, as shown in Figure 19
- Note that the **Plot Variables** tab is active, and the **Panel Variables** tab is inactive. We will discuss panel variables later.
- Note that this dialog box has a drop-down list called **Plot** that lists all the plots in this cell, as shown in Figure 19. Histogram is selected by default.
- Change the X role assignment if needed.
- You can also change the name of the plot.
- You can change the axis assignments to display either the default axes X (bottom) and Y (right), or select the combinations you need.
- Before you select **OK**, you can select any one of the other plots in this cell. Select **kernel** from the **Plot** drop-down list. Now, the dialog box for data assignment for the kernel density plot is displayed, as shown in Figure 20.
- **Note:** The **Fit to existing plot** option is selected for the kernel density plot, and **histogram** is selected as the fitted plot. The histogram will automatically change to use whichever data column the histogram is assigned.

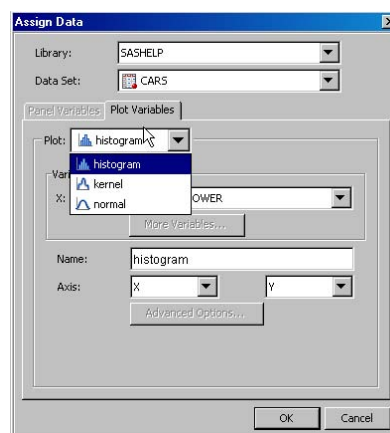


Figure 19. Assign Data Dialog Box

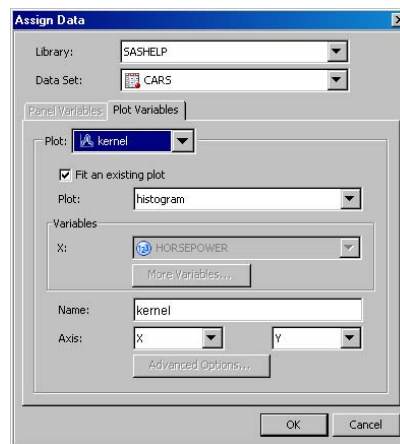


Figure 20. Data Assignment for Kernel Density Plot

SET PLOT PROPERTIES

Various plot properties can be set for any of the plots in the graph by using the Cell Properties dialog box. The Cell Properties dialog box includes three tabs, as follows:

- **General Tab:** For editing the fill and outline settings for the cell background
- **Plots Tab:** For editing various properties for all the plots in the cell
- **Axes Tab:** For editing various properties for all the internal axes for the cell

GENERAL TAB

To edit the background fill and outline settings, click the right mouse button in the cell background, and select **Plot Properties**. Because no plot was selected, the Cell Properties dialog box is displayed with the **General** tab activated, as shown in Figure 21. This tab shows the controls you can use to edit the fill and outline settings.

PLOTS TAB

To edit the properties for any of the plots in the cell, click the right mouse button on one of the plots, and select **Plot Properties**. The plot is selected, and the Cell Properties dialog box is displayed, with the **Plots** tab selected, as shown in Figure 22.

At the top of the tab is the plot list that displays a list of all the plots that are currently included in the cell. The selected plot is shown as selected in this drop-down list. Below this list are various controls to customize specific features of the selected plot. These vary based on the type of the plot.

In this case, we have selected **histogram**. For a histogram, you can customize the following features:

- **Fill options:** The **Style Element** specifies the element from which the visual attributes are to be obtained. The default element is **GraphDataDefault**. You can select another element from the list. Or you can specify a specific fill color using the **Color** drop-down list. The default **Auto** value is derived from the Color attribute of the selected element.
- **Outline options:** The **Style Element** specifies the element for setting all the visual attributes of the outline. The default is **GraphDataDefault**. You can select another element from the list to set all the attributes. Or you can set each attribute individually using the individual controls. The default **Auto** value is derived from the appropriate attribute of the element.
- **Legend Label:** This field specifies the string to be shown in the legend for this plot.

You can select any other plot in the cell for customizing its attributes.

AXES TAB

Most cells have up to four axes. These are as follows:

- **X:** The horizontal axis at the bottom edge of the cell
- **Y:** The vertical axis at the left edge of the cell
- **X2:** The horizontal axis at the top edge of the cell
- **Y2:** The vertical axis at the right edge of the cell

To edit the properties of any one of the four axes of the cell, select the axis to be edited with the right mouse button, and select **Axis Properties**. The Cell Properties dialog box is displayed, with the **Axes** tab selected, as shown in Figure 23.



Figure 21. General Tab

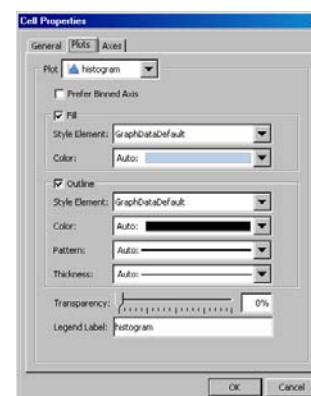


Figure 22. Plots Tab

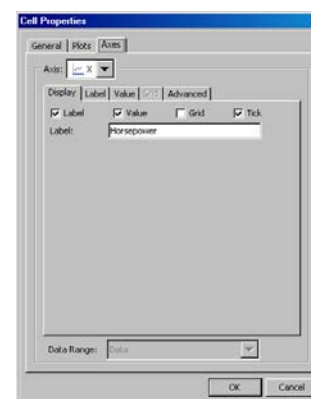


Figure 23. Axes Tab

Only the axes that have plots associated with them are enabled. See the “Assign Data” section and Figure 19. The active axes are included in the **Axis** drop-down list. The clicked axis is selected in this list for customizing. You can select any of the four axes for customizing.

Various settings can be customized using the five tabs:

- **Display:** Control the display of various parts of the axis, such as the label, values, grids, and tick marks. Also set the axis label string. See Figure 23.
- **Label & Value:** Set the attributes for the axis label and values, such as the font face, size, color, and so on. See Figure 24.
- **Grid:** Set the attributes for the grid lines, such as the color, pattern, and thickness. See Figure 25.
- **Advanced:** Control other settings for axis, such as type, axis range, tick sequence, and reverse. See Figure 26.

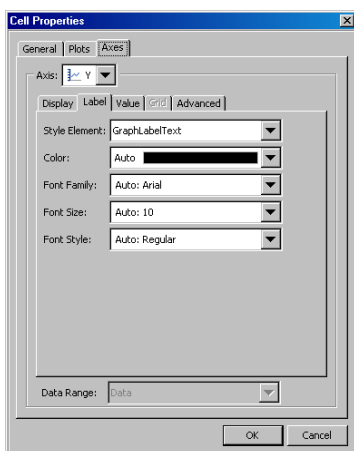


Figure 24. Axis Label, Value

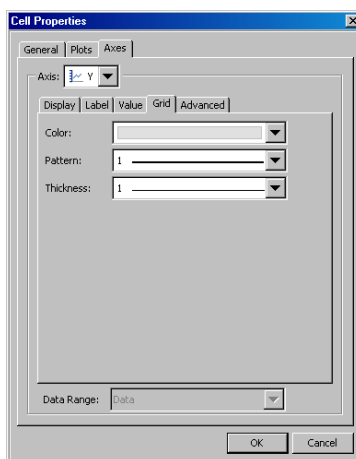


Figure 25. Axis Grid

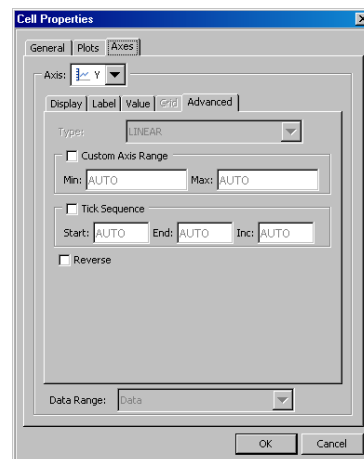


Figure 26. Axis Advanced

LEGENDS

Legend properties can be edited using the Legend context menus. Select the legend with the right mouse button, and select the **Legend Properties** menu entry. Legend properties can be edited as shown in Figures 14, 15 and 17.

CELL CONTENTS

Each cell can contain multiple plots and insets as follows:

- Plots are placed in a stack, with the last one drawn on top.
- Insets such as legends and entries are drawn on top of plots.

The order of stacking these items in the cell can be customized. Press the right mouse button anywhere in the cell and select **Cell Contents** to display the dialog box shown in Figure 27.

Plots: The upper tabbed section shows the list of plots currently existing in the cell. The plots are rendered in the order they are placed, with the last one (shown on top) drawn last. You can change the order of the plots by selecting one of the plots and then clicking the up or down arrows on the right.

Insets: This section includes the list of insets such as legends and entries. These are always drawn on top of the plots, but do have a drawing order amongst themselves.

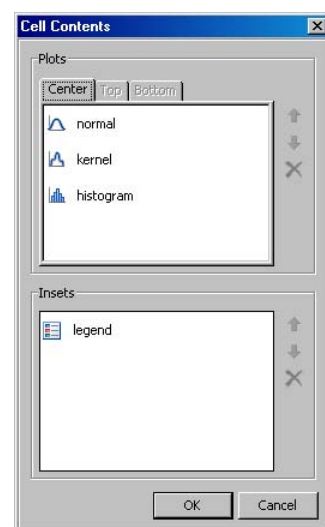


Figure 27. Cell Contents

GRAPH PROPERTIES

The properties for the entire graph can be edited using this dialog box. Click the right mouse button anywhere in a cell, axis legend, title, or footnote, and select the bottom menu entry **Graph Properties** to display this dialog box, as shown in Figure 28. You can customize the following properties of the Graph:

- **Style:** Select one of the many SAS shipped styles or one of your own customized styles for this graph.
- **Background options:** Select a background color.
- **Size:** Set the output size of the Graph. Selecting the **Keep Aspect Ratio** option retains the current aspect ratio when changing either the width or the height.
- **Common Axes:** These check boxes are for use of common axes when there is more than one cell in the graph. More on this topic later.

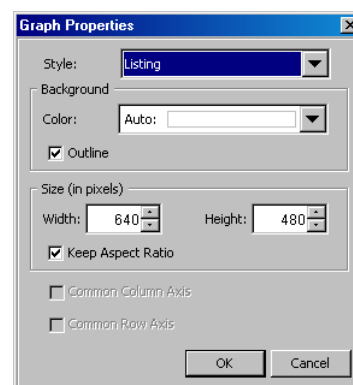


Figure 28. Graph Properties

TITLES AND FOOTNOTES

Select a title with right mouse button and then select the **Title Properties** to display the Text Properties dialog box. You can do the same for footnotes.

Note: All context dialog boxes are available from the **Format** menu.

Creating a Graph from Scratch

Select **File > New > Blank Graph** to start building a new graph from scratch. A new blank graph is displayed. Drag and drop plot icons from the Plots Panel as shown in Figure 7. To add a title or a footnote, click on the **Title** or **Footnote** icon in the menu bar, or select **Insert > Title** or **Insert > Footnote**.

Saving a Graph

Select **File > Save As** to save your graph as a SAS Graph Designer (SGD) file.

Save in the Graph Gallery

Any graph can be saved in the Graph Gallery. To do this, select the **File > Save In Graph Gallery** menu item. This action displays the Save In Graph Gallery dialog box. A default icon for the graph is automatically created from the current graph. Fill out the other fields in the dialog box as shown in Figure 29, and click **OK**.

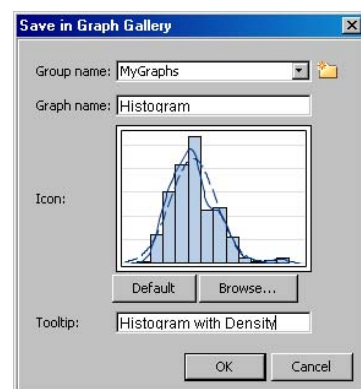


Figure 29. Save In Gallery

- **Group name:** You can save a Graph to a user group in the Gallery. Graphs cannot be saved to the groups shipped with the software. Select a user group from the drop-down list. To create a new group, select the **New Group** button.
- **Graph name:** Provide a unique name.
- **Icon:** Accept the default icon, or select your own using the **Browse** button. This icon represents this graph in the Graph Gallery.
- **Tooltip:** Provide a text string to show in the tooltip.

OPEN A GRAPH

Select **File > Open** to open a previously saved graph. The Open dialog box is displayed, as shown in Figure 30.

- In the Thumbnails view, all SGD files are represented with the SGF file icon. In Figure 30, the ACF.sgd file is shown with such an icon.
- If the associated image icon of the graph is available, the graph icon is shown. For example, in Figure 30, the CarsHistogram.sgd file is represented with the actual representative image of the graph.

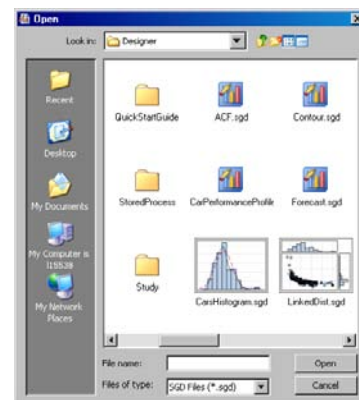


Figure 30. File Open

MULTI-CELL GRAPHS

So far, we have seen how you can create single-cell graphs in the Designer. In addition to a title, a footnote and global legend, these graphs have only one cell with one or more plots from data. Multi-cell plots are a very powerful way of visualizing data to see data side-by-side, and for classification panels where the data is subset by one or more class variables. Different types of multi-cell graphs include the following:

- **Gridded graph:** A graph with multiple cells in a grid without shared axes
- **Lattice graph:** A graph with multiple rows and columns with shared axes
- **Classification panel:** A graph with data classified by one or more class variables
- **Scatter plot matrix:** A graph showing pair-wise relationships between variables

In general, all the techniques described till now for use with single-cell graphs will be reused in the multi-graph scenario. Instead of dropping all the plots and insets in one cell, you can place them in the appropriate cell of the grid.

GRIDDED GRAPHS

This graph is made up of multiple independent cells in a regular grid of rows and columns. Each cell may contain one or more plots and insets. Let us start with the graph shown in Figure 13, and create one used in Figure 18 (Anatomy of a Graph).

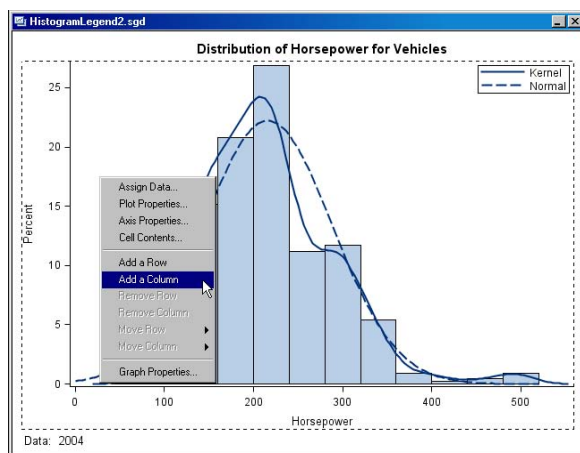


Figure 31. Add a Column

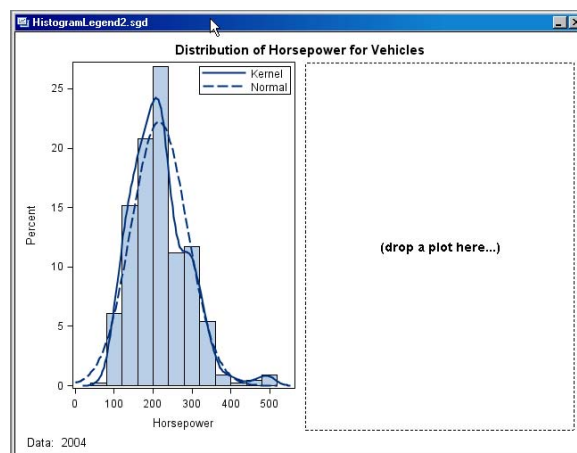


Figure 32. Two Cell Gridded Graph

ADD A COLUMN

We have to add a new cell to the graph, and then populate it as follows:

- Click the right mouse button in the cell of the graph in Figure 31, and select **Add a Column** from the context menu.
- The graph is split into two columns, and a new blank cell is added to the right of the previous single cell. The rest of the graph is unchanged. Now we have the beginnings of a multi-cell Graph, as shown in Figure 32.
- The new empty cell has a hint (**drop a plot here...**), indicating that new plots and insets can now be dropped into the new cell. Now, drag and drop the **Box** icon from the Plots Panel into the new blank cell. Assign the plot variables, as shown in Figure 33.
- In this case, let us assign HORSEPOWER as the Y (analysis) variable, and ORIGIN as the X (group) variable. We also assign the Y axis to the Y2 (right-hand side) vertical axis.
- The resulting two-cell graph is shown in Figure 34. Note that the right-hand cell has the Y axis plotted on the right side, as requested in the Assign Data dialog box.

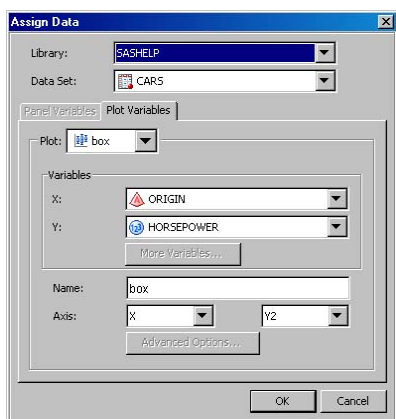


Figure 33. Box Plot Assign Data

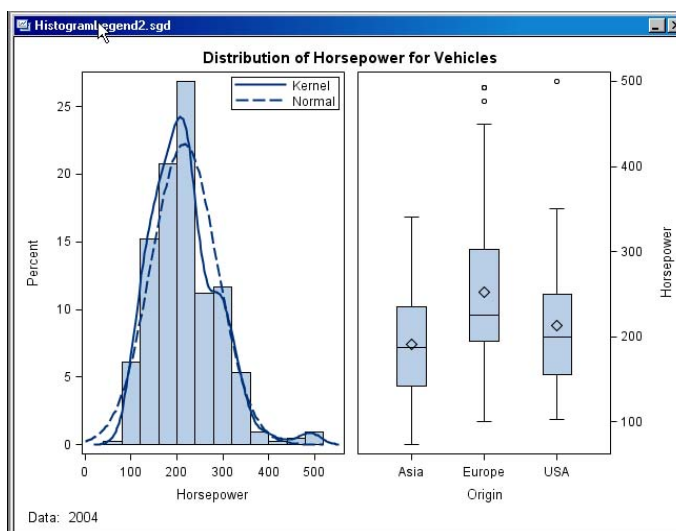


Figure 34. Two-Cell Gridded Graph

LATTICE GRAPHS

A lattice graph is similar to the gridded graph, with one important difference. Rows and columns of these graphs can share common axes. In the graph shown in Figure 34, each X and Y axis has a different variable, measure, or statistic plotted on it. So it does not make much sense to share the axes.

Sharing of axes implies the following:

- The data ranges are shared and the union of the data ranges are used for all axes.
- Various axis offsets and thresholds are equalized across all axes.
- Axis type and label are shared. Often, these have to be set by the user.

Starting with the graph from Figure 13, let us use the following actions to create a one-column, three-row graph as follows:

- Using the cell context menu select **Add a Row**. This creates a new blank cell.
- Drag and drop a **Fringe** icon into the new cell.
- Set the fringe X variable to HORSEPOWER.
- Use the cell context menu in the fringe plot, and select **Add a Row**. This creates another new blank cell under the fringe plot cell.
- Drag and drop a **Box(H)** (Horizontal Box Plot) icon into the new cell.
- Set the box plot Y variable to HORSEPOWER. Leave the X variable blank. This results in the graphic shown in Figure 35.

Notice that in Figure 35, all cells have equal height and each cell has its own X axis. Even though each axis has the same X variable, the axis ranges are not necessarily equal, and the axes might not be lined up. The histogram axis shows tick marks from 0-500, while the other plots do not.

In this case, it is important that the three plots line up to show the correct relative distributions. To do this, we have to make all three cells use a common column axis.

Common Column Axis: As shown in Figure 35, select one of the X axes with the right mouse button, and select the **Common Column Axis** menu item.

Row Weights: To provide more space for the top cell, you can interactively resize the heights of the cells. Hover the cursor just above the bottom cell, and you will see a vertical cursor and a dashed line as shown in Figure 36. Click and drag the line to resize the cell.

Resize the bottom two cells to have a smaller height as shown in Figure 36.

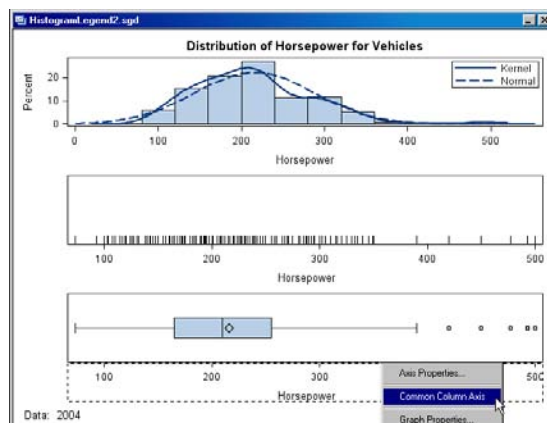


Figure 35. Three-Row Graph

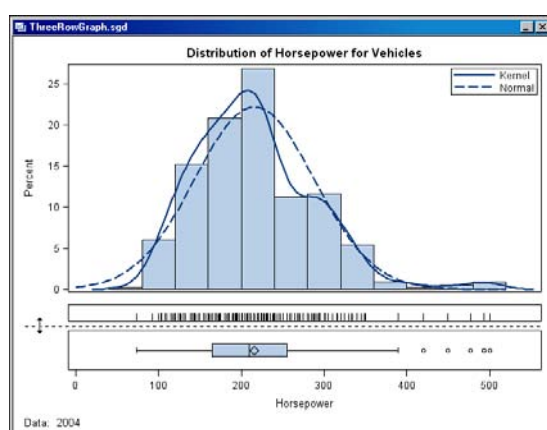


Figure 36. Three-Row Graph

CLASSIFICATION PANELS

This graph displays a regular grid of cells based on one or more classification variables. Each cell displays a common set of plots, for a subset of the data based on the classification variable.

Classification panels can be created in one of two ways:

1. Convert a single-cell graph into a classification panel by adding class variables using the **Panel Variables** tab.
2. Start from the **Panels** tab of the Graph Gallery. This tab has many representative cases of data panel and data lattice panels.

FROM A SINGLE-CELL GRAPH

Let us take the example of the graph showing the distribution of horsepower, as shown in Figure 9. This graph shows the distribution over all the different cars in the data set. To view the same data classified by the country of origin, let us use ORIGIN as the classification variable.

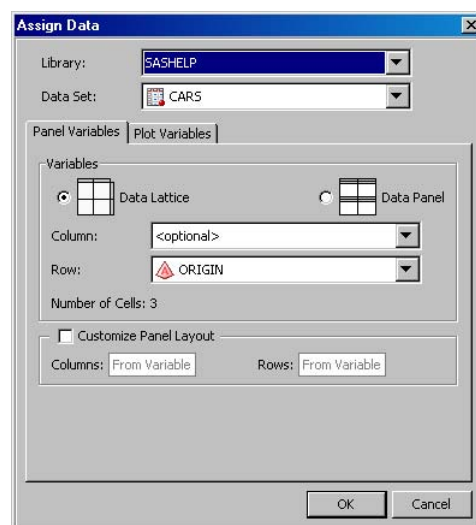


Figure 37. Panel Variables

Since ORIGIN has three values, let us make the graph taller to accommodate the new graph.

- Select **Graph Properties** from the context menu, and change the graph width=300, graph height=450.
- Select the histogram with the right mouse button, and select **Assign Data**. The Assign Data dialog box is displayed. This dialog box has two tabs under the **Data Set** field.
 - **Plot Variables:** Sets the variables to be used for the histogram.
 - **Panel Variables:** Sets the Row or Column class variables.
- Select the **Panel Variables** tab as shown in Figure 37.
- In this tab, you have two options for the type of lattice graph. These are as follows:
 - **Data Lattice:** You can specify a row or a column class variable, or both. Each row and column is labeled with the value of the class variable.
 - **Data Panel:** You can specify up to two class variables, and each cell is individually labeled with the value of each class variable.
- **Data Lattice** is selected by default. We will accept this setting for this case.
- You can select a Row and a Column class variable. Click the **Row** drop-down box, and select **ORIGIN**.
- Click **OK** to obtain the graph as shown in Figure 38.

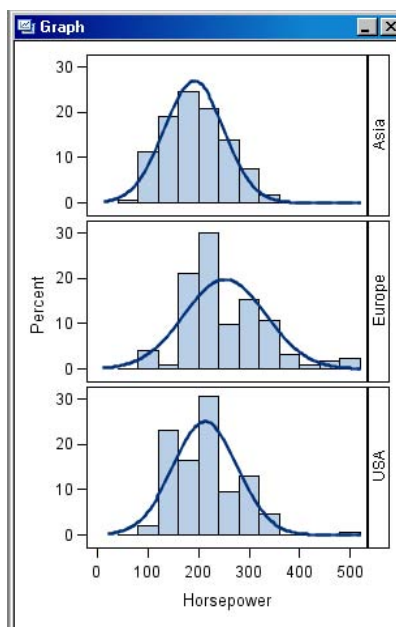


Figure 38. Panel Variables

Figure 38 shows the distribution plot classified by the ORIGIN variable. ORIGIN has three levels, “Asia”, “Europe” and “USA.” Since we set ORIGIN as the Row class variable, the graph is automatically split into a panel of three rows with one cell each. Each row is labeled with the value of the class variable. The entire column has a common X axis.

Note: Some single cell graphs containing ellipses or multiple axes (Y & Y2) cannot be converted. In such cases, the **Panel Variable** tab is inactive.

FROM THE GRAPH GALLERY

Let us create a three-cell column lattice graph of MPG by Drivetrain and Country of origin. Select the **View Graph Gallery** icon from the Menu Bar to display the Graph Gallery. Select the **Panels** tab. This tab includes various types of classification panels. You can select the kind of panel you want, without regard for the actual plot in the cell. The plot can easily be changed.

- Click on **Column Lattice**. Select **OK**. A two-column lattice is displayed using the work.heart data set, with SEX as the column class variable.
- Change the data set to sashelp.cars, and set the Column variable to ORIGIN.
- Click **OK**. Select **Continue** on the warning dialog box to get a three cell blank graph.
- Drag and drop a **Bar** object in one of the cells. The Assign Data dialog box is displayed.
- Set the category variable to DRIVETRAIN and the response variable to MPG_CITY.
- Set Statistics to MEAN, and change the Name to “City”. Click **OK**. Now each cell of the graph displays a bar chart with a header showing the class value.
- Select **Graph Properties** from any context menu, deselect **Keep Aspect Ratio** and change the size of the graph to 500x300.
- Drag and drop another **Bar** object in a cell. The Assign Data dialog box is displayed.
- Set the category variable to DRIVETRAIN and the response variable to MPG_HIGHWAY. Set Statistics to MEAN, and change the Name to “Highway”. Press **OK**. A second bar chart is displayed in each cell overlaying the previous bar. The width of the new bar is narrower by default. This can be set in the plot properties.

- Select the Plot Properties context menu to display the Cell Properties dialog box. Select the **City** plot, and change its **Fill Style Element** to **GraphData1**, and **Transparency** to 40%. Do not press **OK** yet.
- Select the **Highway** plot, and change its **Fill Style Element** to **GraphData2**, and **Transparency** to 40%. Press **OK**.
- Customize the title and remove the footnote.
- Insert a global legend, and select both bar charts in the dialog box. Press **OK**.
- Select the Y axis context menu, change the label to "MPG", and turn on the grid lines to get the graph as shown in Figure 39.

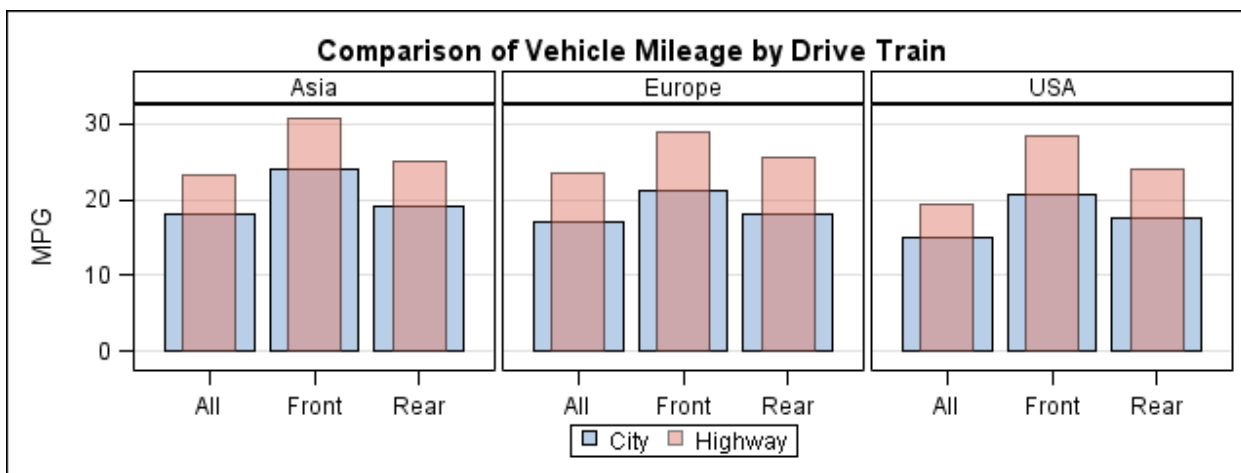


Figure 39. Classification Panel

SCATTER PLOT MATRIX

This is a graph showing pair-wise relationships between multiple variables of a data set. You can create both square and rectangular matrices, with or without confidence or prediction ellipses. For square matrices, you can have the diagonal cells display the variable name, or a distribution plot of the variable.

Scatter plot matrices are special plots that cannot be combined with any other plot. You can create a scatter plot matrix only from the **Matrix** tab of the Graph Gallery, as shown in Figure 40.

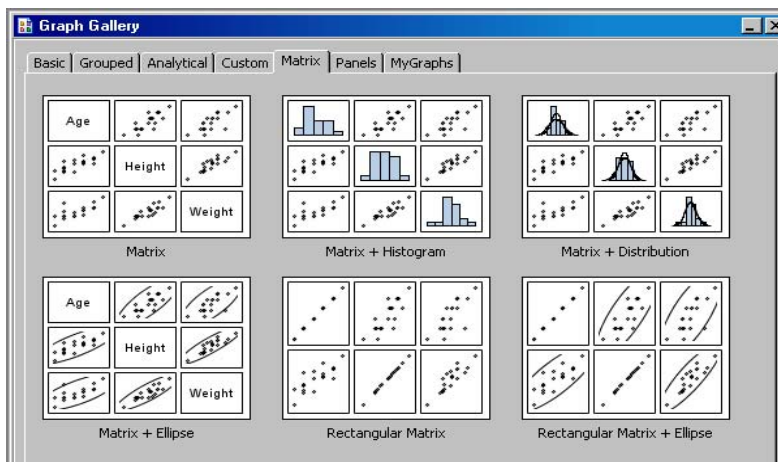


Figure 40. Matrix Tab of the Graph Gallery

SHARED VARIABLE (SV) GRAPHS

Another important category of graphs is what we call the shared variable (SV) graphs. These graphs are built the same way as the other graphs we have discussed so far with the following additional requirements:

- The entire graph must be created from one data set.
- First, the user must define the variables that will be used to make the graph.
- Then, all plots can be defined using only these pre-defined shared variables.

The need for and benefits of an SV graph will be clear with the following use case. Let us take the graph in Figure 36. This is a multi-cell graph, with three cells. Each cell has one or more plots in it. Note that all plots use only one variable, HORSEPOWER.

This is a very useful graph to visualize the distribution of a measure. In fact, after you have built this graph, you might want to reuse it to view the distribution of some other variables in the same or different data set. Let us say you now want to visualize the distribution of the MPG_CITY variable. Here is what you would have to do to get that graph.

1. **Top Cell:** Change the variable for the histogram from HORSEPOWER to MPG_CITY. Because the two density plots are linked to the histogram, these will change automatically.
2. **Middle Cell:** Change the variable for the fringe plot to MPG_CITY.
3. **Bottom Cell:** Change the Y (analysis) variable for the box plot to MPG_CITY.
4. Because the X axis is shared, during the change you will see some odd behavior for the X axis, as it will briefly display data from both HORSEPOWER and MPG_CITY.

Clearly, we need a way to be able to do this easily and quickly. Such plots are often made using many different plots, but with a few (or one) variables.

The SV plot is designed for such usage. To build such a plot, you first define the variable or variables you want to use in a graph. In this case, we define a shared variable V1 and assign it to HORSEPOWER. Then, for each of the plots in the graph, we will use V1. Later, to change the graph from HORSEPOWER to MPG_CITY, all we need to do is to change the assignment of V1 to MPG_CITY.

CREATE AN SV GRAPH

- Select **File > New > Blank Shared Variable Graph**. A blank SV graph is created, and the Assign Data dialog box is displayed, as shown in Figure 41.
- Select the library and data set you want to use. Let us use SASHELP.CARS.
- Note the new **Shared Variables** tab to the left of the tabbed panes. The other tabs are present, but currently disabled.
- Assign the variable or variables you want to use in your graph. In this case, we will assign V1 to HORSEPOWER using the **Variables** drop-down list. By default, the **Type** is **Any**. Change it to **Numeric**.
- **Note:** You can add more shared variables by selecting the **Add a Variable** button.

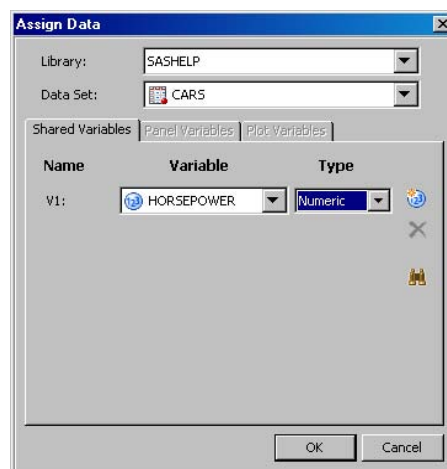


Figure 41. Panel Variables

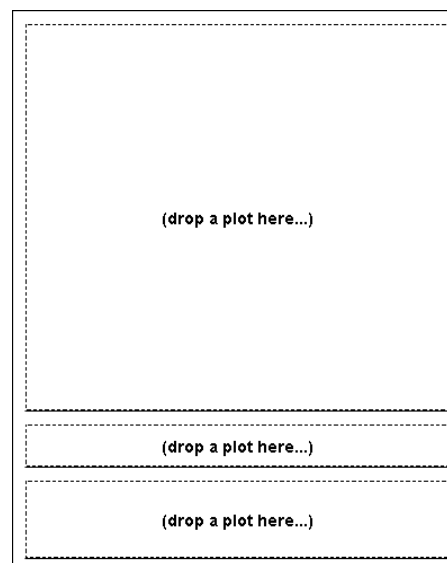


Figure 42. Blank Graph

- Select the right mouse button in the cell area, and select **Add a Row**. Do this action again to obtain a blank graph with three stacked cells.
- Move the cursor to the region between the bottom two cells, and **drag** the dotted line down to resize the cell. Repeat the same for the upper cells. The resulting blank graph is shown in Figure 42.
- Drag and drop a **Histogram** icon in the top cell. The Assign Data dialog box for the histogram is displayed, as shown in Figure 43.
- **Note:** The data set is SASHELP.CARS, and cannot be changed. The **Panel Variables** and **Plot Variables** tabs are now active, and the **Plot Variables** tab is selected.
- Set the X (analysis variable) to **V1 (HORSEPOWER)**. Note that only the variables previously assigned in the **Shared Variables** tab are available in the drop-down lists for the plots.

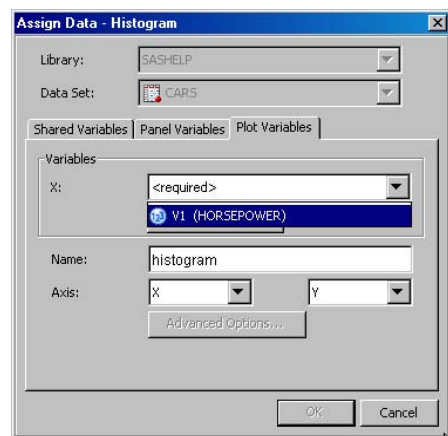


Figure 43. Panel Variables

- Drag and drop the two density graphs on top of **the histogram**. Set X to V1 in both cases and customized them as we did earlier.
- **Drag and drop** the **Fringe** plot with X set to V1 in the middle cell. Drop a **Box** plot with Y set to V1 in the bottom cell to produce the graph as shown in Figure 44.

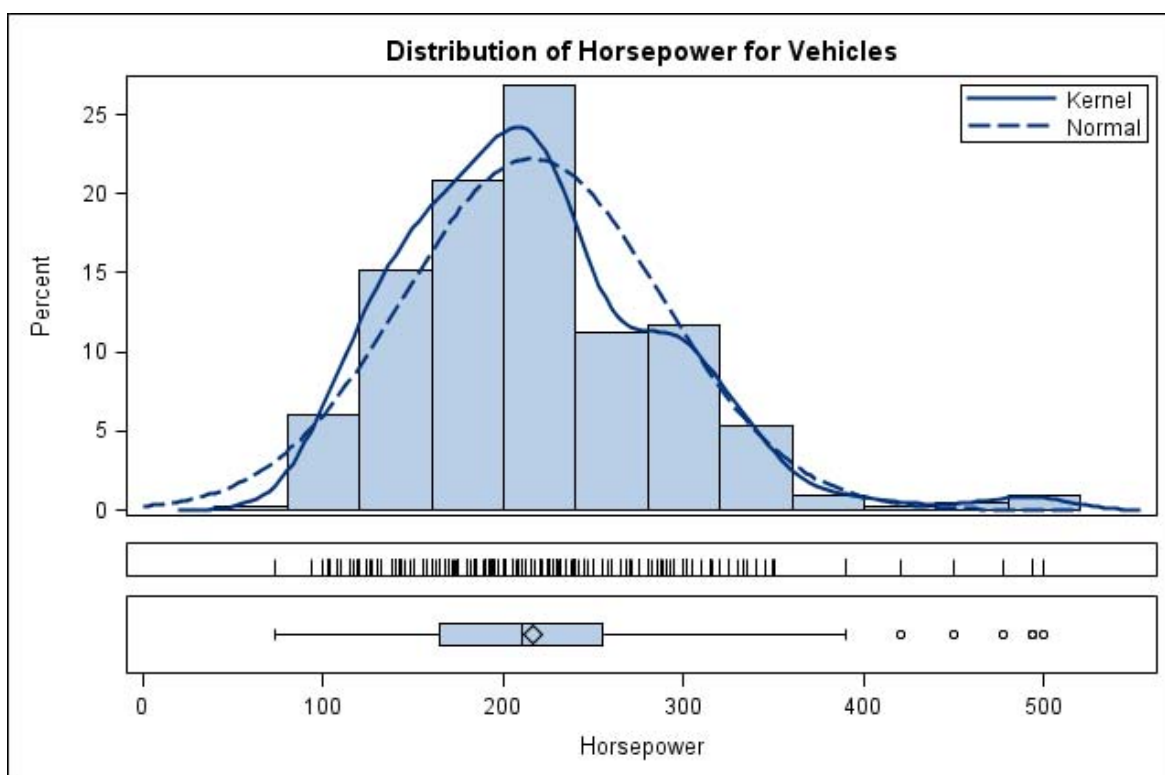


Figure 44. Shared Variable Graph

Now, to change this plot from HORSEPOWER to MPG_CITY, you just need to bring up the Assign Data dialog box, and in the **Shared Variable** tab, reassign the V1 SV to MPG_CITY or any other data set variable.

This can also be done when running this graph in batch mode using the SGDESIGN procedure.

STYLES

APPLYING A STYLE

You can change the Style of a Graph to any one of the SAS styles shipped with the system by using the **Format > Style > StyleName** menu. The recent five styles are listed in the menu. Other styles can be accessed from the More Styles dialog box, including any custom styles. In Figure 45, we have changed the style of the graph to **Analysis**.

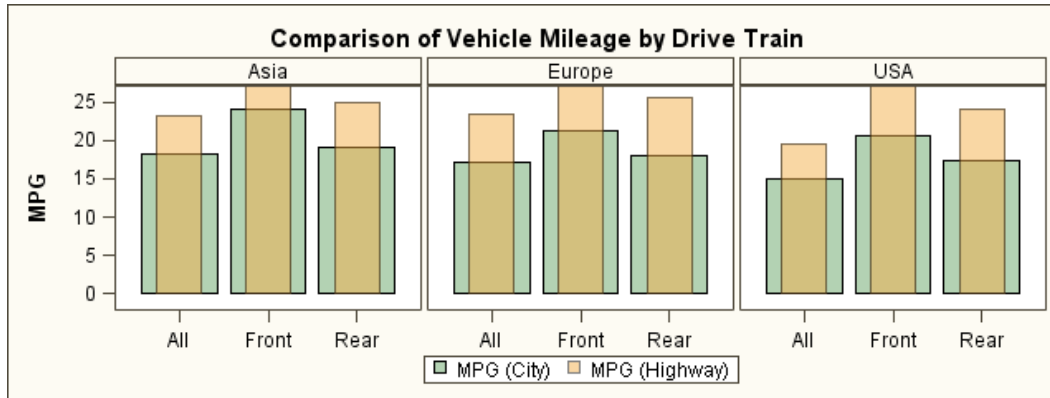


Figure 45 – Classification Panel with Analysis style

EDITING OR CREATING A STYLE

You can edit a SAS style, and save it as a custom style. Start the Style Editor tool from the **Tools > Style Editor** menu. The Style Editor is displayed, as shown in Figure 46. You can edit the current style or create a new style.

Note: Styles supplied by SAS cannot be changed. You can edit one of the styles supplied by SAS, but then it has to be saved under a new name. This is a restriction in the Designer, and not in the styles themselves.

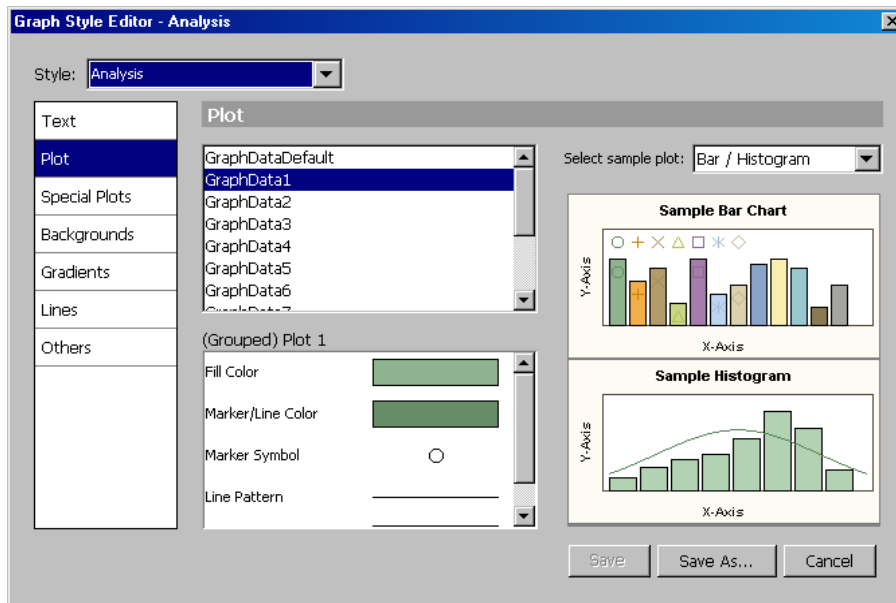


Figure 46. Graph Style Editor

VIEW CODE

As mentioned earlier, the Designer is a GUI-based interactive application that leverages the feature set of the GTL syntax behind the scenes. As you build a graph, the necessary STATGRAPH template is created using the appropriate GTL syntax. You can view the syntax for the currently active graph by selecting **View > Code**.

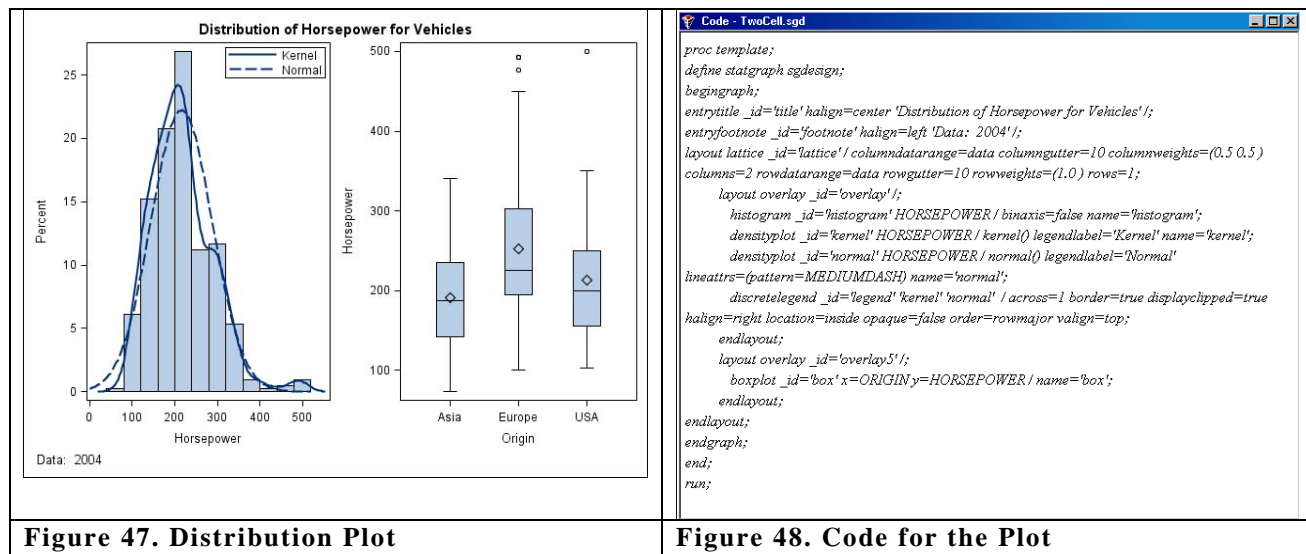


Figure 47 shows the distribution plot we created earlier. To view the STATGRAPH template code for this graph, select the graph, and then select **View > Code**. The code for the graph is displayed in the Code window, as shown in Figure 48.

We will not go into the details of the GTL code here as that is beyond the scope of this document. However, Figure 48 shows the following structure of the template:

- the PROC TEMPLATE statement and the DEFINE STATGRAPH statements.
- the outermost BEGINGRAPH – ENDGRAPH block.
- an ENTRYTITLE statement for the title at the top.
- an ENTRYFOOTNOTE statement for the footnote at the bottom.
- a LAYOUT LATTICE – ENDLAYOUT block. This block allows for two cells.
 - a LAYOUT OVERLAY – ENDLAYOUT block defining the left cell.
 - a HISTOGRAM statement.
 - a DENSITYPLOT statement for the kernel density curve.
 - a DENSITYPLOT statement for the normal density curve.
 - a DISCRETELEGEND statement for the legend in the top right corner.
 - a LAYOUT OVERLAY – ENDLAYOUT block defining the right cell.
 - a BOXPLOT statement.

You can cut and paste this code in a SAS Program Editor window and run the program to create this template. You can create the graph using the SGRENDER procedure.

THE SGDESIGN PROCEDURE

Any graph produced by the Designer and saved as an SGD file can be sent to any ODS destination by using the SGDESIGN procedure. The basic syntax of the procedure is as follows:

```
PROC SGDESIGN SGD="sgd-file-name";
```

If the graph shown in Figure 39 is saved to the CarsPanel.sgd file on the C: drive, then this graph can be sent to the HTML destination by using the following syntax. The graph uses the original data set that was used when creating the graph.

```
ods html;
proc sgdesign sgd='c:\CarsPanel.sgd'; run;
ods html close;
```

You can create a graph from a different data set as long as the new data set has variables of the same name and type.

```
data sedans;
  set sashelp.cars;
  where type="Sedan";
run;

ods html;
proc sgdesign sgd="c:\CarsPanel.sgd" data=sedans; run;
ods html close;
```

SHARED VARIABLE GRAPHS

For running an SV graph using this procedure, the shared variables can be set using the DYNAMIC option of the procedure. So, the graph shown in Figure 44 can be run for different variables by setting the dynamic V1 to other variable names as follows:

```
ods html;

proc sgdesign sgd='c:\SVHistogram.sgd';
  dynamic V1="MPG_City"; run;

proc sgdesign sgd='c:\SVHistogram.sgd' data=sashelp.heart;
  dynamic V1="Cholesterol"; run;

ods html close;
```

THE SGDESIGN MACRO

The %SGDESIGN macro is the method for starting the ODS Graphics Designer application. Normally, you would invoke it without any parameters from the Program Editor in DMS mode:

```
%sgdesign;
```

This macro does not work when invoked from the command prompt. It also does not work in batch mode. The following is a common option for this macro:

REFRESH= Y | N

If you add or modify any data sets or format options, you should run %sgdesign(refresh=y) to pick up your changes. These changes will not be reflected in the Designer otherwise. Default = N.

Using the %SGDESIGN Macro: To start the Designer normally, submit the following code:

```
%sgdesign;
```

To pick up any new libraries, data sets or format-related option changes in the DMS session while designer is running, submit the following code:

```
%sgdesign(refresh=y)
```

SOME SAMPLES

Layouts, plots, and insets with legends, titles, and footnotes can be combined in innumerable ways to produce the graph you need. Here are some common examples.

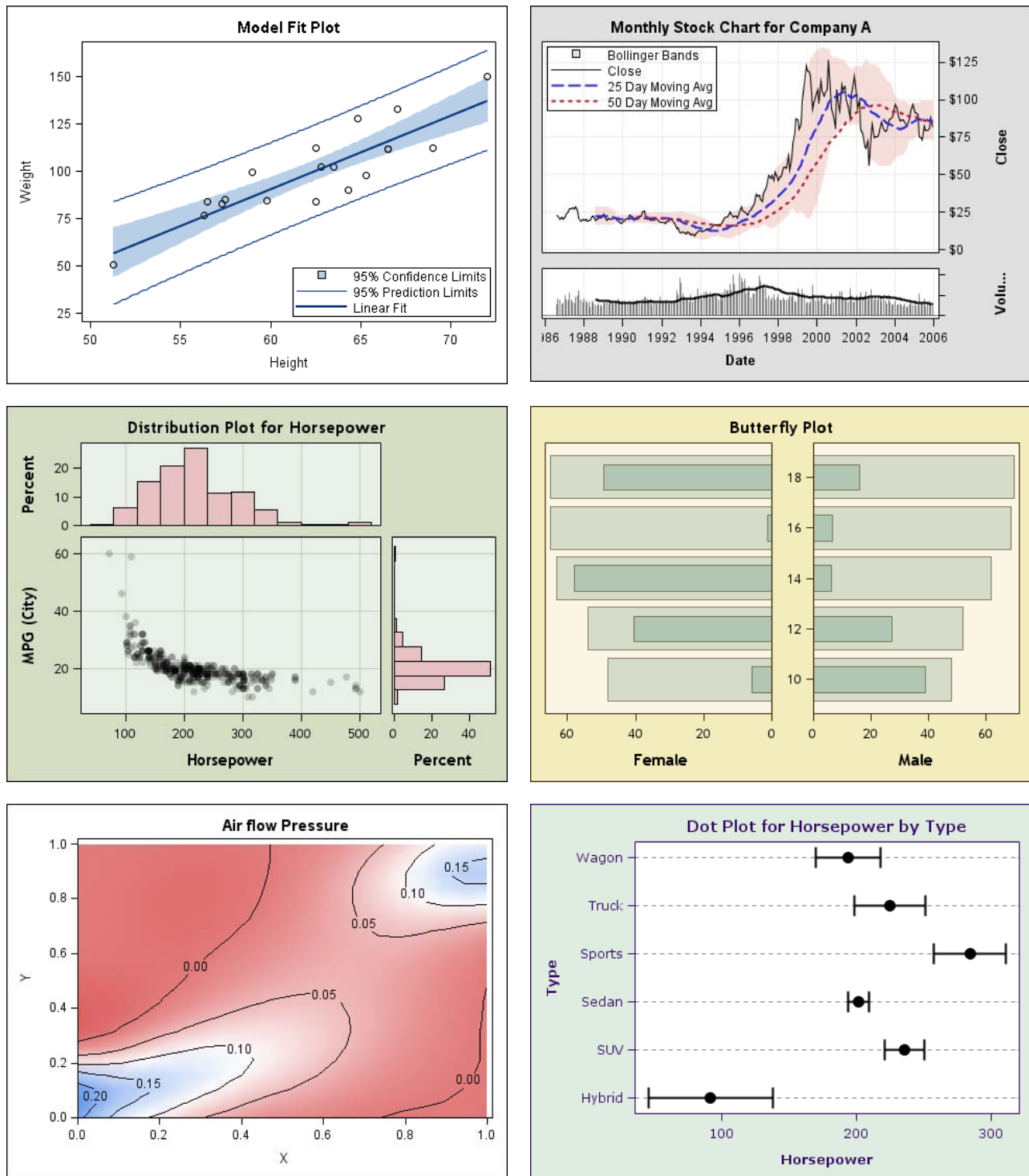


Figure 49 - Samples

CONCLUSION

The ODS Graphics Designer is a powerful application to create analytical graphs that uses an interactive, GUI-based process. The application is based on the same underlying technology as that which creates the graphs in the ODS Graphics system, so the output is consistent in features and appearance with the rest of the ODS graphics output. Now you can do all your work within the SAS environment, and do not need to export your data to other software just for graphics.

Additionally, any graphs you build can be run in batch with different data and variable assignments using the SGDESIGN procedure. You can also use the Designer as a learning tool to come up to speed on GTL programming. The Designer builds STATGRAPH templates to do the graphs, and you can view these templates as you change your graph step by step. To go beyond the Designer feature set, you can cut and paste the GTL code into a SAS Program Editor window and extend it as needed.

RECOMMENDED READING

Heath, Dan. 2007. "New SAS/GRAPH Procedures for Creating Statistical Graphics in Data Analysis." *Proceedings of the 2007 SAS Global Forum*. Cary, NC: SAS Institute Inc. Available at www2.sas.com/proceedings/forum2007/193-2007.pdf.

Heath, Dan. 2008. "Effective Graphics Made Simple Using SAS/GRAPH® "SG" Procedures." *Proceedings of the 2008 SAS Global Forum*. Cary, NC: SAS Institute Inc. Available at www2.sas.com/proceedings/forum2008/255-2008.pdf.

Matange, Sanjay. 2008. "Introduction to Graph Template Language." *Proceedings of the 2008 SAS Global Forum*. Cary, NC: SAS Institute Inc. Available at www2.sas.com/proceedings/forum2008/313-2008.pdf.

Schwartz, Susan. 2008. "Butterflies, Heat Maps, and More: Explore the New Power of SAS/GRAPH." *Proceedings of the 2008 SAS Global Forum*. Cary, NC: SAS Institute Inc. Available at www2.sas.com/proceedings/forum2008/243-2008.pdf.

Heath, Dan. 2009. "Secrets of the SG Procedures." *Proceedings of the 2009 SAS Global Forum*. Cary, NC: SAS Institute Inc.

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