

## CHAPTER

## 1

# Introduction to SAS/GRAPH Statistical Graphics Procedures

|   |    |
|---|----|
| <i>Overview of SAS/GRAPH Statistical Graphics Procedures</i>                                    | 3  |
| <i>Introduction to the SGPLOT Procedure</i>   | 4  |
| <i>Introduction to the SGPANEL Procedure</i>  | 5  |
| <i>Introduction to the SGSCATTER Procedure</i>  | 7  |
| <i>Introduction to the SGRENDER Procedure</i>   | 9  |
| <i>The ODS Graphics System</i>  | 10 |
| <i>Statistical Graphics Procedures and the Output Delivery System (ODS)</i>                     | 10 |
| <i>Differences between Statistical Graphics Procedures and Traditional SAS/GRAPH Procedures</i> | 11 |
| <i>References</i>   | 12 |

## Overview of SAS/GRAPH Statistical Graphics Procedures

SAS/GRAPH statistical graphics procedures (SG procedures) enable you to easily create complex statistical graphics that use the principles of effective graphics\* to accurately communicate the results of your analysis to your consumers. The SG procedures require minimal coding, which enables you to focus on your statistical analysis instead of the visual appearance of your graphs.

Default appearance attributes such as colors, fonts, and line styles are set by the current ODS style. SAS provides a set of styles that have been optimized to produce clear and effective graphics. Attributes have been chosen to ensure that graph elements have sufficient visibility and contrast, even when color is not used. Graphs elements are visually balanced so that no one element unintentionally appears to be more important than any other. Graphs produced by the SG procedures are clean and uncluttered, which enables you to make easy comparisons and interpret information accurately.

The SG procedures use the Graph Template Language (GTL) to create the most commonly used graphs. The GTL is a comprehensive language for defining statistical graphics. For more information about the GTL, see *SAS/GRAPH: Graph Template Language User's Guide*.

There are four SAS/GRAPH statistical graphics procedures, each with a specific purpose. Each procedure supports BY processing and the paging of large paneled graphs where applicable.

- The SGPLOT procedure is designed to create a single-celled graph, with multiple plots overlaid within a single set of axes. The procedure syntax supports many different types of plots and graph features.
- The SGPANEL procedure creates classification panels for one or more classification variables. Each graph cell in the panel can contain either a simple plot or multiple, overlaid plots.

\* For more information about the principles of effective graphics, see Cleveland (1993) and Robbins (2005).

- The SGSCATTER procedure creates paneled graphs with multiple scatter plots. You can create three different types of layouts.
- The SGRENDER procedure is a utility procedure that produces graphs from templates that are written in the Graph Template Language.

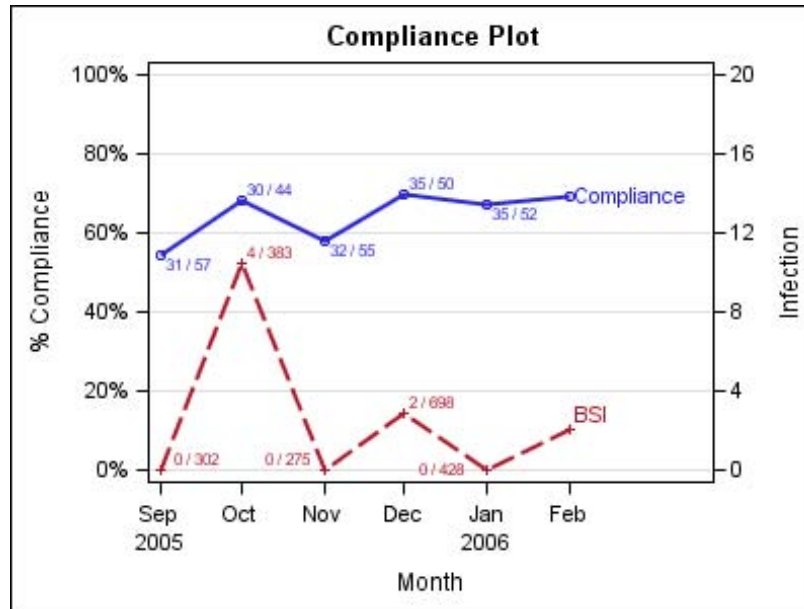
## Introduction to the SGPLOT Procedure

The SGPLOT procedure is optimized to display overlaid plots on a single set of axes. The procedure syntax supports the following features:

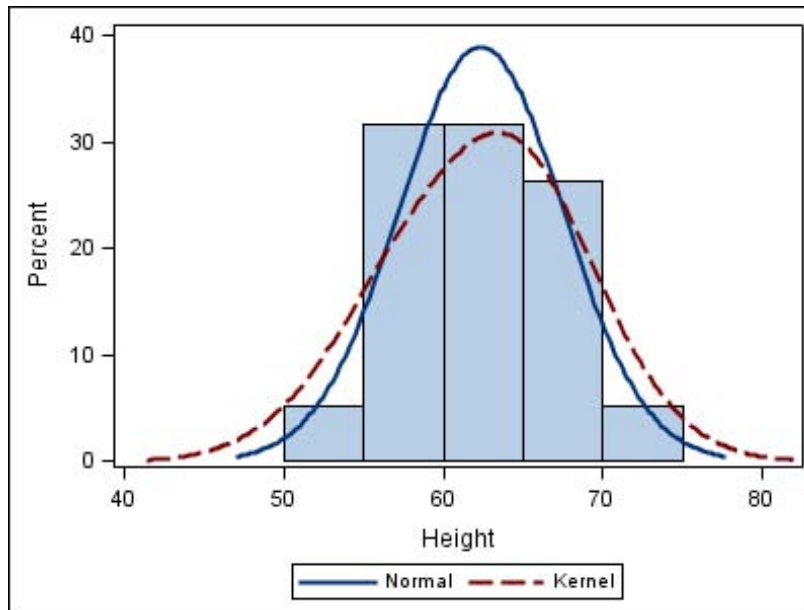
- Basic plots: scatter plots, series plots, band plots, needle plots, and vector plots.
- Fit and confidence plots: loess curves, regression curves, penalized B-spline curves, and ellipses.
- Distribution plots: histograms, box plots, and density curves.
- Categorization plots: bar charts, dot plots, and bar-line charts.
- Insets, legends, and reference lines.

All of the plot statements that are used in the SGPLOT procedure share a single set of axes. You can customize these axes by using axis statements such as XAXIS and YAXIS.

The following images show examples of types of graphs that you can create with the SGPLOT procedure:



This is an example of two series plots that are overlaid in a single graph. Each plot is assigned to a different vertical axis. Data labels and curve labels have been added for direct reference.



This is an example of a graph that uses a histogram, a kernel density curve, and a normal density curve.

For more information about the SGPLOT procedure and the procedure syntax, see Chapter 4, “The SGPLOT Procedure,” on page 121.

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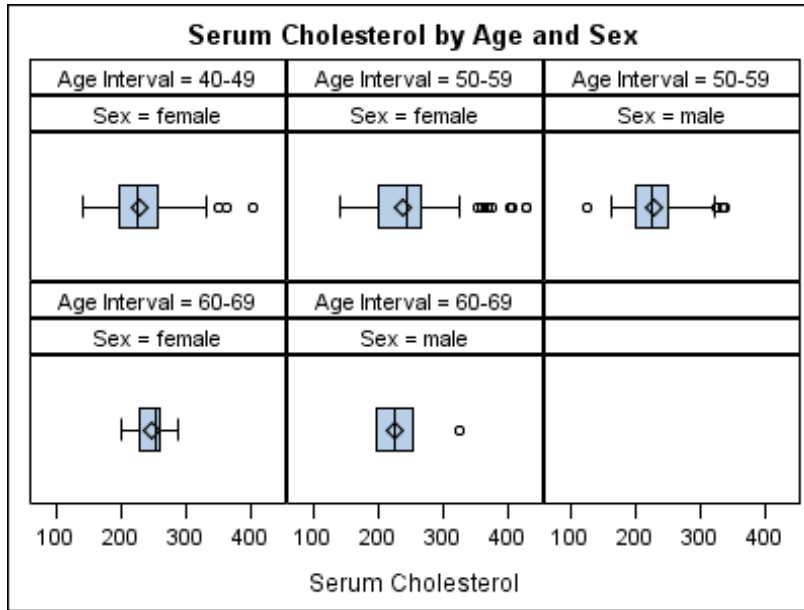
## Introduction to the SGPANEL Procedure

The SGPANEL procedure creates a panel for the values of one or more classification variables. Each graph cell in the panel can contain either a single plot or multiple overlaid plots. The procedure syntax supports the following features:

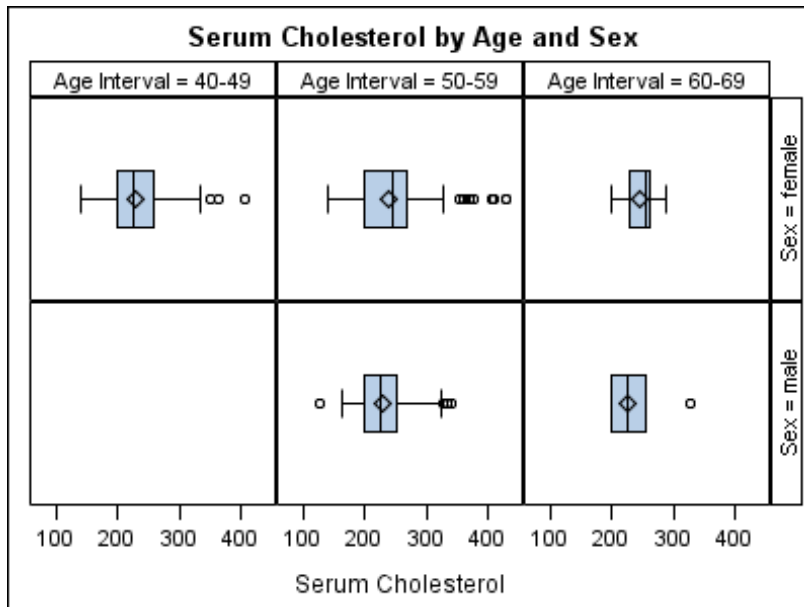
- four types of panel layouts: PANEL, LATTICE, COLUMNLATTICE, and ROWLATTICE
- basic plots: scatter plots, series plots, band plots, needle plots, and vector plots
- fit and confidence plots: loess curves, regression curves, and penalized B-spline curves
- distribution plots: histograms, box plots, and density curves
- categorization plots: bar charts, dot plots, and bar-line charts
- legends and reference lines

The SGPANEL procedure can create several layouts, depending on the value of the LAYOUT= option. You can specify the PANEL layout, the LATTICE layout, the COLUMNLATTICE layout, or the ROWLATTICE layout.

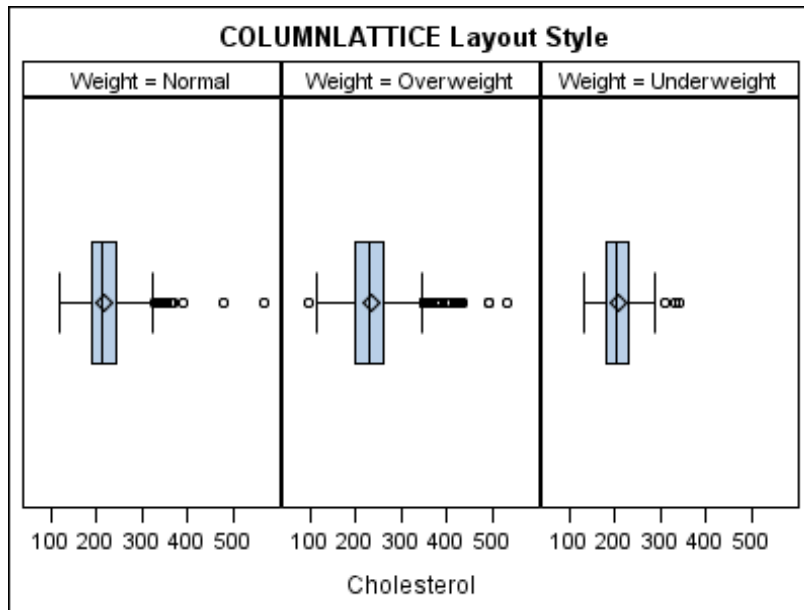
The following examples show some types of layouts that you can create with the SGPANEL procedure.



This is an example of the default PANEL layout. In the PANEL layout, each graph cell represents a specific crossing of values for one or more classification variables. A label above each cell identifies the crossing of values that is represented in the cell. By default, cells are created only for crossings that are represented in the data set.



This is an example of the LATTICE layout. In the LATTICE layout, the graph cells are arranged in rows and columns by using the values of two classification variables. Labels above each column and to the right of each row identify the classification value that is represented by that row or column. A cell is created for each crossing of classification values.



This is an example of the COLUMNLATTICE layout. In the COLUMNLATTICE and ROWLATTICE layouts, the graph cells are arranged in a single row or column by using a single classification variable. A cell is created for each value of the classification variable.

For more information about the SGPANEL procedure and the procedure syntax, see Chapter 3, “The SGPANEL Procedure,” on page 27.

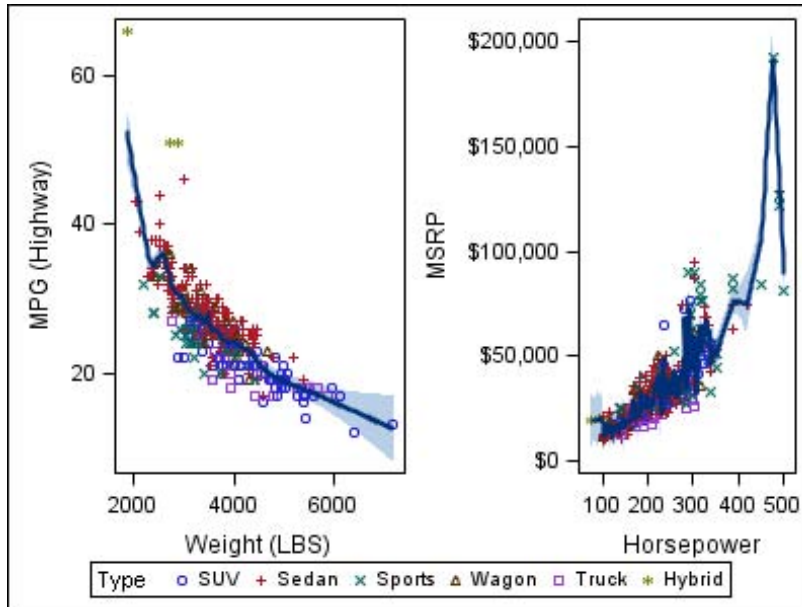
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## Introduction to the SGSCATTER Procedure

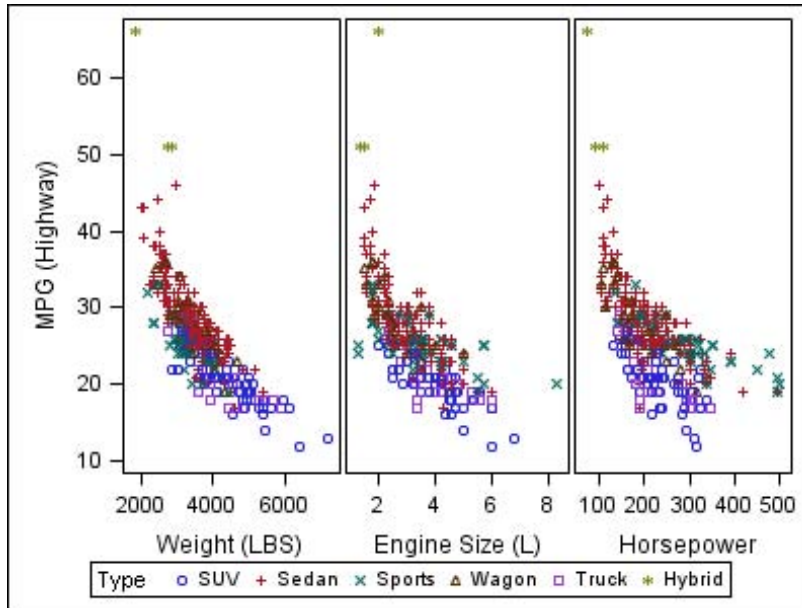
The SGSCATTER procedure creates a paneled graph for multiple combinations of variables. The procedure syntax supports the following features:

- three types of graph layouts: PLOT, COMPARE, and MATRIX
- basic scatter plots
- fit and confidence plots: loess curves, regression curves, penalized B-spline curves, and ellipses
- distribution plots: histograms, box plots, and density curves
- legends

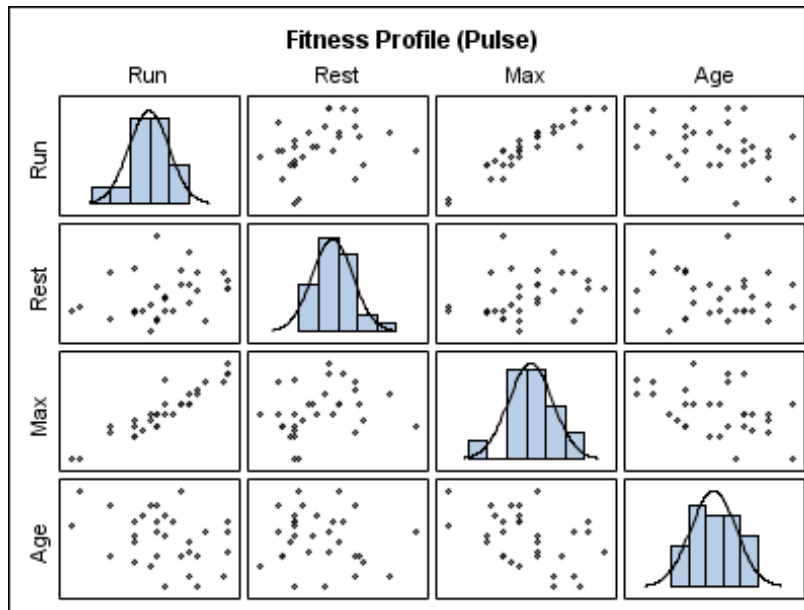
The SGSCATTER procedure has three plot statements that create different types of layouts, as shown in the following examples:



The PLOT statement creates a paneled graph with multiple independent cells. A cell is created for each combination of X and Y variables that you specify.



The COMPARE statement creates a paneled graph that uses common axes for each row and column of cells.



The MATRIX statement creates a matrix of scatter plots, in which each cell represents a different combination of variables. In the diagonal cells, you can place labels, histograms, or density curves.

For more information about the SGSCATTER procedure and the procedure syntax, see Chapter 5, "The SGSCATTER Procedure," on page 221.

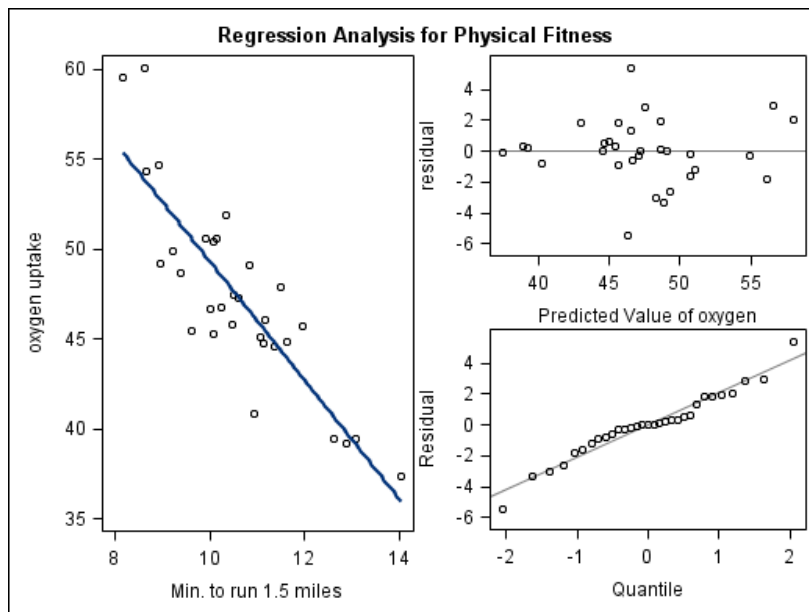
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## Introduction to the SGRENDER Procedure

The SGRENDER procedure creates graphical output from templates that are created using the Graph Template Language (GTL). You can use the GTL to create many different types of plots, paneled graphs, and matrices, some of which cannot be created with the other SG procedures.

For more information about the SGRENDER procedure, see Chapter 6, "The SGRENDER Procedure," on page 251. For more information about the GTL, see *SAS/GRAPH: Graph Template Language User's Guide*.

The following example shows a layout that you can create by using the GTL and the SGRENDER procedure.




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## The ODS Graphics System

SAS/GRAPH statistical graphics procedures (SG procedures) are a part of the ODS Graphics System—a set of SAS/GRAPH features that enable you to create and edit statistical graphics.

The ODS Graphics System contains the following features:

### *SAS/GRAPH statistical graphics procedures*

provide a concise syntax for creating effective statistical graphs. The SG procedures provide a traditional SAS procedure interface for the most commonly used features of the Graph Template Language.

### *SAS/GRAPH Graph Template Language (GTL)*

provides a comprehensive language for creating statistical graphics. You can use the Graph Template Language to create customized layouts and graphs that are beyond the scope of the SG procedures.

For more information about the Graph Template Language, see the *SAS/GRAPH: Graph Template Language Reference* and the *SAS/GRAPH: Graph Template Language User's Guide*.

### *SAS/GRAPH ODS Graphics Editor*

enables you to edit and enhance graphs that are produced by the SG procedures or by the Graph Template Language.

The ODS graphics editor is an interactive editor that enables you to modify the elements of a graph or to add new features, such as titles, arrows, and text boxes.

For more information about the ODS Graphics Editor, see the *SAS/GRAPH: ODS Graphics Editor User's Guide*.

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## Statistical Graphics Procedures and the Output Delivery System (ODS)

Output from the SAS/GRAPH statistical graphics procedures (SG procedures) is generated by the Output Delivery System (ODS). An ODS destination must be open to create output from the SG procedures.



The SG procedures automatically obtain their default appearance options from the current ODS style. The ODS styles are optimized to produce effective graphics without any changes to the defaults. However, you can use appearance options in your plot statements to override the default style settings, such as colors and fonts.

The ODS GRAPHICS statement enables you to set the output options for your statistical graphics. For example, you can use options in the ODS GRAPHICS statement to specify the size and format of your output images. For more information about the ODS GRAPHICS statement, see “Using the ODS GRAPHICS Statement” on page 282.

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## Differences between Statistical Graphics Procedures and Traditional SAS/GRAPH Procedures

In SAS 9.2, the default appearance of all graphs is determined by the ODS style that is currently in use. In general, this provides an effective default graph with minimal coding. When SAS/GRAPH coding is added to modify fonts, colors, line properties, or marker properties, it overrides the defaults that are defined by the style. This is true for both traditional SAS/GRAPH procedures and the statistical graphics procedures.

The following table lists some of the differences between traditional SAS/GRAPH and statistical graphics procedures:

| Traditional SAS/GRAPH  | Statistical Graphics Procedures  |
|--|--|
| Properties for text, markers, and lines can be set with global statements such as GOPTIONS, AXIS, LEGEND, PATTERN, SYMBOL, and NOTE.   | User control over visual properties is set with statements or options within the procedure.  |
| For some graphs, the plot type is determined by global options. For example, the INTERPOL= option in the SYMBOL statement might determine whether a graph is a scatter plot or a box plot.     | The plot type is determined by the plot statement only.  |
| The default graph output is produced as a GRSEG entry in a SAS catalog. Other output formats, such as an image or metagraphics file, can be created by selecting an appropriate device driver. | Only image files are created—GRSEGs and device drivers are not used. You can select your image format by using the IMAGEFMT= option in the ODS GRAPHICS statement.   |
| The size and format of graphical output is controlled with options such as the HSIZE=, VSIZE=, and DEVICE= options in the GOPTIONS statement.  | The size, format, and name of output images can be controlled with the HEIGHT=, WIDTH=, IMAGEFMT=, and IMAGENAME= options in the ODS GRAPHICS statement. The ODS GRAPHICS statement is similar in purpose to the GOPTIONS statement, but it is used with the Statistical Graphics procedures only. |
| All of the ODS destinations are supported. For the LISTING destination, a GRSEG node is created in the Results tree and the image appears in the Graph window.                                 | All of the ODS destinations are supported. For the LISTING destination, an image node is created for the graph in the Results tree. You can open the graph in an external viewer or in the ODS Graphics Editor.  |

| <b>Traditional SAS/GRAPH</b>   | <b>Statistical Graphics Procedures</b>  |
|--|---|
| All options for the TITLE and FOOTNOTE statements are supported.   | Some options for the TITLE and FOOTNOTE statements are not supported. See “TITLE and FOOTNOTE Statements” on page 19.   |
| Both SAS/GRAPH fonts (such as SWISSB) and system fonts (such as Arial) are supported.                      | Only system fonts are supported.  |
| Marker symbols can be either created from fonts or selected from a predefined set of named marker symbols. | Marker symbols can be selected only from a predefined set of named marker symbols. The named marker symbols are different from the named marker symbols in traditional SAS/GRAPH.   |
| Area fills can use either solid colors or patterns such as crosshatching.                                  | Area fills can use solid colors only. Transparent fills are supported.  |
| Anti-aliasing is not supported.  | Anti-aliasing is used for text and lines by default. You can disable anti-aliasing by using the NOANTIALIAS option in the ODS GRAPHICS statement.   |
| Transparency is not supported.   | You can specify the degree of transparency for many graphics elements.  |
| Scaling of fonts and markers is not supported.   | Scaling of fonts and markers is on by default. This means that the sizes of fonts and markers are adjusted as appropriate to the size of your graph. You can disable scaling by using the NOSCALE option in the ODS GRAPHICS statement. |
| Some procedures support RUN-group processing.  | RUN-group processing is not supported.  |
| The Annotate facility is supported.  | The Annotate facility is not supported. However, you can use the ODS Graphics Editor to annotate your graphs.   |

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## References

- Cleveland, W. S. (1993), *Visualizing Data*, Summitt, NJ: Hobart Press.
- Robbins, N. B. (2005), *Creating More Effective Graphs*, Hoboken, NJ: Wiley-Interscience.