OVERVIEW OF SAS/GRAPH(R) PROCEDURES AND FACILITIES

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Using non-SAS/Graph Techniques

Proc Print; Proc Tabulate; Proc Freq;...

Most SAS® output is based on a SAS procedure. In some sense, all output is graphic in nature. The objective in producing presentable output is that it be easily read and the message be apparent. Several features in the non-Graph side of the SAS system help. Many of the features of SAS/Graph are simply extensions of basic SAS statements, adding options for positioning and color.

Title 'text'; Footnote 'text';

SAS software allows titling and footnoting output with up to ten lines of text. The procedure output is adjusted to fit on the page between any titles and footnotes. The area for SAS/Graph output follows the same rule when outputting to a screen or other graphics device. A title remains in effect until a lower numbered title is submitted below it. The title thus effects output of procedures which follow it. A title will affect a procedure above it when it falls before the Run; statement or the next Data; or Proc; statement. The same rules apply to footnotes.

Titles and footnotes can also be specified using the Title or Footnote windows in the Display Manager. When no titles are specified, most SAS procedures, excepting SAS/Graph, put the title 'SAS' on their output. The Title; and Footnote; statements work essentially the same under SAS/Graph, with the addition of several options that control placement and appearance of the text. These options will be ignored if an active title is used with a non-Graph procedure. The Move=(+/-x,+/-y) option can specify absolute or relative movement. The Draw=(+/-x,+/-y,...) option allows line drawing. Color=, Height=, and Font= control obvious features, but can be abbreviated C, H, or F. The text appears within quotes, and can be interrupted with options as needed.

Options FormChar='XXlXX,...';

Other information may appear at the top of output, like the date and page number. The NoData, NoTitle, and other options in an Options; statement control the appearance of your output to some extent. The Display Manager's Options window allows you to view and edit these SAS options. In addition, the FormChar option controls the method used to box tables from Proc Freq; Proc Tabulate; Proc Calendar; etc. You should specify characters for the corners and connecting bars as 'B3C4D5A6C8BFC9C5B4D0C1D9X' if your printer supports the IBM® extended ASCII codes.

Proc Chart; Proc Plot;

The Chart and Plot procedures are closer to what would normally be called graphics. They both do exactly what the name implies, charts and plots. However, these graphs are output using normal ASCII characters, for instance, the bars in a bar chart are simply rows of asterisks (*). The graphics procedures of SAS/Graph require output to devices that display, plot, or print images in a true graphics mode. The SAS/Graph procedures all start with the letter G, for Graph. Thus, the SAS/Graph counterparts of Chart and Plot are GChart and GPlot, respectively.

SAS/Graph procedures get their data from a SAS dataset. Options specific to these procedures allow the frequencies, sums, groups, etc. to be determined by each procedure. So there is usually no need to pre-process the data before calling the graphic procedure.

Outputting

Format; Label;

The Label; and Format; statements affect SAS/Graph output just as in normal SAS procedures. The Label; statement replaces a variable name in the output. A Format; statement replaces and groups data values in the output.

Proc format library=library;

value fiscal 83='S3/84' 84='84/85' 85='85/86' 86='86/87'
87='87/88' 88='88/89' 89='89/90';

picture assm other=' 00.0' (prefix:='S');

data demo.mise;

input fiscal 2. assm
5.1 @;

label fiscal='Fiscal Year' assm='Assessments';

format fiscal mon8. assm assm.;

cards'
83 8.4'8417.6 8511.8 8614.6 8722.2 8815.2 8924.0

GOptlons;

The GOpts; statement is like Options; in that it provides control of global settings during your SAS session. GOptlons provides specific control of colors, text fonts and heights, and other features specific to SAS/Graph output.

GOptlons prompt display device=egal norotate gunit=ceils
colors=(red blue lilac vip orange fio rose);

639
Devices

You specify your output device in SAS/Graph with the Device= option in a GOptions; statement. The devices supported by SAS/Graph include many high-resolution graphics monitors, plotters, and color and laser printers. On the PC, the EGAL device driver supports the Enhanced Graphics Adapter's high resolution display, but Vector Graphics Adaptors are not supported until Release 6.04. HP Plotters are listed by model (e.g., HP7475). Postscript laser printers are supported by PS and more specific models, like QMS9800.

Colors

The colors used will depend upon the output device capabilities. Colors can be specified by common names, or several precise formats like hue/saturation/intensity.

Proc GDevice;

The GDevice procedure allows modification of a device driver. Certain features of each device can be changed, or a driver for a model similar to one that is supported can be created. This procedure is helpful when another page size is desired, or a higher resolution. These options can also be set with a GOptions; statement, but using GDevice will permanently change the option.

Proc GTestIt;

The GTestIt procedure can be used to test a device. It produces output with various test pattern colors and shapes, which can be compared to the output in the manual for accuracy.

Assist

The SAS/ASSIST menu environment is provided with base SAS software. Assist is a push-button environment developed by SAS Institute using SAS/AF. SAS/ASSIST can be invoked the first time by entering "AF C=SASHELP.ASSIST.PRIMARY.PROGRAM" on the Display Manager command line, and "AF" thereafter. Assist allows the user to create basic SAS code without actually coding. The options under the Graphics menu do not exhaust the SAS/Graph features and options. Nevertheless, SAS/ASSIST is worth invoking for beginners and advanced users. You are allowed to save the generated SAS code and use it as a learning example; the code can later be modified. For the advanced user, it allows a quick start to coding, because selection of input datasets and variables are menu driven. This eliminates remembering variable and dataset names, as well cutting down on typing errors.

Graphics without Graphs

Text control is typically a part of most graphic presentations. It can also stand alone when a presentation involves communicating purely textual information. Several procedures and statements provide simple and flexible methods for enhancing the impact of your message.

Proc GPrint;

The GPrint procedure prints a standard ASCII file on your graphics device. The FileRef= option specifies a file name, which should have been defined previously with a

Filename: statement. The CText option specifies a color for printing. The font, height, and other parameters can be specified in a GOptions; statement (FText=, HText=, etc.). Output from any Display Manager window can be saved with the FILE command.

If you are routing normal SAS procedure output to GPrint, remember to exclude titles on the non-Graph procedure. The pagesize and LineSize options may also need to be adjusted before submitting the procedure, depending on the graphic character size and space taken by graphic titles and footnotes.

Proc PrintTo fileref=filename;

To automate moving output from a standard SAS procedure to GPrint, the PrintTo procedure can be used to route output to a file instead of the Display Manager Output window.

Note 'text';

The Note; statement is only supported under SAS/Graph. It is similar to Title; and Footnote;, except it places text within the space between titles and footnotes. Text can thus overwrite a graphic. The Note; statement is not numbered like titles and footnotes, cannot appear outside a procedure, and does not remain active outside that procedure.

Fonts

The default font for titles in SAS/GRAPH is COMPLEX, which is, contrary to its name, a simple and quick character set. It is drawn with lines, not filled in. SIMPLEX, DUPLEX, and TRIPLEX are similar. ITALIC, GITALIC, and TITALIC are italics based on these fonts. SCRIPT and CSCRIPT are script (cursive) variations. SWISS is a filled Roman font with serifs. BRUSH is a filled Roman font with serifs. CENTURY and ZAPF are filled Roman fonts with serifs. OLDENG stands for Old English.

Foreign characters include GERMAN, GREEK and COGREK, CYRILLIC (Russian), and HEBREW. MATH includes mathematical symbols; WEATHER, meteorology; ELECTRON, electronic; CARTOG, cartography (map making); and MUSIC, musical notes, etc. MARKER includes arrows and such, and SPECIAL includes zodiacal signs, planetary symbols, and other symbols found on a box of Lucky Charms cereal.
Add an L to a font name for a light variation, X for medium. Add a U for uniform spacing. Add an E for an empty font. Add B and I for Bold and Italic. Spacing of characters not filled, or outlined. Not all these variations can be applied to all fonts. Enter the Display Manager command 'Catalog SASHelp.Fonts' to see what is applied to all the fonts. Enter the Display Manager available. Release 6.06 of the SAS system for Personal Computers (PC's) will add support for Bitstream fonts, compatible, Hewlett-Packard(R) compatible, and various other output devices.

Proc GFont;
In addition to the supplied fonts, a procedure in SAS/Graph allows you to define your own characters and build a new font. You essentially record the path of a pen in drawing a character—storing the position of each turning point in the stokes in a SAS dataset. This would obviously take some time, but would be worthwhile for integrating a couple of common symbols or logos in your graphics.

Proc GSlide;
The GSlide procedure simply prints or displays active titles, footnotes, and any notes specified within it. The result is, of course, a word slide without graphics.

Proc GChart;
GChart produces several types of charts. The chart is adjusted to fit in the space left between titles and footnotes. Certain features of the charts can be controlled using Pattern; Axis; and Legend; statements, which are described below.

The Vbar; and Hbar; statements produce vertical and horizontal bar charts, commonly called histograms. A Block; statement produces a three-dimensional bar chart, which appears as columns rising up from the specified group columns and rows.

The Pie; statement presents a pie showing slices that represent proportions of a category. A Star; statement is similar to a pie chart, but each slice is extended out from the center for a distance that represents some other value. This can be thought of as a two-dimensional pie.

Patterns;
Pattern; statements specify what colors and/or crosshatching patterns are used to fill bars, pies, and other areas used by SAS/Graph procedures. The color, angle, and density of crosshatching can be given by various Value option format statements. The appropriate format depends upon the type of area drawn by the procedure: polygon, bar, or pie slice. Patterns are used by a procedure in order. Without Pattern; statements, a default order of colors and crosshatching are used. A pattern can also be used more than once by using the Repeat option.

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Legends:
A legend can be removed or redesigned using the `Legend` statement. The legends are numbered for reference within the procedures. The positioning of the legend cannot be controlled.

Proc GPlot:
The GPlot procedure produces plots of points against and x and y axes. A `Plot` statement specifies what variables to plot. The points can be represented by various symbols, colors, etc. A `Symbol` statement (described below) is referenced to define a plotting method. A `Bubble` statement places circles on a plot which sizes represent a third variable.

```
proc gplot data=demo.disaster (keep=date dead) out=work.tempplot; by date; run;
proc gplot data=work.tempplot;
plot dead*date / frame ha:xis='Oljan1925'd 'Oljan1975'd 'Oljan2000'd;
format dead comma7.; label dead='Deaths'; run;
```

Symbols:
Control over the characters or symbols plotted is given with a `Symbol` statement. A symbol is referenced by placing an equal sign (=) and the symbol number after the plot variable specification in the procedure.

In addition to special symbols and coloring, the `Symbol` statement allows connection of the points in a plot. The points can be connected by a line, or a smoothed or regressed line can be shown. Regression can achieve a one, two, or three degree fit. Smoothing uses medians and other measures of the points about each other to smooth out outliers and spurts. The degree of smoothing can be rough, or a very smooth curve can be produced.

```
data demo.randsin;
do i=1 to 150 by 5;
x=i+2*(ranuni(62662)–5);
y=sin(362652)+2*(ranuni(12345)–5); output;
end;
proc gplot data=demo.randsin; plot y*x=I/ frame;
```

Another Dimension to SAS

Proc G3d:
A three dimensional plot can be produced with the G3d procedure. Needles can connect point to the x–y surface in a scatter plot, with various symbols representing the points in space. The `Scatter` statement plots point, while the `Plot` statement connects the dots.

```
data demo.cowboy;
do x=-5 to 5 by 2;
do y=-5 to 5 by 2;
z=sin(sqrt(x*x+y*y)); output;
end;
end;
proc g3d data=demo.cowboy; scatter y*x=2 / tilt=66 rotate=66 shape='point' size=3 color=yellow 'squares needle';proc g3d data=demo.cowboy; plot y*x=2 / tilt=66 rotate=66
crop=yellow 'bottom=green noaxes';
```

Proc G3grid:
Data can be collapsed or smoothed using the G3grid procedure. This is necessary when a three dimensional plot is too noisy or too many points are represented. The value of smoothing has already been emphasized.

Proc GContour:
A flat representation of three dimensional data can be achieved with the GContour procedure. Various colors and patterns can be used to delineate the Z level of a graph.

```
data demo.cowboy;
do x=-5 to 5 by 2;
do y=-5 to 5 by 2;
z=sin(sqrt(x*x+y*y)); output;
end;
end;
proc g3grid data=demo temp out=demo2;
grid y*x=z;
run;
proc g3d data=demo2; plot y*x=z;
```

Mapping

Proc GMap:
Mapping is achieved with the various statements of the GMap procedure. Maps depend upon special datasets that contain the points necessary to draw the areas of a map. While datasets can be created, SAS provides county-level maps for the U.S.

Choro:
A Choropleth map is a map of each area in various colors, depending on the values being mapped by the procedure. The `Choro` statement is used for the simplest two-dimensional maps.

Surface:
A `Surface` statement produces lines across the map with spikes that represent the response values for each area.

Prism:
A `Prism` statement will produce a three-dimensional map with each area of a map raised up to a level that
represents its value in the data. Some areas may be hidden by higher areas in front of them. The viewing angle can be adjusted for the best affect.

The GProject, GReduce, and GRemove procedures are utilities that help define maps. The GReduce procedure can change the resolution. GRemove allows you to remove boundaries between areas, which is like regionalization.

```sas
proc format library=library;
  value Fotal
   0  = "Under 250"
   250 = "250-750"
  750 = "750-1,500"
  1500 = "1,500-2,500"
  2500 = "Over 2,500";
run;
```

**Annotate**

**Data**

To annotate is to make marks and notes on a work. A special data set is used when a procedure calls an annotation. This dataset contains an ordered list of functions and other variables. Labels, lines, bars, and circles (or arcs) are available. With patience, detailed backgrounds can be produced. In addition, data-dependent references allow output from SAS/Graph procedures to be labeled and designed.

The resulting annotations are applied to any graphic by specifying the annotate dataset in an Annotate= option on the appropriate graph statement. The size, font, color, and other controls are applied in the annotate dataset observation order. The positioning of annotations can be absolute or relative, referencing the entire screen, the plot area (inside titles and footnotes), or the data area. Data-dependent positioning allows the annotation to automatically adjust when data is replaced or corrected.

```sas
data barval;
length text $20
function style $8
xys $4
position $2;
set demo.miles;
function='label'
style='swivel'
xys='2'
yys='2'
position='2'
when='A'
x=fasal;
y=assm;
text=left("put(assm,assm;");
proc gchart data=demo.miles;
vsbar fasicl/discrete type=sum sumvar=assm
annotate=barval;
```

**Macros**

SAS has supplied several macros that help construct an Annotate dataset. These macros initialize the length, X and Y system, and other essentials. The macros should reside on your PC under the ISASROOT\SASMACRO directory.

**Proc GAnno**

The GAnno procedure is provided to allow display of an Annotation without invoking another procedure. This is useful when you are testing a screen or when the Annotation is a complete display.

**Proc GReplay**

Graphs can be saved in a user catalog by specifying a GOut= option in most procedures. The value provided can name a permanent or temporary catalog. The same value is then used with the IGOOut= option. The name of the specific output is given in the procedure call for some procedures, and in the statement producing the output for
other procedures with a Name= option. This name, or the
position number of the output in the catalog, is given in a
Replay statement. By default, output is named after the
procedure used and saved under Work.GSeg, then erased
at the end of the session.

```sas
proc g3d data=demo.cowrb gout=demo.hat;
plot y=x z/name='ahat';
proc greplay nofs igout=demo.hat;
replay ahat;
```

Template ;
Templates can be created to allow presentation of more
than one graph on one screen or page. A template is
basically a set of windows in which graphs can be
displayed. It can be defined either through the GReplay
TDef statement or interactively in GReplay's fullscreen
mode. Interesting distortions, effects, and comparisons
can be achieved fairly easily. Output can also be overlaid
using the template facility.

Output is placed in the window(s) of a template by using
the TReplay statement of the GReplay procedure, instead
of the Replay statement. The graphic name or number is
listed after the window number it is to fill. Templates
cannot be used in full-screen replay mode.

The location of the template definition is given in a TC
(Template Catalog) statement. SAS Institute has included
several common template definitions in the
SASHHELP.TEMPLT catalog.

```sas
proc greplay nofs igout=demo.demo;
tc demo.demo;
query foursq dot='Four square window panes'
 1 / ulx=000 uly=100 urx=049 ury=100
    lxx=000 lyy=052 lrx=049 lry=052
    color=red
 2 / ulx=051 uly=100 urx=100 ury=100
    lxx=051 lyy=052 lrx=100 lry=052
    color=blue
 3 / ulx=000 uly=048 urx=049 ury=048
    lxx=000 lyy=000 lrx=049 lry=000
    color=green
 4 / ulx=051 uly=048 urx=100 ury=048
    lxx=051 lyy=000 lrx=100 lry=000
    color=yellow
template foursq;
  treplay 1:display 2:disstar2 3:disday 4:displot;
```

End Notes
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