USING THE SAS/GRAPH® TEMPLATE FACILITY TO ROTATE
MULTIPLE PLOTS PER PAGE IN BATCH COMPUTING

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ABSTRACT:
Combining different graphics output on one page can aid in comparisons and comprehension. Similarly, display of graphics output in vertical, or portrait, style can facilitate viewing and emphasize a point. These two concepts can be combined to generate multiple plots per BY variable on the same page through creative use of the SAS/GRAPH® template facility in PROC GREPLAY. The template can be called numerous times to produce such graphics output via batch computing for all values of the BY variable.

INTRODUCTION:
The presentation of data through graphics rather than tables can be extremely useful in making a point. SAS/GRAPH® provides us with a number of good tools for doing this, one of which is the template facility. In this presentation, I will discuss three features of this facility which can be taken advantage of to convey and emphasize certain points and to do so economically through batch computing:
- rotating a plot to vertical
- placing multiple plots on a page
- using BY statements in the graphics procedures

Rotating a graph can be useful because presenting data horizontally can convey the impression that a line is flat, whereas presenting the same data vertically may show that the line has a slope. If the presenter is attempting to emphasize the slope, a vertical expression of the data is preferable.

If the information on two different plots must be compared, it is much easier for the viewer to make the comparison when both graphs are on the same page, rather than flipping back and forth between pages. This is another case where vertical plots are helpful, since this approach will give the x and y axes similar dimensions, whereas a horizontal approach would greatly reduce the y axis.

This situation of placing two plots on the same page can be achieved over an entire data set using a BY statement in two PROC GPLOT's and then replaying them onto a template through PROC GREPLAY. This can be accomplished in batch mode, saving on personnel and CPU time.

All three of these concepts can be realized by using the SAS/GRAPH® template facility.

METHODS:
Rotation:
There are a large number of device drivers for which SAS does not support the rotate/norotate option. In these cases it becomes necessary to find an alternative rotation method. The SAS/GRAPH® template facility provides this.

The template facility makes use of the following coordinate system:

\[
\begin{array}{cc}
(0,0) & (100,100) \\
(0,100) & (100,0)
\end{array}
\]

All panels defined through this facility must specify four boundaries within the above ranges: lower left (LL), upper left (UL), upper right (UR), and lower right (LR). By a simple 90° clockwise shift of this coordinate system on paper, panels can be specified that will cause the output of SAS/GRAPH® procedures to be placed in a vertical, rather than horizontal, position:

\[
\begin{array}{cc}
(0,0) & (0,100) \\
(100,0) & (100,100)
\end{array}
\]

This template design produces a rotated (vertical) plot:

Panel 1: LL=(100,0) UL=(0,0) UR=(0,100) LR=(100,100)

Multiple Plots Per Page:

It is possible to place more than one panel on a rotated template. The following template description consists of two panels which, when invoked through PROC GREPLAY, will produce two rotated plots on the same page:

Panel 1 LL=(55,0) UL=(0,0) UR=(0,100) LR=(55,100)
A display of the template, either on the screen (full screen mode) or on the plotter (line mode), will look like this:

```
(0,100) (100,100)
(0,0) (100,0)
```

Note that the panel boundaries are vertical, where in a non-rotated plot they are horizontal. There is also some degree of overlap between the two panels, allowing more room for each plot, but without causing the plots to overlap on the page. Save this template as a member in a SAS graphics catalog for future use with PROC GREPLAY.

BY statements in PROC GPLOT:

While a template can be defined in either interactive or batch mode, the following algorithm is ideal for running in batch mode.

The template saved above will be utilized to produce two different plots for each subject in a data set. The first one will plot the blood levels of a metabolite over time, and the second will plot the dose of drug received by the same patient over the same time interval. By displaying both plots on the same page, the observer can easily discern a relationship between drug dosage and metabolite concentration.

To generate these different plots over an entire data set, two PROC GPLOT's will be executed, each with a BY statement, and each routing output to a graphics catalog for subsequent re-playing rather than to a plotter.

```
********** First Plot (Metabolite) **********;
*** Set height of by-line. ***;
GOPTIONS HBY=3.0;
*** Create output for first panel. ***;
***This will include title for whole graph***;
PROC GPLOT DATA=SAMPLE GOUT=WORK.PLOT;
PLOT METAB • DAY / NOLEGEND VAXIS=AXISI
HAXIS=AXIS2;
BY SUBJECT;
*** Join values with straight line ***;
*** connected by stars. ***;
SYMBOLI H=2.5 C=BLACK V=STAR I=JOIN L=1;
*** Create title for whole graph. ***;
TITLE1 H=3.5 J=C 'Metabolite and Dose Levels ' 'Daring Study';
*** Create y-axis label. ***;
TITLE10 H=2.5 J=C A=90 R=270 'notartnecnoC';
AXISI LABEL=(C=BLACK H=2.5 ' ')
ORDER=(0 TO 100 BY 20) VALUE=(H=2.5);
AXIS2 LABEL=(C=BLACK H=2.5 ' ')
ORDER=(0 TO 10 BY 1) VALUE=(H=2.5);
NOTE H=2.8 M=(77,51) 'Metabolite';

********** Second plot (Dose) **********;
*** Turn off printing of by line. ***;
GOPTIONS HBY=0;
*** Create output for second panel. ***;
***This will include legend for whole graph.***;
PROC GPLOT DATA=SAMPLE GOUT=WORK.PLOT;
PLOT DRUG' • DAY / NOLEGEND VAXIS=AXISI
HAXIS=AXIS2;
BY SUBJECT;
*** Join values using step method. ***;
SYMBOLI C=BLACK V=NONE I=STEPR3;
TITLE1;
*** Create y-axis label. ***;
TITLE10 H=2.5 J=C A=90 R=270 'esoD';
AXISI LABEL=(C=BLACK H=2.5 ' ')
ORDER=(0 TO 10 BY 2) VALUE=(H=2.5);
AXIS2 LABEL=(C=BLACK H=2.5 ' ')
ORDER=(0 TO 10 BY 1) VALUE=(H=2.5);
NOTE H=2.8 M=(77,52) 'Drug Dose';
*** Print a legend. ***;
FOOTNOTE1 H=2.5 J=C 'Days Post-Treatment';
```

To produce these plots for all subjects in a data set, determine the number of subjects (n) and set up TREPLAY statements in PROC GREPLAY accordingly. Members of a graphics catalog are placed in the catalog in the order in which they were generated, so the numerical order of catalog members will follow the order of subjects in the PROC GPLOT BY statements. The first plot (metabolite) for the first subject will be catalog member 1; the first plot for the second subject will be catalog member 2; the first plot for the third subject will be catalog member 3. This continues until there are n metabolite plots in the catalog. Then the second set of plots (dose) for all subjects is added to the catalog, becoming members n+1, n+2, n+3, ... n+m.

To generate these plots in the correct order, use a TREPLAY statement for each subject. Specify the template panel number.
followed by the graphics catalog member number in each TREPLAY statement.

If n=3:

```plaintext
*** plot graphs. ***;
PROC GREPLAY IGOUT=WORK.PLOT
 TC=TEMPL.TEMPL.TEMPLATE=ROT2;
 TREPLAY 1:1 2:4; *** Subject 1. ***;
 TREPLAY 1:2 2:5; *** Subject 2. ***;
 TREPLAY 1:3 2:6; *** Subject 3. ***;
```

The graphs resulting from this method possess the following features:

1. They are rotated, allowing enough room for two plots to be presented with reasonable dimensions.
2. Both plots are on the same page, aiding the comparison of the drug dose a subject is receiving with the change in their metabolite levels.

3. The plots can be run in batch mode, conserving the time of the graphics programmer as well as computing resources.

CONCLUSION:

By shifting the coordinate system used in the SAS/GRAPH® template facility 90° clockwise, panels can be specified that will produce a rotated plot through PROC GREPLAY. Multiple and different rotated plots per page can be defined, aiding in viewer comprehension. Through use of the TREPLAY statement, the template can be called numerous times to produce such graphics output via batch computing, conserving programming resources.

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METABOLITE AND DOSE LEVELS DURING STUDY

![Graph showing metabolite levels for Subject 1](image)

SUBJECT=1

METABOLITE

![Graph showing drug dose levels](image)

DRUG DOSE

DAYS POST-TREATMENT