THE AXIS STATEMENT:
YOUR ALLY FOR CONTROLLING GRAPHIC TEXT

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ABSTRACT

One of the strengths of SAS/GRAPH® that you can easily take advantage of is the control that is available for the presentation of lettering and symbols in the titles and labels associated with a plot's axis. The AXIS statement is especially useful when precise control is needed. The AXIS statement need not be hard to use. However because many of the options are structured differently than in other statements, some users do find it difficult to get the AXIS statement to do what they want.

This paper will provide an introduction to the AXIS statement, its more common options, and some examples of how they can be used. Options and features are available that can turn an ordinary axis into one that becomes an integral part of the graphic.

Text options include:
  • text can be enhanced by changing the fonts, color, and size.
  • text can be rotated and moved to various positions on the graphic.

The AXIS statement can also be used to control the appearance of the axes of a chart or plot. Options include the ability to:
  • control axis scaling.
  • place special values on the major tick marks.
  • specify the number and placement of major and minor tick marks.

AXIS STATEMENT STRUCTURE

The AXIS statement is used to control the appearance and scaling of the axes on a plot. This statement can be used in any procedure within SAS/GRAPH (except G3D) that produces an axis. Unlike SYMBOL and PATTERN statements, the AXIS statement is self contained and is not additive. It takes the form of:

```
AXIS <statement options>;
```

The syntax for AXIS statement options is similar for most of the options. The option name is followed with an equal sign and the option modifiers are contained in parentheses following the equal sign. Most options can be turned off by using ‘none’.

AXIS statement options include:

```
minor = (n=5 h=1) specifies five minor tick marks of a length of one cell unit.
label = none blanks out the label for this axis.
major = (n=6 h=1.5) requests six major tick marks each with a length of 1.5 cells.
value = none blanks the values associated with the major tick marks.
```

CHANGING TEXT ORIENTATION WITH ROTATE= AND ANGLE=

It is often very useful to be able to place axis labels next to the vertical axis of a scatter plot. The ROTATE= option applies to individual letters while ANGLE= applies to the entire string. You can also use these options in the AXIS statement to further control text orientation.

Axis labels can be produced using the AXIS statement, and the ANGLE= and ROTATE= options behave in a similar fashion in this statement as they do in the TITLE and FOOTNOTE statements.

```
axis1 label = (f=simplex angle=90 'Ozone levels at three locations'
                 j=c angle=90 h=1.5
                'Ozone levels at three locations'
                j=c angle=-90 rotate=90 h=1.5
```

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The LABEL= option is used to define label text within the AXIS statement. Within the parentheses the options and text strings are arranged as they are for titles and footnotes.

USING THE LOGARITHM OPTIONS

Generally speaking axes tend to have equally spaced major and minor tick marks. When data are highly skewed to the right (a few observations with very large values) or to the left (a few observations with very small values), linearly scaled plots will not show enough detail for a majority of the observations.

One approach to this type of problem is to use the logarithmic transformation on the data. This may show the detail, but results in a graph that is not scaled in the original units. The AXIS statement contains two options that allow the user to plot actual values against a logarithmic scale. Logarithmic scales do not have equally spaced minor tick marks, and while the major tick marks are equally spaced, the difference in value between them is not constant.

The two options that allow logarithmic scaling are LOGSTYLE and LOGBASE. LOGSTYLE is used to select a tick mark and spacing style for the axis and LOGBASE is used to select the logarithmic base.

LOGSTYLE=EXPAND results in the unequally spaced minor tick marks.

LOGSTYLE=POWER plots the exponent rather than the actual value. This results in a plot similar to what one would expect if

The following code generates some logarithmic data and demonstrates what happens when it is plotted with and without using the AXIS options LOGSTYLE and LOGBASE.

data logdata;
do x = -1 to 3 by .1;
y = 10 ** x;
output;
end;
axis1 logstyle=expand logbase=10;
proc gplot data=logdata;
plot y * x;
plot y * x / vaxis=ax1is1;
symbol1 v=none i=join 1=1;
title1 'Y = 10' move=(+0,+.5) 'X';
footnotel j=2 h=2 'Figure 2';
run;

The same data are plotted twice with different options for the vertical axis.
WORKING WITH TICK MARK TEXT STRINGS

It is at times useful to replace the tick mark numbers on one or both of the axes with textual information. Without using the ANNOTATE facility there are a couple of ways that this can be accomplished.

- user defined formats
- VALUE = option in the AXIS statement.

Defining and using formats is fairly easy and was the only choice prior to the introduction of the AXIS statement. It is more difficult to fine tune the final graphic when you use formats, because there is little or no font, size, or color control. This example shows you how to control the tick mark labels using the AXIS statement where these options are available.

By using the AXIS statement you can define labels for each major tick mark as well as for the axis itself. The VALUE = option in the AXIS statement allows specific text strings to be associated with specific values and increased control is achieved by making use of font and size options.

Primary control in the VALUE = axis option is exercised by specifically identifying the tick mark number. Usually this implies that the user has specified the number of major tick marks e.g. (major=(n=12) or order=(1 to 12)), or knows how many tick marks there will be. The tick mark is designated with the T = option. Attributes for a specific tick mark will immediately follow the appropriate T = option. The user can independently control the font, size, and color of the text for each tick mark.

In this example code the first axis statement (AXIS1) uses t=3 to identify the tick mark number which will have the string 'Alert' instead of its value (which would have been 2). AXIS2 defines a default font and height for the axis (h=1.5 f=simplex) and also changes these two options for the fourth and fifth tick marks (Apr and May).

* define the vertical axis;
  * define the horizontal axis;

The control of the characteristics of tick marks in the VALUE = statement is positionally dependent. In this example the AXIS2 statement has a fairly complicated VALUE = option. The default height (h=1.5) and font (f=simplex) is established by making the specification before any of the T = options. As soon as the first T = option is specified, other options such as H = and F = will apply to the tick mark designated by the preceding T = option. Thus, the font can be changed for T = 4 and T = 5 without changing the default font for the other tick marks.

Tick mark values are character strings and as such they can be placed at an angle and have individual characters rotated. The following code places the horizontal tick mark labels at an 55 degree angle.

* Axis and pattern control;
* Horizontal axis;

In the resulting graphic we have placed the word ALERT on the vertical axis (replacing the 2) and have changed the font and size for the two months of particular interest.

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* Axis and pattern control;
* Horizontal axis;
DEALING WITH DATES

SAS dates and dates in general can present unique problems when used to define points on an axis. SAS dates are stored as the number of days since the beginning of time (January 1, 1960 in the SAS world). The date April 5, 1978 for example is stored as 6669.

When an unformatted variable containing SAS dates is used to define an axis (usually the horizontal axis), the displayed values convey little meaningful information. The following code plots the Dow-Jones Average for a one month period. The variable DATE is a SAS date, but has not format associated with it.

```sas
axis1 order=('01jun85'd to '01sep85'd by month);
```

The AXIS2 statement in the following code will assign a date value for the Monday of each week (03AUG81 is known to be a Monday).

```sas
axis1 label=(h=1.5 a=90 'Volume (X1000)');
axis2 label=(h=1.5 a=90 f=swiss 'Volume (X1000)');
axis2 order=('03aug81'd to '31aug81'd by week)
value=(h=1.5);
```

Even if a format e.g. DATE7., is used, the resulting tick mark values are of little use. Because months do not have an equal number of days, the resulting axis may contain dates that add little meaning to the graphic. For most graphs, major tick marks are equally spaced, however on axes representing dates, we may want to have the tick marks represent something like the first of each month. This means that the major tick marks will have an unequal spacing. For example, if the first major tick mark is on 01 April, 01 May will be 30 days later, and 01 June will be 31 days after that.

Fortunately, the ORDER= option in the AXIS statement can be used to specifically address issues associated with SAS dates. The ORDER= option is used to determine which values are to receive major tick marks. In the axis defined in the following code, major tick marks start on June 1 and continue on the first of each month through September.

```sas
axis1 order=('01jun85'd to '01sep85'd by month);
```

The AXIS2 statement in the following code will assign a date value for the Monday of each week (03AUG81 is known to be a Monday).

```sas
axis1 label=(h=1.5 a=90 f=swiss 'Volume (X1000)');
axis2 order=('03aug81'd to '31aug81'd by week)
value=(h=1.5);
```

```sas
proc gplot data=voll.dow;
plot volume*date=l / vaxis=axis1;
symbol1 v='V' f=simplex l=1 I=join
```
On the horizontal axis, date is ordered by week. You can also set the increments to any of the valid arguments for the INTCK and INTNX functions. These include increments for DATE intervals (DAY, WEEK, MONTH, QTR, and YEAR), DATETIME intervals (DTDAY, DTWEEK, DTMONTH, DTQTR, and DTVYEAR), and TIME intervals (HOUR, MINUTE, and SECOND).

**SUMMARY**

The AXIS statement is a very useful tool for customizing graphical displays. It is both flexible and powerful. If you take the time to get to know it will work as your ally when generating graphs.

**TRADEMARK INFORMATION**

SAS/GRAPH is a registered trademark of SAS Institute, Inc. in the USA and other countries. * indicates USA registration.

**References**


**ABOUT THE AUTHOR**

Arthur L. Carpenter has over eighteen years of experience as a statistician and data analyst and has served as a senior consultant with California Occidental Consultants, CA-LOXY, since 1983. His publications list includes a book on SAS/GRAPH, a number of papers and posters presented at SUGI, and he has developed and presented several courses and seminars on statistics and SAS programming. Art has served as a steering committee member and president of the Southern California SAS User’s Group, a Section Chair and Conference Co-chair of the Western Users of SAS Software regional conference, WUSS, and in various positions at SUGI. He has developed and presented several courses and seminars on statistics and SAS programming and has taught for Colorado School of Mines, University of Redlands, and University of California at San Diego.

CA-LOXY offers SAS contract programming and in-house SAS training nationwide, including a three day course on SAS/GRAPH.

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