Abstract.

Using the well-developed structure of ISPF dialogs and the specialized SAS interface functions provided by IIF, we have developed two interactive subsystems for producing SAS Version 5 graphics quickly and efficiently. With these subsystems, novice computer users can develop sophisticated graphs, and expert users can synergistically develop graphs per se and generate SAS code for subsequent modification. We continue to develop new subsystems to incorporate new ideas and new products.

Disclaimer.

The opinions and findings discussed below are those of the authors, and do not reflect a position of the Federal Reserve Bank of Chicago or the Federal Reserve System.

The need for quick, efficient subsystems.

The authors (hereafter, 'we') are part of the technological support group of the Economic Research department of the Federal Reserve Bank of Chicago, which provides analytical and graphical support to a staff of economists and senior management examining time series and other data to detect trends in the economy.

The department's presentations use both 35mm color slides and monochrome hardcopy. Presentations are often prepared under very tight deadlines to be shown under unknown viewing conditions.

Because the graphs depict time series data, the production of graphics must often be delayed until the release of the most current statistics. Subsequent tight deadlines force us to be able to quickly develop programs for both slides and hardcopy. Under such conditions, detailed graphics standards are necessary to insure visual consistency in presentations.

The slide presentations are given both inside and outside of the bank, often under poor viewing conditions. To counteract problematic room lighting and seating, we have developed a 'high contrast' style.

Over the past few months, our high contrast style has evolved from simple displays of time series to more sophisticated graphics in modified settings. The programs have become increasingly complex and so on. We intend to continue testing this method as new versions of the components become available in order to resolve the quality problems. However, we have discontinued testing for now.

Because of the increasing complexity of our graphics and our limited success with GGXA, it became imperative to develop the fastest, most efficient program development environment that we could.

Current subsystems.

We use two subsystems of our present programming environment to develop presentation graphics.

That environment, called CERES, was written using three components: the SAS system; ISPF, IBM's dialog management facility; and IIF, an interface between SAS and ISPF, developed by Tangram Systems Corporation. SAS procedures and data steps handle the data and draw the graphs. ISPF handles the interaction with the user, displaying panels to accept and validate information from the user, and generating SAS code based on that information. IIF extends ISPF's capabilities by displaying selection lists of SAS data sets and variables, and verifying information from the user about SAS objects. IIF submits the program to interactive SAS, and keeps a structured index for browsing and printing input code, the SAS log, and procedure output. Input SAS code can also be recaptured from this index, reedited, and resubmitted.

CERES is designed to be useful to both the economists and managers, and to the technological support group.

The two graphics subsystems of CERES are a SAS programming panel and a set of Advanced Graphics panels.

SAS Programming Panel.

One subsystem is the SAS programming panel, designed for a more experienced SAS user to write SAS programs directly (see Figure 1). This panel has a command line for TSO commands and fields in which to specify a data set and member for SAS source code. From a list of options the user chooses whether to edit the source code, whether to submit the source code, and if it's submitted, whether to browse the SAS log and whether to browse the SAS procedure output.

The edit option invokes the standard ISPF/PDF editor. If the submit option is checked, entering the END command on the edit panel submits the code to SAS. Code may also be submitted directly, without editing.

If requested, the SAS log is displayed. If requested, the procedure output is displayed.

Both the SAS log and the procedure output may be browsed by paging up and down, using FIND commands, and so on. The user
Advantages of SAS Programming Panel.

The strongest advantage of this SAS panel is its speed in both program development and execution. This subsystem executes our typical SAS/GRAPH program about two to three times faster than other methods we have tried; longer programs execute still more quickly. Advantages in program development time are even greater: five to six times faster, again with greater gains for longer programs.

The subsystem has several other advantages. Because the Browse Index is organized in an index structure, browsing or printing previous work is straightforward, even trivial. Because the subsystem uses the same editor (ISPF/PDF) that is used in our other applications, users don't have to learn a new editor, and the look of the panel is consistent with our other applications. More importantly, ISPF/PDF is the best MVS/TSO editor available, an extremely comprehensive and powerful tool when writing code. Last, when positioning annotation by trial and error, it's both quick and less distracting to paste by the log or procedure output by leaving those option fields blank. Of course, even if the user doesn't browse the log and output upon submission, the log and output are still put into the Browse Index for later reference.

Advanced Graphics Subsystem.

While the SAS programming panel works well for an experienced user writing SAS programs directly, we have also developed an Advanced Graphics subsystem in which the user merely supplies information, and the subsystem itself writes the SAS program.

While the subsystem is designed to be easy enough for a user with no SAS experience, it is also designed to be powerful enough for an expert SAS user, since it generates detailed SAS code that can be recaptured and edited with the SAS programming panel. It is designed primarily to graph time-series data; that is, the horizontal axis is denominated in years, not cities or divisions of a corporation.

The Advanced Graphics main panel (see Figure 4) lists various types of graphs and utilities. Here are the steps to produce the first sort of graph, a line plot.

(See Figure 5) The user names a graph format, which determines aspects of style such as color, size, and type font for labeling, and PATTERN and SYMBOL statements. The next field is for the list of variables to be plotted; if the field is left blank, a selection list of SAS variables is displayed, just as the ISPF/PDF editor displays a member selection list if no member is specified. Here we have chosen to plot Standard & Poor's 500 Stock Index. There are also fields for titles and footnotes, basic axis specification, and some info for PROC GREPLAY.

Pressing ENTER brings up a second panel (see Figure 6) for specifying axis and data annotation, and some common special features. At the Federal Reserve, a lot of research pertains to business cycles; the options here allow the user to indicate expansions and recessions on the graph. We've chosen to have the recessions shaded (in the hardcopy format used here, the recessions are drawn as empty boxes), and the business cycle peaks and troughs labeled. Hitting ENTER again brings us back to the first line plot panel.

Filling in the check-to-execute field draws Graph 1. (see Graph 1) Note that the stock market turns down before every recession -- and at other times as well, leading to the old saw about the market correctly predicting fifteen (in this case) of the last six recessions.

Another chart Advanced Graphics can produce is a cycle chart. Cycle charts show comparisons of different recessions or different recoveries. Refer to Graph 2 as an example. (see Graph 2) This graph depicts the growth in the total number of persons employed in the United States during recoveries. The zero point on the horizontal axis is the bottom of the recession, that is, the beginning of the recovery. Quarters of a year before and after that are also marked. For each recovery, change in total employment is calculated relative to its level at the beginning of the recovery. The range of past experience is plotted as dashed lines; the current expansion is plotted as a solid line. This graph seems to show that recent growth in employment has been quite strong compared with past expansions.

Cycle charts like this require several data steps to restructure the underlying data. To look at one way, the horizontal axis here isn't years, but rather is the number of quarters into the recovery. Thus, Advanced Graphics is more than simply a collection of front ends for each part of SAS. Advanced Graphics has more than just SAS syntax built in.

Other parts of Advanced Graphics include facilities to produce bar charts, word charts, and a GREPLAY facility.

The graph formats are the key to Advanced Graphics. Formats are written by the support group, either for general use, like the HARDCOPY format used for the S&P graph, or for specific presentations. By preparing all of the graphs for a presentation using the same format, we insure stylistic consistency throughout the presentation.

Formats are created and maintained using the panel of graph format utilities. (see Figure 7). Graph formats are stored as ISPF tables and edited with the ISPF table display service (see Figure 8). SAS code governing various aspects of style is stored as rows of a table, which is processed by the ISPF file tailoring that writes the SAS/GRAPH program. Again, formats are developed by members of the support group, so it's ok for this part to require a little more experience than other parts of GERVAN.

Advantages of Advanced Graphics panels.

Obviously, this subsystem works well for the user who knows no SAS but wants to produce SAS/GRAPH graphics. But its most powerful use goes beyond that. We have been extremely pleased
with Advanced Graphics as a detailed code generator using the Recapture Previous Submissions feature on the SAS panel. The code is free of syntax errors and is sufficiently detailed to cut program development to about half the time of converting an old program using the SAS programming panel. Thus this subsystem is extremely useful to users with no SAS experience and those with lots of SAS experience.

Future Subsystems.

What's left out of Advanced Graphics? One major area is the ability to do cross-sectional graphs, i.e., to specify something other than time for the horizontal axis. We plan a separate subsystem for this that will look and work in much the same way as Advanced Graphics.

Another area is the ability to easily draw the icons (collections of flags for international graphs, market baskets for inflation graphs, etc.) now produced through direct ANNOTATE programming. We are tentatively considering an icon library; users would select an icon from the library to be drawn as part of the annotation of the graph produced by Advanced Graphics.

Summary.

Using the well-developed structure of ISPF dialogs and the specialized SAS interface functions provided by IIF, we have developed two interactive subsystems for producing SAS Version 5 graphics quickly and efficiently. With these subsystems, novice computer users can develop sophisticated graphs, and expert users can synergistically develop graphs per se and generate SAS code for subsequent modification. We continue to develop new subsystems to incorporate new ideas and new products.

Trademark notices.

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IIF is a trademark of Tangram Systems Corporation, Cary, NC, USA.

Communicating with the authors.

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Figure 1. The SAS programming panel.

Figure 2. The Browse Index.
Figure 2. The Previous Submissions Index.

Figure 4. The Advanced Graphics main panel.
Figure 5. Line plot, panel 1.

Figure 6. Line plot, panel 2.
Select option ===>  

C COPY - Copy the format named _______ to ________
D DELETE - Delete the format named ________
E EDIT - Edit aspects of the format named ________
L LIST - List existing formats

Figure 7. Graphics formats utilities panel.

Edit HARDCOPY ------------ Graphics Formats ------------------ ROW 10 OF 85
Command ===> Scroll ===> CSR

? Aspect L SAS Code

FOOTNOTE 01 f=simplex h=1.0 j=1 c=black
FOOTNOTE 02 f=simplex h=1.0 j=1 c=black
HAXIS 01 value=(f=simplex h=1.0 j=1 c=black)
HAXIS 02 label=none
HAXIS 03 color=black
HAXIS 04 style=1
HAXIS 05 ;
PATTERN 01 v=x2 c=black
PATTERN 02 v=x2 c=black
PATTERN 03 v=x2 c=black
PATTERN 04 v=x2 c=black
PATTERN 05 v=x2 c=black
PATTERN 06 v=x2 c=black
PLABEL 01 when='b'; color='black'; style='simplex'; size=1.0; position='a';
PLABEL 02 xsys='2'; ysys='1';
PLABEL 03 function='label'; y=99.999; text='F';
PLABEL 04 x=45.08; output;
PLABEL 05 x=48.83; output;
PLABEL 06 x=53.50; output;

Figure 8. Editing graphics formats.
Graph 1
Standard and Poor's 500 Stock Index

Graph 2
Employment

Percent change from trough