FSGRAPH–A COMBINATION OF THE SAS/FSP® AND SAS/GRAPH™ PRODUCTS FOR DEVELOPING GRAPHICS

R. D. Muller, Elanco Products Company

Abstract: A system has been developed to generate SAS code for all procedures in the SAS/GRAPH product from data entered in SAS data sets on screens in PROC FSEDIT of the SAS/FSP package. Data entered on screens includes such items as data set names, variable names, axis colors, labels, etc. The system permits for rapid creation of graphics during interactive SAS sessions, with provisions made for editing and storing both the input SAS data sets and the resultant generated SAS code. Provisions are also made for storing and replaying the graphic images using GOUT data sets and PROC GREPLAY.

The system is particularly useful for decision support applications where users with minimal programming knowledge desire to use SAS/GRAPH as an exploratory data analysis tool on previously created SAS data sets.

An extenuation of the system permits for use of selected procedures on nongraphics devices such as nongraphics terminals and printers.

INTRODUCTION

To effectively utilize SAS/GRAPH, users must be at least moderately experienced in the use of the SAS programming language and must have a fairly well established understanding of the operating environment in which they are working. A quick overview of the documentation furnished with SAS/GRAPH indicates minimal programming knowledge is required for simple graph requests when the user is willing to accept many of the defaults furnished by SAS. As the request becomes more complex and defaults are no longer acceptable, the programming knowledge requirements increase immensely.

SAS/GRAPH is designed as an exploratory data analysis tool, i.e., for use in those situations where the user is asking, "What does my data tell me?" The data in question is usually already resident in the computer, either in SAS data sets or in files which can quickly be converted to SAS data sets. SAS/GRAPH is also used as a tool for producing graphics on data which is not already computer resident. However, use of SAS/GRAPH under such conditions often entails more time, effort and programming knowledge than would be required by other graphic software packages.

With these thoughts in mind, a system was planned to make SAS/GRAPH an easier-to-use tool for decision support work

CONSIDERATIONS

A number of considerations went into the design of the system to establish a "wish list" of desired features:

1. The system should alleviate the tedious task of writing SAS programming code, thereby allowing the user to concentrate on the data and what questions might be asked of the data.
2. To achieve widespread acceptance, the system must operate in an interactive environment.
3. SAS is an integrated software system (data base management, report writing, graphics, etc.). The graphics system should take advantage of all integration that is centered around the concept of the SAS data set.
4. SAS operates on an ever increasing number of operating systems–TSO, CMS, etc. The system should be transportable from one environment to another with minimal conversion requirements upon arrival in a new environment. This requirement meant that the system make minimal use of command level languages such as TSO CLIST and the VMCMS EXEC2 languages. This also excludes the use of ISPF Dialogue Manager Panels as proposed by Prague (1982).
5. Exits from the interactive SAS environment to environments outside SAS for such things as editing files are time consuming and are particularly awkward for inexperienced users; such exits should, therefore, be minimized.
6. SAS/GRAPH works on a number of hardware devices. The system should be independent of devices and work across them. Ideally, the system should provide for local customization to overcome any idiosyncracies associated with the device and its local installation.
7. Documentation for use of the system should be readily available on-line.
8. The system should be very generic in its total overall approach to SAS/GRAPH (i.e., all procedures and all options for all procedures should be covered). However, the system should also be modular in approach to permit for customized application on specific projects.
9. A modular approach should be taken to the systems architecture to provide for rapid development, testing, etc. A modular approach permits for small pieces of the overall system to be independently tested and also permits for multiple program entry points.
10. Many users have shared limited access to graphics equipment. Therefore, the system should make provision for primitive graphic creation on nongraphics terminals and printers for those SAS procedures which produce output for such devices. The system should be upwardly compatible from nongraphics devices to graphics devices.

SYSTEM ARCHITECTURE

To meet these requirements, the system was designed entirely within the SAS programming language. As mentioned earlier,

command level languages (CLIST and EXEC2) and ISPF Dialogue Manager Panels were discarded early. The only exceptions to this were those operations necessary for file maintenance and storage (copying, erasure, file definition, etc.) which are either more readily handled by, or must be handled by operating level commands.

Several new features of SAS 79.6/SAS 82.3 were key to the decision to stay entirely in SAS:

1. The %INCLUDE statement which permits for easy inclusion of files of SAS statements for processing. The ability to nest %INCLUDE statements within other files that were already "%INCLUDED" was essential.

2. The CMS and TSO statements which allow TSO and CMS commands to be placed within files of SAS statements.

3. The ability to create GOUT data sets in graphic procedures with a device type of Independent.

Examination of the code required to create horizontal bar charts ranging from simple to complex indicated from 3 to 40 inputs would be required to create the graphs if key input variables were to be input to SAS and allow SAS to write its own code. Thus, a system in which the user is "interrogated" at the terminal on a "question-by-question" basis would result in many negative (null) responses, wasting both user and computer time. This system uses the "interrogation" approach only for those operations which require a single entry to determine the course of program execution (branching, etc.). All operations requiring multiple entry are grouped under "the FSEDIT approach."

A. **User Interrogation Approach:**

Interrogation approaches used in this system include:

1. A single question placed on the screen for user input response.

2. A menu placed on the screen for a single user input response.

Questions and menus are both generated on the screen by use of FILE TERM and PUT statements in a SAS data step (DATA _NULL_) where a FILEDEF (ddname) has been issued for the terminal with a name of TERM. The user's response is input in the same SAS data step via the INFILE INTERM and INPUT statements with INTERM being a FILEDEF (ddname) issued for the terminal. A SAS program analyzes the user input, writing SAS statements that specify the future course of direction to a temporary file which is then brought in for processing via the %INCLUDE statement.

B. **The FSEDIT Approach:**

The "FSEDIT approach" taken as an alternative to line-by-line interrogation of the user for operations requiring multiple input is an approach in which a SAS data set is created containing the appropriate variables necessary for the graph creation. This data set is initially created containing no observations and is then edited via PROC FSEDIT, following which it is processed via a SAS program that writes SAS statements to a temporary external file. The external file is then brought in for processing via the %INCLUDE statement. This technique bears some similarity to a program distributed by SAS Institute on the CMS sample library SAMPBASE MACLIB *(FSDATA). This technique is also referenced in a paper by Hardison and Muller (1984).

The technique is presented in Figure 1. The sample programming code, greatly condensed for brevity, addresses creation of a horizontal bar chart.

1. Create a SAS data set (WORK.HBAR) containing variables that correspond to the variables necessary for proper construction of a series of SAS statements for the procedure PROC GCHART. This data set contains no observations when constructed; however, the variables are of the correct type (numeric or character) and length. The code to create the data set is listed in Figure 1-4. The program is invoked from interactive SAS by the %INCLUDE statement (Figure 1-1.)

2. The code to invoke PROC FSEDIT is also listed in Figure 1-4, as is the statement to invoke the SAS code generator (%INCLUDE SUGIHB2). File TEMP1 as generated by the program is listed in Figure 1-6. When it is "%INCLUDED," the data set is edited using PROC FSEDIT. The values entered on the screen are those items of information necessary to draw the chart, e.g., data set names, variable names, titles, axis colors, etc. The data entry screen is shown in Figure 1-2.

3. Using this data set (WORK.HBAR), construct the SAS code necessary to run the procedure in another external temporary file (FILE TEMP2). Code is constructed by a SAS program generator (SUGIHB2, Figure 1-5) processing each observation of the data set on a variable-by-variable basis, checking for the presence of an entry. If an entry is detected for a variable, the program writes the appropriate SAS code to FILE TEMP2.

4. Upon completion, FILE TEMP2 is processed using the %INCLUDE statement at the end of the SAS code generator.

5. If the generated SAS code is correct, the graphic appears on the device (Figure 1-3). If not, the SAS error message appears.

6. The user is returned to interactive SAS.

A SAMPLE SESSION

The system will be demonstrated via a sample session under VM/CMS to create a horizontal bar chart (Figure 2). From interactive SAS (Figure 2-1), the user includes a file containing a program that creates a master menu (Figure 2-2). From this menu, a selection is made for the desired activity (selection 4, graphics on graphics terminals). In this case, another menu is generated (Figure 2-3). The user selects option 13 to create a horizontal bar chart. The user is next asked if this request is to edit a previously existing SAS data set (WORK.HBAR) or is to create a new SAS data set (Figure 2-4). The request will be

creation if (1) the data set WORK.HBAR does not already exist, or (2) the user desires to destroy the presently existing values in the WORK.HBAR data set with a new data set containing 0 observations. Following creation, the data set is then edited (Figures 2-5 through 2-7). The data set creation and the entrance to PROC FSEDIT are both transparent to the user since OPTIONS NONOTES NOSOURCE2 are in effect.

If the user had desired to edit an already existing WORK.HBAR data set, PROC FSEDIT would be entered.

From a programming standpoint, all operations prior to the point of editing data set WORK.HBAR have been conducted by "painting" the screens (questions and menus) with FILE TERM and PUT statements and inputting the single answer responses by INFILE INTERM and INPUT statements (the "user-interrogation" approach mentioned earlier).

A. **Data Entry:**

Upon entrance to the editing of the WORK.HBAR data set, the user is faced with three screens of choices/options (Figures 2-5 through 2-7). Only a few fields are required; the rest are optional. Note the extensive flexibility permitted on these screens for providing on-line documentation that is immediately-at-hand. If further customization were required for specific applications, a wide variety of information could be placed on these screens near the input fields; including such things as SAS data set names, variable names, etc. All of this would be accomplished by modifying the screen data set of PROC FSEDIT.

The user may add any number of observations to data set WORK.HBAR with each observation defining a single horizontal bar chart. Upon completion of data entry, exit is accomplished via the Return key (PF2), the code to produce graphics is generated, processed and the graphics or error messages appear on the screen for viewing (Figure 2-8).

If the user had set up an option under selection 2 of the main FSGRAPH menu to save generated SAS code, a prompt will follow for the file name in which the code is to be stored (Figure 2-9). Appropriate file copying measures are taken, following which the user is returned to the home panel for FSGRAPH.

B. **Other Comments/Features:**

Examination of the various menus and FSEDIT screens reveals a number of options and features that have been included in the FSGRAPH system.

1. **Figure 2-5. Exit/Delete Field.** The first field of the first FSEDIT screen provides an Exit/Delete function. If entered, the current observation will be ignored rather than processed. Thus, if five graphs are being created, several can be "set aside" while others are being perfected.

2. **Figure 2-5. Title, Footnote, Note, Symbol and Pattern Packages.** Numerous graphics require repeated uses of the same titles, footnotes, patterns etc. Rather than entering this information repeatedly on every data entry screen, provision is made to create "packages" of these items with unique names. The package names are entered on screens such as Figure 2-5. The "packages" are SAS macros created from the main FSGRAPH menu (Figure 2-3) in options 5-9 (see point 8 below). The names under which they are stored must follow the SAS macro naming conventions.

3. **Figure 2-5. Titles on Data Entry Screen.** In addition to the title package, provision is made for three additional titles to be entered in the HBAR data set.

4. **Figure 2-7. Overgrid.** Provision is made for an overlaying grid (OVERGRID) to aid in placement of note copy by providing coordinates. An entry envokes a SAS macro containing a set of note statements with absolute draw commands. The effect of placing an entry here is shown in Figure 3-1.

5. **Figure 2-7. Extended Annotation.** Extended annotation provides for placement of additional notes and underlines. Placement of an entry here results in additional FSEDIT screens being generated to place notes (Figure 3-2) and underlines (Figure 3-3) in the plot. The end result of these entries is the plot in Figure 3-4.

6. **Figure 2-7. Formats.** Formats are a convenient means of improving the appearance of SAS/GRAPH output. Formats can be either those furnished by SAS or custom-created (see point 13 below).

7. **Figure 2-7. Labels.** Labels are another means of improving the appearance of SAS/GRAPH output. Many graphics procedures use those labels associated with the variable in the SAS data set if the Label statement has been used at data set creation. As an alternative, labels can be entered here.

8. **Figure 2-3. Main FSGRAPH Menu–Selections 5-9, Package Creation.** These selections permit for the creation of "packages" that are used for repetitive titling, labeling, etc. Samples of a "Title Package" screen (Figure 3-5) and "Pattern Package" screens (Figures 3-7 through 3-9) show the amount of documentary information that can be added. The packages are "stored" as SAS macros. Screens 3-6 and 3-10 show the prompts for the macro names that assign a "package" name.

9. **Figure 2-3. Main FSGRAPH Menu–Selections 10-22, SAS Procedures.** All current (SAS 82.3) SAS/GRAPH procedures are available with the exception of PROC G3GRID.

10. **Figure 2-3. Main FSGRAPH Menu–Selection 24, Macro Utility.** Various packages for titles, etc., are stored as macros. In addition, when FSGRAPH is first invoked, a series of macros are created for a standard set of patterns and symbols. This selection provides for listing currently defined macros (Figure 3-11 and 3-12). Most of the macros in Figure 3-12 are pattern and symbol packages created at FSGRAPH invocation.

11. **Figure 2-3. Main FSGRAPH Menu, Selection 25, Print Hard Copy.** This selection provides several means for generation of graphs on various hard copy devices when SAS code stored in files needs to be re-run. This screen and the programs it invokes are highly installation dependent (Figure 3-13).

12. **Figure 2-3. Main FSGRAPH Menu, Selection 26, Work Data Set Utilities.** As seen earlier, SAS data sets such as WORK.HBAR are used to enter variable information to generate graphs. This selection (Figure 3-14) provides screens for storage and retrieval of these data sets from session to session. A sample screen for storage is shown in Figure 3-15.

13. **Figure 2-3. Main FSGRAPH Menu, Selection 27, Create Custom Formats.** PROC FORMAT is an excellent means of grouping data values into classifications, reassigning values, etc.; and is an excellent alternative to IF statements and assignments via assignment statements in a SAS Data Step. This selection provides for entry of values (Figure 3-16) to create formats. In addition, six more pages of on-line documentation are available (not shown).

14. **Figure 2-3. Main FSGRAPH Menu. Selections 1, 2 and 4, Device Characteristics.** Device settings, default colors, VPOS, HPOS, HSIZE, VSIZE, etc., are all very important to successful graphic creation. These selections provide:

    a) A listing of current graphic options via PROC GOPTIONS (selection 1)

    b) A means of altering GOPTION settings (selection 2, Figures 3-17 and 3-18)

    c) Test patterns with PROC GTESTIT (selection 4).

15. **Figure 2-3. Main FSGRAPH Menu, Selection 3, PROC GREPLAY.** The 82.3 release of SAS/GRAPH provides for the creation of GOUT data sets with the device type of independent. Provision is made in all procedures of FSGRAPH for the name of a GOUT data set (Figure 2-6). Selection 1 provides a menu for entering this name and invokes PROC GREPLAY. This is useful not only for efficient examination of previously generated graphs, but also for replaying graphs generated at terminal screens on hard copy devices such as bed plotters.

16. **Figure 2-2. FSSAS Primary Menu. Selection 3, Graphics on Nongraphics Devices.** The design of this system (NGGRAPH) is similar to the design of FSGRAPH with several notable exceptions. (1) Provision is made only for PROC CHART and PROC PLOT (Figure 3-19). (2) Prior to execution of a procedure, PROC PRINTTO is invoked to direct the printed output of the procedure to an external file (Figure 3-20). Following completion of the procedure, the file is automatically examined on the screen via PROC FSLIST. This provides for exceptionally good appearing copy on the screen since PROC FSLIST honors the ASA carriage control characters (Figure 3-21). The sequence of events for the user during the terminal session is nearly identical to that observed on a graphics terminal.

CONCLUSION

By combining SAS/GRAPH with SAS/FSP, FSGRAPH provides a very user friendly system for making graphics a decision support tool. FSGRAPH is transportable to any SAS operating system and provides a means of making SAS easier to use for individuals with limited computer background. For more sophisticated SAS programmers, FSGRAPH permits concentration on the data being analyzed and the questions that might be asked of it.

Roger D. Muller
Elanco Products Company
A Division of Eli Lilly and Company
740 South Alabama Street
Indianapolis, Indiana 46285

References:

Hardison, C. D. and R. D. Muller, 1984. "Use of PROC FSEDIT to Generate SAS Code." SUGI Proceedings–1984.

Prague, C. N., 1982. "SAS/GRAPH for the Non-SAS User." SUGI Proceedings–1982.

Prague, C. N., 1983. "Increasing Productivity: Batch and On-Line Interfaces to SAS Using SPF Dialog Manager." SUGI Proceedings–1983.

Figure 1. The "FSEDIT Approach for Generating SAS Code.

Figure 1-1. Terminal, Invocation of System.

```
  ??
%inc sugihbar;
                                                    VM READ
```

Figure 1-2. Terminal, Data Entry.

```
                    Edit SAS data set: WORK.HBAR                [ Screen  1
Command ===                                                     [----------
                                                                [ Obs     1
------------------------------------------------------------------------------

                    DSNAME: fsdemo.people____
                    XVAR:   age_____________
                    TYPE:   mean____
                    SUMVAR: ht______
```

Figure 1-3. Terminal, Resultant Graphic.

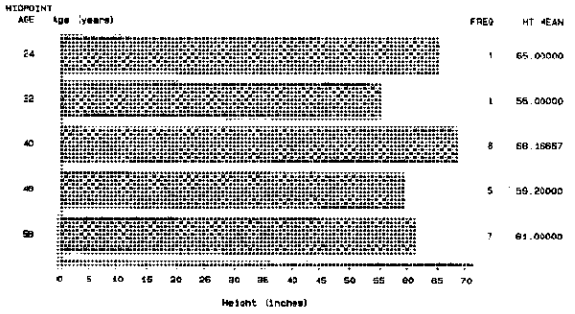

Figure 1-4. Initial SAS Program.

```
 SUGIHBAR SAS      A1  F 80  TRUNC=80 SIZE=15 LINE=0 COLUMN=1
===
00000 * * * TOP OF FILE * * *
      [...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
00001 CMS FILEDEF TEMP1 DISK TEMP1 SAS ;
00002 CMS CLRSCRN;
00003   /*****************************************************************/
00004   /*  COMMENT WRITE SAS CODE IN FILE TEMP1 TO CREATE DATA SET      */
00005   /*  WORK.HBAR, THEN EDIT WORK.HBAR VIA PROC FSEDIT AND INVOKE    */
00006   /*  A SAS CODE GENERATOR (sugihb2) TO PROCESS IT                 */
00007   /*****************************************************************/
00008 DATA  NULL ;
00009   FILE TEMP1;
00010    PUT 'DATA HBAR;LENGTH dsname $17  xvar $8 type $8 sumvar $8 ; run; '
00011        'PROC FSEDIT DATA=HBAR SCREEN=DEMO.FSHBSC OPT=1;RUN;';
00012    PUT '%INCLUDE SUGIHB2   ;  ';
00013  STOP;
00014 RUN;
00015 %INCLUDE TEMP1; RUN;
00016 * * * END OF FILE * * *
```

Figure 1-5. SAS Code "Generator".

```
 SUGIHB2  SAS      A1  F 80  TRUNC=80 SIZE=24 LINE=0 COLUMN=1
===
00000 * * * TOP OF FILE * * *
      [...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
00001 CMS FILEDEF TEMP2 DISK TEMP2 SAS A;
00002 COMMENT*************************************************************;
00003 ** DEVELOP SAS SOURCE CODE IN FILE TEMP2 BY PROCESSING THE OBSERVATIONS;
00004 **   IN SAS DATA SET WORK.HBAR  ***********************************;
00005 COMMENT*************************************************************;
00006 DATA  NULL ;FILE TEMP2 NOTITLE NOPRINT;
00007  SET WORK.HBAR;
00008   LEN1=LENGTH(DSNAME);
00009   LEN2=LENGTH(XVAR);
00010   LEN3=LENGTH(TYPE);
00011   LEN4=LENGTH(SUMVAR);
00012  PUT 'PROC GCHART DATA=' DSNAME $VARYING17. LEN1 ';' ;
00013  PUT 'HBAR ' XVAR $VARYING8. LEN2 '/TYPE=' TYPE $VARYING8. LEN3  8 ;
00014  IF SUMVAR NE ' ' THEN PUT ' SUMVAR=' SUMVAR $VARYING8. LEN4 @;
00015  PUT ';' ;
00016 RETURN;
00017 RUN;
00018 COMMENT*************************************************************;
00019 **End of generation of SAS Source Code in file TEMP2 **********;
00020 ***********************************************************;
00021 COMMENT*************************************************************;
00022 ** Next statement includes statements in TEMP2 for processing;
00023 *************************************************************;
00024 %INCLUDE TEMP2; RUN;
00025 * * * END OF FILE * * *
```

Figure 1-6. First "Generated" File.

```
 TEMP1    SAS      A1  F 80  TRUNC=80 SIZE=1 LINE=0 COLUMN=1
===
00000 * * * TOP OF FILE * * *
      [...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
00001 DATA HBAR;LENGTH dsname $17  xvar $8 type $8 sumvar $8 ; run;
00002 PROC FSEDIT DATA=HBAR SCREEN=DEMO.FSHBSC OPT=1;RUN;
00003 %INCLUDE SUGIHB2   ;
00004 * * * END OF FILE * * *
```

Figure 1-7. Second "Generated" File.

```
 TEMP2    SAS      A1  F 80  TRUNC=80 SIZE=2 LINE=0 COLUMN=1
===
00000 * * * TOP OF FILE * * *
      [...+....1....+....2....+....3....+....4....+....5....+....6....+....7...
00001 PROC GCHART DATA= FSDEMO.PEOPLE;
00002 HBAR AGE/TYPE=MEAN SUMVAR=HT;
00003 * * * END OF FILE * * *
```

Figure 2. FSGRAPH - Sample Session.

Figure 2-1.

```
  ??
%inc fssas;
  3*OPTIONS GEN=0 S=80 NOCAPS NONOTES NOSOURCE2;
    1-//FSSAS
                                                    RUNNING
```

Figure 2-2.

```
Welcome to the world of FULL SCREEN SAS at Eli Lilly &    (VERS 2.0 (
Co.  This panel is the FSSAS HOME panel for various SAS   (VM/CMS    (
activities.  Select an activity by inputting a number at  (12/01/83 (
the bottom of this screen._


 1. Create a SAS Data Set (Invokes FSDATA)
 2. Use various SAS Procedures (Invokes FSPROC)
 3. Use Graphics Procedures on NONGRAPHICS Terminals
      (Invokes NGGRAPH)
 4. Use Graphics Procedures on GRAPHICS Terminals
      (Invokes FSGRAPH)
 5. HELP
 6. QUIT, Return to Interactive SAS

ENTER NUMBER OF YOUR CHOICE:
4
                                                    RUNNING
```

Figure 2-3.

```
Welcome to the world of FULL SCREEN SAS GRAPHICS at Eli    [Vers 1.0 [
Lilly and Company.  This panel is your HOME panel, from    [VM/CMS   [
it you can select various graphics activities by           [06/01/83 [
inputting a number at the bottom of this screen.
 1. Review Current GOPTIONS    16. BLOCK CHART
 2. Alter Machine GOPTIONS     17. Subset & Project MAP DATA SETS
 3. Proc GREPLAY               18. DRAW MAPS
 4. Run 2 Test Patterns        19. CONTOUR Plot
 5. Create TITLE Packages      20. 3D Plot
 6. Create FOOTNOTE Packages   21. GPRINT - Ext. Files to Graphics
 7. Create NOTE Packages       22. GSLIDE - WORD Graphics
 8. Create SYMBOL Packages     23. open
 9. Create PATTERN Packages    24. MACRO Utility
10. SIMPLE PLOTS               25. PRINT Hardcopy
11. COMPLEX PLOTS              26. Work SAS Data Set Utilities
12. VERTICAL BAR CHARTS        27. Create CUSTOM FORMATS
13. HORIZONTAL BAR CHARTS      28. HELP, PF Key Descriptions
14. PIE CHARTS                 29.  Return to FSSAS Primary Menu
15. STAR CHARTS                30.  QUIT, RETURN TO INTERACTIVE SAS.
ENTER NUMBER OF YOUR CHOICE:
13
                                                              VM READ
```

Figure 2-4.

```
Do you wish to edit an existing hbar file (Edit)
or do you wish to create a new hbar file (Create)
or do you wish to exit (eXit)

ENTER either E or C or X
c
                                                              VM READ
```

Figure 2-5.

```
                         Edit SAS data set: WORK.HBAR                 [ Screen  1
Command ===                                                           [----------
Note: This application uses 3 screens.                                [ Obs     1
---------------------------------------------------------------------------------
!!!!!!!:SCREEN 1, HORIZONTAL BAR CHARTS !!!!!!!!!!!!!!!!!! Exit/Delete: _
                                                            (Blank or 1)
THIS FIRST SECTION MUST ALWAYS BE COMPLETED
DSname:   fsdemo.people____  Variable on Left Side axis:  age_____
Type of Chart: mean
Valid chart types are:  FREQ(default) CFREQ PCT CPCT SUM MEAN (note that some
of these are statistics calculated within this procedure.  See manual p36)
THIS SECTION MUST COMPLETED IF TYPE OF CHART OF CHART IS SUM OR MEAN
Variable to be summed or averaged(mean):  ht______
THIS SECTION IS USUALLY PARTIALLY COMPLETED:
Title Pkg: ________  Foot Pkg: ________  Note Pkg: ________
Pattern Pkg:
Title#              Title
  1_  A Demo for the 1984 SUGI Meeting___________________________________
  3_  .h=2 .f=titalic FSGRAPH - Horizontal Bar Chart_____________________
  __  _______________________________________________________________________
                                       *MORE Options/Info  PF11
```

Figure 2-6.

```
                         Edit SAS data set: WORK.HBAR                 [ Screen  2
Command ===                                                           [----------
                                                                      | Obs     1
---------------------------------------------------------------------------------
!!!!!!!!!!!!!!!! SCREEN 2, HORIZONTAL BAR CHARTS !!!!!!!!!!!!!!!!!!!!!!!.!!!!!!!!
THE REMAINING SECTIONS ARE OPTIONAL:
Gout DSname: _________________ By Var1: ________ By Var2: ________
Axis Color: ________  Color Axis Labels: ________
Horizontal axis specif.: ______________________________
Vertical axis specific.: _____________________________________________
                         Levels(no. bars cont. variables on left side): _
Group Variable (on left side): ________
Subgroup Variable(for coloring): ________
Discrete: _ (blank if answer is no, type 1 if numeric values are to be treated
 as discrete rather than continuous.)
                           *MORE Options/Info  PF11
```

Figure 2-7.

```
                         Edit SAS data set: WORK.HBAR                 [ Screen  3
Command ===                                                           [----------
                                                                      [ Obs     1
---------------------------------------------------------------------------------
!!!!!!!!!!!!!!! SCREEN 3, HORIZONTAL BAR CHARTS !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
THE FOLLOWING OPTIONS ARE NOT FREQUENTLY USED, SEE MANUAL PP 36-39
OPTIONS (leave blank if no, enter 1 if yes)
Nosymbols: _ Nozeros: _ G100: _ Missing: _ Overgrid: _ Ascend: _ Descend:
Nostat: _ Freq: _ Cfreq: _ %: _ C%: _ Sum: _ Mean: _ Exterded Annotation: _
Minor: ___ (number of minor tick marks on horizontal axis)
Reference Line: ________ (Only 1 permitted, runs vertically upwards from
 horizontal axis, specify value on horizontal axis)
Freq Variable: ________ (normally when TYPE=FREQ has been specified,
  each observation contributes a value of 1 to the frequency counts.  If a
  variable is specified here, the value of that variable is contributed
  to the frequency count, rather than 1).
Formats: ______________________________
Labels: age=Age in Years  ht=Height in Inches______________________________
```

Figure 2-8.

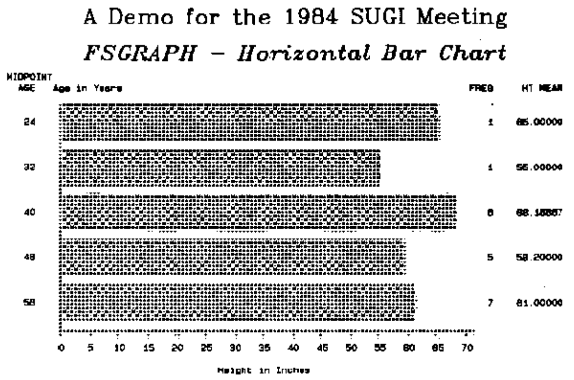

Figure 2-9.

```
You have your OPTIONS set to save the generated SAS code that produced
the preceeding graph in a file in your accout.  Do you still wish to
save this code (yes or no)
ENTER Y, OR N
y
In what file? ENTER FILENAME AND '(APP' if the statements are
to be appended to other statements already in the file.
NOTE: DO NOT USE file name that are the same as names of
SAS MACROS that are used during the current session.
sugitest
                                                              VM READ
```

Figure 3. Miscellaneous FSGRAPH Features.

Figure 3-1.

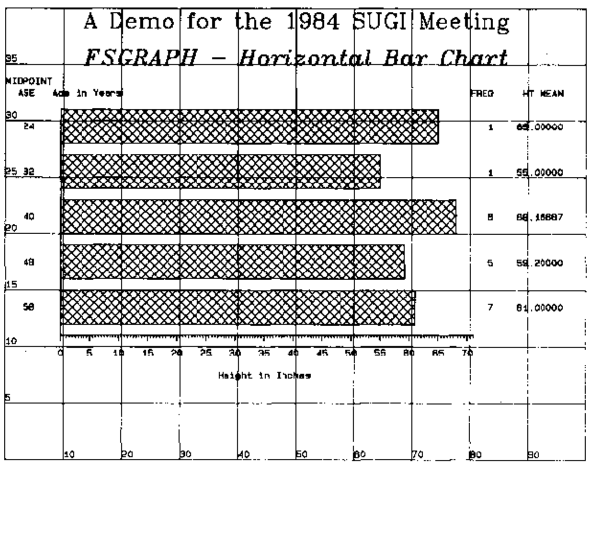

Figure 3-2.

```
                    Edit SAS data set: WORK.ANNOT                 [ Screen  2
Command ===                                                       [----------
                                                                  [ Obs     1
-----------------------------------------------------------------------------
!!!!!!!! SCREEN 2, EXTENDED ANNOTATION !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
                                        HPOS & VPOS are coordinates
NOTES (Screen 1 of 2)                   Ht is height in character units
                                        Justify=L,C or R
HPOS VPOS  Font    Color    Ht   J Ang Rot Ang=angle of line(-90 to +90) def=0
             N O T E   T E X T          Rot=Rotation of letters=(0 to 360)
12__ 4___ none____ red_____ 1___ _ ___ ___     def=0
          Place Notes With Annotate and Overgrid Options________
                                   [MORE Options/Info   PF11
```

Figure 3-3.

```
                    Edit SAS data set: WORK.ANNOT                 [ Screen  4
Command ===                                                       [----------
                                                                  [ Obs     1
-----------------------------------------------------------------------------
!!!!!!!!!!!!!! SCREEN 4, EXTENDED ANNOTATION !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
LINES TO BE DRAWN ON GRAPHIC
  COORDINATES (in character units)
-------------------------------------------------------------------
              Starting   Ending                    Starting   Ending
     Color    HPOS VPOS  HPOS VPOS        Color    HPOS VPOS  HPOS VPOS
1.   red_____ 10__ 3___  60__ 3___   2.   red_____ 60__ 3___  60__ 6___
3.   red_____ 60__ 6___  10__ 6___   4.   red_____ 10__ 6___  10__ 3___
5.   red_____ 9___ 2.5_  61__ 2.5_   6.   red_____ 61__ 2.5_  61__ 6.5_
7.   red_____ 61__ 6.5_  9___ 6.5_   8.   red_____ 9___ 6.5_  9___ 2.5_
9.   ________ ____ ____  ____ ____   10.  ________ ____ ____  ____ ____
11.  ________ ____ ____  ____ ____   12.  ________ ____ ____  ____ ____
13.  ________ ____ ____  ____ ____   14.  ________ ____ ____  ____ ____
15.  ________ ____ ____  ____ ____   16.  ________ ____ ____  ____ ____
17.  ________ ____ ____  ____ ____   18.  ________ ____ ____  ____ ____
19.  ________ ____ ____  ____ ____   20.  ________ ____ ____  ____ ____
```

Figure 3-4.

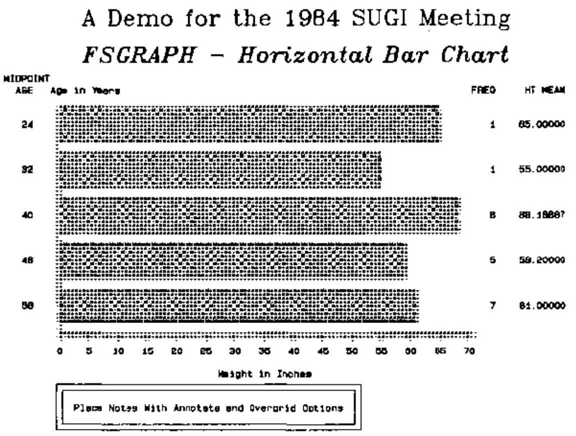

Figure 3-5.

```
                    Edit SAS data set: WORK.TITLE                 [ Screen  1
Command ===                                                       [----------
                                                                  [ Obs     1
-----------------------------------------------------------------------------
!!!!!!!!!!SCREEN1, TITLE PACKAGES !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
THE FOLLOWING MUST ALWAYS BE SPECIFIED:
Title Number: 1_ (1 to 10)
Text:    Demos for the 1984 SUGI Meetings___________________________
THE FOLLOWING ARE USUALLY SPECIFIED:
Color:   red_____ (limited by machine being used)  Font: triplex_
Height:  3     (may contain a decimal, usually a number from 1 to 4)
THE FOLLOWING ARE OCCASIONALLY SPECIFIED:
Justify: ________ (left, right or center (default))
Angle:   ____________ (slante line, -90 to +90, default is 0)
Rotate:  ____________ (rotates type, 0 to 360, default is 0)
Move:    ________ (specifies beginning position from lower left as
                   an x,y coordinate, e.g 10,20)
Draw:    ______________________________   (specifies the X,Y
         coordinates for drawing a line.  The general form for drawing
         a line from the current position of the pointer to a point
         that is 50 x units to the right is:  +0,+0 +50,+0
```

Figure 3-6.

```
Enter a unique name for the TITLE PACKAGE
you are creating, the name must begin with a letter
and may contain up to 7 more letters or numbers
TITLEA
                                                         VM READ
```

Figure 3-7.

```
                    Edit SAS data set: WORK.PATTERN               [ Screen  1
Command ===                                                       [----------
Note: This application uses 3 screens.                            [ Obs     1
-----------------------------------------------------------------------------
ALL OF THE FOLLOWING INFORMATION IS REQUIRED:
Pattern No.:  1_      Repeat: 1__ (number of times this pattern statement is
Color: red_____        to be repeated before the next one is called)
Value for Shading Crosshatching etc.:  m1x045__
The values permitted on the third line are:
For Proc GCHART                    For Proc GCONTOUR GMAP GPLOT
-----------------------            -------------------------------
X1   X indicates                   S    S indicates solid
X2    crosshatching,               E    E indicates empty
X3   1 to 5 indicates              Mxxxxx
X4    increasing density            1X
X5                                  2N
L1   L indicates slash              3
L2    marks, upper left             4
L3    to lower right                5
          C O N T I N U E D   O N   N E X T   S C R E E N
                                             *MORE Options/Info PF11
```

Figure 3-8.

```
                    Edit SAS data set: WORK.PATTERN               [ Screen  2
Command ===                                                       [----------
                                                                  [ Obs     1
-----------------------------------------------------------------------------
!!!!!!!!.!! SCREEN 2, PATTERN PACKAGES !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Values for Shading, Crosshatching Cont'd
For PROC GCHART cont'd            For PROC GCONTOUR GMAP & GPLOT
--------------------------        --------------------------------------
L4
L5
R1   R indicates slash             For the Mxxxxx specification, the second
R2    marks, lower left            column indicates density of filling, 1=
R3    to upper right               light, 5=dark.  In the third column X in-
R4                                 diates crosshatching, N indicates angled
R5                                 slashes.  A blank in the third column spec-
S    S indicates solid             ifies parallel vertical lines.  The last
E    X indicates empty             three columns specify start angle from 0
                                   to 360 degrees.  If X was specied, the
                                   crosshatching will be at a 90 deg angle.
                        *MORE Options/Info  PF11
```

Figure 3-9.

```
                    Edit SAS data set: WORK.PATTERN               [ Screen  3
Command ===                                                       [----------
                                                                  [ Obs     1
-----------------------------------------------------------------------------
!!!!!!!!.!! SCREEN 3, PATTERN PACKAGES !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Value Permitted for Shading Crosshatching, etc. (cont'd)
  FOR PIE CHARTS
     --------------------
 PSOLID     Solid-Fill Pie Slices
 PEMPTY     Empty Pie Slices
 Pntaaa     n=1 to 5 (density of shading)
            t=X or N  (Crosshatching or nocrosshatching)
            aaa=starting angle
```

Figure 3-10.

```
Enter a unique name for the PATTERN PACKAGE
you are creating, the name must being with a letter
and may contain up to 7 more letters or numbers
PATTERNA
                                                         VM READ
```

Figure 3-11.

```
MACRO Utility for FSGRAPH                                   [Vers 2.0 [
                                                            [VM/CMS   |
                                                            [06/01/83 [

During the use of FSGRAPH, various TITLE, FOOTNOTE
NOTE, SYMBOL and PATTERN PACKAGES are developed.  While
it is transparent to the user, these are actually stored
as SAS MACROS.  This makes it very convenient for
the same package to be used repeatedly during a terminal
session.  To provide for permanent storage of these packages,
the user should save the SAS code that is being generated in
files as he responds to prompts following the development of
each package

The following utilities are available for your use (note
that no provision is made for storing macro statements, this
can only be done as the macro is being developed):

 1. Pull in Macros stored externally on a CMS File
 2. List Names of currently defined Macros
 3. List contents of a specific Macro that is currently defined.

ENTER NUMBER OF YOUR CHOICE:
                                                             VM READ
```

Figure 3-12.

```
MACRO DIRECTORY
FSHOME   HLINE    VLINE    GRIDMAJ  GRIDMIN  JPLUS    NPLUS    JSTAR
NSTAR    SOLID    EMPTY    CX1      CX2      CX3      CX4      CX5
CL1      CL2      CL3      CL4      CL5      CR1      CR2      CR3
CR4      CR5      MX1      MX2      MX3      MX4      MX5      MR1
MR2      MR3      MR4      MF5      ML1      ML2      ML3      ML4
ML5      CHOME    TITLZA   PATTERNA

Enter C to Return
                                                             VM READ
```

Figure 3-13.

```
The following choices are available to you for printing   [Vers 2.0 [
hardcopy of a SAS Graph at Eli Lilly and Company when      [VM/CMS   [
you wish to obtain hardcopy on a non-CRT device.           [06/01/83 [

All of these options assume that you have developed
your graph on a CRT using FSGRAPH and have stored the
resulting SAS statements in a file in your account as
you were prompted after each step.  An alternative method for
generating hardcopy is to store the graphic output of a procedure
in a GOUT Data Set and then using PROC GREPLAY (FSGRAPH - Sel-
ection 3 to recreate the graph on an alternate device.

Enter your choice at the bottom of this screen.  You will
be prompted for the file name that contains the SAS Statements
Appropriate modifications of that file will automatically be
made and you will proceed as directed (which is obviously very
device dependent).

 1. Print on IBM3287 4-Color Printer
 2. Print on an HP7221 Bed Plotter
 3. Dicomed 35mm Slides (not yet avail)
 4. Quit, Return to FSGRAPH home panel

ENTER NUMBER OF YOUR CHOICE:
                                                             VM READ
```

Figure 3-14.

```
Information entered on FSGRAPH Screens that is used to     [Vers 2.0 [
generate SAS code is stored in SAS Data Sets.  All SAS     |VM/CMS   |
Data Sets used in FSGRAPH have the fist level name WORK.   |06/01/83 [

These data sets may be moved from the 'work' files and
permanently saved in permanent SAS Data Sets.  To do this
requires that the work data sets be copied into a permanent
SAS data library.

Enter your choice at the bottom of this screen.

 1. Move WORK.datasets to PERMANENT.datasets
 2. Move PERMANENT.datasets to WORK.datasets
 3. Quit, Return to FSGRAPH home panel

ENTER NUMBER OF YOUR CHOICE:
                                                             VM READ
```

Figure 3-15.

```
                          Edit SAS data set: WORK.UTILW          [ Screen   3
Command ===                                                      |----------
                                                                 [ Obs      1
-------------------------------------------------------------------------------
!!!!!!!!!!!! SCREEN 3, DATA SET UTILITIES !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
Saving WORK. Data Sets
    Work name  Permanent name       Work name   Permanent name
 1. hbar____   save.hbar01_____   2. ________   ______________
 3. ________   ________________   4. ________   ______________
 5. ________   ________________   6. ________   ______________
 7. ________   ________________   8. ________   ______________
 9. ________   ________________  10. ________   ______________
11. ________   ________________  12. ________   ______________
13. ________   ________________  14. ________   ______________
15. ________   ________________  16. ________   ______________
17. ________   ________________  18. ________   ______________
19. ________   ________________  20. ________   ______________
```

Figure 3-16.

```
                     Edit SAS data set: WORK.FORMT               [ Screen   1
Command ===                                                      |----------
                                                                 [ Obs      1
-------------------------------------------------------------------------------
!!! SCREEN 1, BUILDING CUSTOM FORMATS WITH PROC FORMAT !!!!!! Exit/Delete
!!!!!!!!!!!SEE USER'S MANUAL PAGE 735, ALSO SEE NEXT SCREENS      (Blank or ||
Name of Format Being Created: AGEFMT   (rules and help PF11)
           RANGE (help PF11)       LABEL (help PF11)
          -------------------- --------------------------------------
       1. low-12______________ = Preteens_____________________________
       2. 13-19_______________ = Teens________________________________
       3. 20-29_______________ = Twenties_____________________________
       4. 30-39_______________ = Thirties_____________________________
       5. 40-high_____________ = Other________________________________
       6. ____________________ = _____________________________________
       7. ____________________ = _____________________________________
       8. ____________________ = _____________________________________
       9. ____________________ = _____________________________________
      10. ____________________ = _____________________________________
Permanent?: _ (1 if yes, blank if no, note that a special logon is required
when entering SAS prior to answering yes (see next screen PF11)).
```

Figure 3-17.

```
                     Edit SAS data set: WORK.ALTER               [ Screen   1
Command ===                                                      [----------
Note: This application uses 4 screens.                           [ Obs      1
-------------------------------------------------------------------------------
!!!!!!SCREEN 1, SETTING GOPTIONS!!!!!!!!!!!!!!!!!!!!!! Exit/Delete: _
SEE LAST Screen for information on DEFAULT settings that are either
furnished by SAS or altered locally by this program for specific devices.
Commonly set options:
Device: ________ (enter accepted abbrev for machine name)
Color Background: ________ (not all devices support this feature)
No. of Vertical Positions: ___  No. of Horizontal Positions: ___
Vertical Size(inches): ________  Horizontal Size (Inches): ________
Gout Data Set Type: _ (blank=independent(default), 1=dependent)
                                        *MORE Options/Info  PF11
```

Figure 3-18.

```
                     Edit SAS data set: WORK.ALTER               [ Screen   2
Command ===                                                      [----------
                                                                 [ Obs      1
-------------------------------------------------------------------------------
!!!!!!Screen 2, Setting GOPTIONS!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
OTHER:
Altering FIRST Title Line:
  Font: ________ (default is complex)
Altering ALL Title Lines:
  Color: ________ (default is the first color of colors list)
BY Statement Options:
  Color: ________ (default is first color of colors list)
  Font: ________ (default is the hardware type)
  Height: ____ (default is 1)
DEFAULT COLORS:
  Color List: ________ ________ ______ ______ ______ ______ ________
   (form is red,blue,etc)
  Default Color Patterns: ________  Default Color Symbols: ________
                                   *MORE Options/info PF11
```

Figure 3-19.

```
Welcome to the world of FULL SCREEN SAS PROCEDURES for     [VERS 2.0 [
NONGRAPHICS TERMINALS at Eli Lilly & Co.  This panel is    [VM/CMS   [
your NONGRAPHICS HOME panel, use it to select various ac-  [12/01/83 [
tivities by inputting a number at the bottom of this screen.

WARNING: BE SURE TO SET LS AND PS FOR YOUR TERMINAL (SELECTION 3)
DEFAULT SETTINGS FOR NGGRAPH ARE LS=80 PS=24.

 1.                          13.
 2. REVIEW Current Options   14.
 3. ALTER Machine Options    15.
 4. Create TITLE Packages    16.
 5. Simple PLOTS             17.
 6. Complex PLOTS            18. MACRO Utility
 7. Vertical Bar CHARTS      19. PRINT Hardcopy
 8. Horizontal Bar CHARTS    20. Store work SAS Data Sets
 9. Pie CHARTS               21. Create CUSTOM FORMATS
10. Star CHARTS              22. HELP, PF Key Descriptions
11. Block CHARTS             23. RETURN to FSSAS Primary Menu
12.                          24. QUIT, RETURN TO INTERACTIVE SAS

ENTER NUMBER OF YOUR CHOICE:
                                                             VM READ
```

Figure 3-20.

```
Are the new graphs to be generated to be added to (A)
or replace (R) those graphs in file FT20F001 SASPRINT A

Enter Either A or R
                                                             VM READ
```

Figure 3-21.

```
              A Demo for the 1984 SUGI Meetings

                      NGGRAPH - HBAR

                    BAR CHART OF MEANS
MIDPOINT
  AGE    Age (years)                          FREQ       HT MEAN
         [
  24     [**********************************    1       65.00000
  32     [*****************************         ?       55.00000
  40     [***********************************   6       68.16667
  48     [*******************************       5       59.20000
  56     [********************************      7       61.00000
         -----+-----+-----+-----+-----+-----+---
             10    20    30    40    50    60

                     Height (inches)
```