The Challenge
The challenge was to develop a systematic approach to software-acceptance testing for SAS/FSP®, SAS/AF®, and SAS/DMI© software. These full-screen, interactive procedures do not readily conform to standard or conventional testing methods; they generate minimal output, and testing needs to be carried out in an interactive environment. A different approach to software testing from that used for conventional software evaluation was needed to accommodate the interactive and highly visual nature of these procedures.

What is Needed in a Testing Facility?
Software-acceptance testing needs to be systematic in its approach. That is, it needs to be orderly and to follow a plan. The testing facility should ensure that all procedures work as documented and that all screens and panels are displayed and function properly. Documentation and supporting material must be checked for accuracy and clarity. Full-screen Help files, tutorials, and examples must also be examined and tested. Procedures must be checked for consistency internally and across operating systems. Error and stress handling must also be checked.

What is Needed in a Status/Tracking Facility?
A status/tracking facility is very important for software testing. This must be intimately tied to the testing facility. This status/tracking facility should provide for report generation and an on-line status update all without leaving the menu system. The status/tracking facility must also be available on-line, and this should be linked to the status facility.

The Solution
A system was developed that uses SAS/AF software to build a menu-driven system that not only aids in software evaluation, but also links together report generation and an on-line status facility. This menu system makes use of the SAS macro facility, SAS/FSP software, and the link to IBM's ISPF facility provided by SAS/DMI software (MVS only) to create a truly interactive application facility. The menu system allows for a systematic approach to testing, provides a means for report generation, and allows on-line storage and retrieval of test results. Procedures can be tested, reports generated, and status updated all without leaving the menu system.

Status/Tracking Facility
A SAS data set that contains a record of all problems reported during software testing is maintained. Once a problem is encountered, it is first checked against this data set to determine if it has been reported previously or if it is similar to an existing entry. If not, an entry is added to the data set. Browsing and updating of the problem-tracking data set is accomplished through the SAS/FSP procedures FSEDIT and FSBROWSE. An FSEDIT modified screen is used to aid in data entry.

Report generation from any entry in the tracking data set is provided by the link between the SAS/FSP procedures FSEDIT and FSLETTER. A letter in an FSLETTER catalog was designed to allow FSEDIT to fill in the fields and produce a report. Once in FSEDIT or FSBROWSE, the observation you want to print a report of is located. Now, enter the SEND command followed by the name of the letter. The values from that observation are substituted within the pre-designed letter. You can now make changes and print the report.

Through the use of a SAS/AF program screen, subsetting of the data set on various criteria was implemented. Using criteria entered on the user portion of the SAS/AF screen, a temporary data set is created. This temporary data set is used in conjunction with a temporary SAS data set with only the desired observations. If you wish to print all observations in the data set, enter the SEND or EDIT command followed by the name of the letter. Execute the XYZZY command from the FSLETTER edit or send screen. A letter will be sent to the printer for each observation in the data set, beginning with the one from which you entered the SEND or EDIT command.

Testing Facility
SAS/AF software was used to build a front-end to the SAS/FSP, SAS/AF, and SAS/DMI testing facility. A main menu allows for a choice of entering the tracking/status or testing facility. Once the testing facility is chosen, a SAS/AF program screen that sets up all data sets and files needed for testing is submitted to the SAS system. Permanent data sets and files are allocated, and work data sets are created. This facility ensures that all needed data sets and files are available for use. Since all allocations and de-allocations of data sets and files are carried out in only two SAS/AF program screens, only these two SAS/AF programs need to be changed when moving to another operating system.

Interactive Testing
There are two main sections of the testing facility. One allows a tester to choose the desired options and test the full-screen procedure. The data sets and files created or allocated by the allocation program are available for use. A SAS/AF program screen lists all
options available and allows for checking of user fields (for example, checking of variables within a chosen data set). Once within the desired full-screen procedure, hard-copy check sheets are used for testing. These check sheets list all commands available for each screen within each full-screen procedure. Checking off each command as tested ensures that all commands are tested and provides for a written record of interactive testing.

Standard Jobs
The second portion of the testing facility consists of the standard interactive test streams for each full-screen procedure. These test streams test all options, singularly and in combination, available for each procedure. They test for unallocated librefs, empty data sets, large data sets (with and without formats), and data sets allocated as INPUT only. The effect of various SAS options of each procedure is also addressed. These test streams give a good, quick test of the procedures. By running these test streams on two different terminals side-by-side, you can quickly check for any inconsistencies. This allows for comparison of two versions of SAS software or SAS software run under two operating systems.

The test streams automatically print the SAS log and if appropriate the SAS files. This is done with the aid of the AUTOCALL macro %DMSCMD. This macro allows for display manager commands to be submitted as code. In this case the display manager command to clear the SAS log at initiation and to print the SAS log at termination is submitted from the SAS/AF program.

- %DMSCMD(clear log);
- standard test stream
- %DMSCMD(print log);

The on-line status file is updated from a SAS/AF program screen using the AUTOCALL macro %DMSCMD and the display manager command that allows the SAS log to be saved to an external file. SAS system macros are used to fill in the date, version of SAS running, and the operating system.

- options nosource;
- %DMSCMD(clear log);
- %PUT &PROC on &SYSDATE - SASVER= &SYSSVER under &SYSSCP ;
- %DMSCMD(save log logx);
- options source;

SAS/DMI Testing
SAS/DMI testing was incorporated in the testing and status/Tracking Facility for the MVS operating system. This allowed access to sample programs, allocation to sample data sets, and access to the status/tracking facility. This also allowed for testing of the interaction of the various full-screen procedures together with SAS/DMI software. SAS/DMI was also used in the testing of SAS/FSP and SAS/AF software under OS. Because SAS/DMI software allows for multiple concurrent SAS sessions, SAS software could be tested under various versions of the SAS system at the same time.

Conclusion
The development of a menu-driven system for software testing achieved all the objectives needed in such a facility. SAS/AF and SAS/FSP software provided all the tools needed to make a truly interactive application facility. This menu system aids in software evaluation, while at the same time linking together report generation and an on-line status system. The facility allows for a systematic approach to testing, provides a means for report generation, and allows on-line storage and retrieval of test results.

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