Macro - How and Why

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Abstract

Time does not allow for a complete macro course; however, the student is provided with a complete course to finish at home. The course assumes that the student is familiar with some basic SAS® (elementary DATA steps, PROC PRINT, etc.) and how to operate interactively with the display manager, but it does not assume any knowledge of macro.

Some basic macro programming will be introduced during the hands on workshop. We begin with the idea of macro as a parameter driven unit of SAS code. The main example is drawn from a macro that generates SAS code for making test prints. Various features are added throughout the lecture with the student implementing and/or testing some of them to end up with a fairly useful little macro that also illustrates what macro is all about.

If you complete the course you will end up having macros getting help from other macros to solve significant problems. Quentin McMullen has been a great help in developing and preparing an earlier version of the course.

Introduction

The beginner often mistakenly gets the impression that SAS macro is sort of a super SAS programming language. It isn't. It is a language for manipulating text to make SAS programs. Through examples, the workshop emphasizes principles that help one to understand the role of macro in SAS programming and the nature of the problems that it can solve.

SAS has developed in a context where variable names are known and tied to specific data elements. This makes it easy to quickly develop small programs that can accomplish a lot. However, the programs are typically applicable to a very specific situation. When given a new dataset, the LIBNAME must change and the member name must change and all the usage of variable names may no longer be appropriate. In a word, SAS programs can be simple, but brittle, i.e. they break easily when applied to a slightly different set of data. Consequently, many changes may be needed when the situation changes only slightly.

SAS programs may make good templates for particular problems, but they are not general solutions. They usually require some macro programming to make them general solutions to a class of related problems. The main significance of the macro language is that it can provide some of the flexibility needed to make general programs using the SAS language. A macro may be thought of as a parameterized unit of SAS code. So this is where we begin. Why? When one begins teaching macro with macro variables, one has already started by teaching the student to emphasize global macro variables. My intention is to teach without building in bad examples that should later be explained away.

The role of macro, as a parameterized unit of SAS code, is then extended by introducing decision making and looping to give the unit more power. Lists are a central concept to organizing programs, so lists, how to make them, how to manipulate them, and what they can do for you is a theme that runs throughout the course.

Both iterative and conditional looping are covered since conditional looping is required for handling lists.

To keep things simple as possible no procedures beyond PROC PRINT are used before Example 13. The emphasis is placed on macro tools, style, and technique. However, the concept of generating a macro variable from the SELECT statement of PROC SQL is used in a simple form in Examples 13 and 14 because it is the easiest way to assign a list to a macro variable. Dictionary files are introduced, since they are an important way to get and use system information for project management. On the other hand, the traditional topic, array of macro variables, is not introduced. Instead %SCAN is used to get at the elements of a list.

Of course, an hour and 15 minutes is much too short to cover even the minimum of our desires, so some of the material will be left to the student for self study. This should be possible because the code includes explanatory comments.

The complete course is available at the NESUG Proceedings site, http://www.nesug.org/proceedings/ Click the icon to the left of the paper to download the course materials.
In addition to the examples provided, you can learn a great deal from papers presented in SAS conferences. Lex Jansen has created a very good site for searching in general for papers at http://lexjansen.com/nesug/. Note that on the left hand side of the page one can search for many different user group conferences. There is also a place to search the SAS-L archives and view current SAS-L messages. SAS-L is an electronic user group that is very active and eager to answer your questions about SAS and macro. Answering questions on SAS-L is about the best way to learn anything about SAS including macro.

The Course

Lesson 1:

1) Macro as a parameterized package of SAS code
2) %MACRO and %MEND statements
3) Key word parameter
4) Parameter resolution
5) Macro comment statement
6) Option MPRINT to see generated SAS code

Macro: %tprint
Service: Synchronization of title statement and print

Lesson 2:

1) Enhanced functionality by addition of parameters
   • Control number of observations
   • Better title control
   • Control columns printed
2) Parameter as part of a SAS word
3) %PUT statement for debugging
   • _LOCAL_ as key word to %PUT

Macro: %tprint
New Features: More parameters
            Reporting of _LOCAL_ macro variables

Lesson 3:

1) _AUTOMATIC_ variables
   • SYSLAST holds name of last created data set
2) %LET statement to reassign macro parameter value
3) Macro parameter references resolve inside double quotes
4) Macro modification

Macro: %tprint
New Features: Default title problem fixed

Lesson 4:

1) %IF statement to make macro execution decision
   • Debugging
   • Error reporting
2) %LENGTH function to test for existence of parameter value

Macro: %tprint
New Features: More parameters
            Better control
Lesson 5:
1) %GOTO statement to control macro flow
2) %UPCASE() function
3) %GLOBAL statement
4) %LET statement to create global macro variables
5) MLOGIC and SYMBOLGEN options for debugging
6) %SYMDEL statement to delete global macro variables

Macro: %tprint
New Features: Test for execution mode

Lesson 6:
1) Macro function %EVAL
   * Does integer/boolean arithmetic
   * Used in %IF
   * Used wherever an integer is expected

Macro: %compare - illustrate use of %EVAL in a %IF statement

Lesson 7:
1) Iterative %DO-loop
   * Using a simple %PUT statement
2) %LOCAL statement
   * Local variables do not exist outside of an executing macro
3) Option MLOGIC

Macro: %loop - illustrate iterative %DO-loop

Lesson 8:
1) Iterative %DO-loop
   * Using PROC PRINT code

Macro: %PrintLoop - illustrate iterative %DO-loop

Lesson 9:
1) %SCAN function
2) %STR function

Lesson 10:
1) Conditional %DO-loop
   * %PUT statement in loop

Macro: %PutAll - illustrate conditional %DO-loop

Note: Use conditional %DO-loops to parse lists. Iterative %DO-loops are less appropriate for such tasks. The structure of the macro code in examples 10, 11, and 12 is identical. This is standard "shell code" for constructing a conditional %DO-loop. The only significant difference among the examples is the code inside of the loop.
Lesson 11:
1) Conditional %DO-loop
   • PROC PRINT code in loop

Macro: %PrintList - illustrate conditional %DO-loop

Lesson 12:
1) Conditional %DO-loop
   • Invoke %tprint in loop
2) Call a helper macro within a macro
3) Pass parameters from outside macro to inside macro

Macros: %PrintList [NEW]- illustrate conditional %DO-loop
         %tprint     [OLD]

Lesson 13:
1) List creation with PROC SQL INTO: SEPARATED BY
2) SQL Dictionary files

Lesson 14:
1) Supervisor macro %PrintAll to generate list of datasets and then pass the list to %PrintList

Macros: %PrintAll [NEW]
         %PrintList [OLD]
         %tprint    [OLD]

New Features: "Supervisor macro" reads in a control dataset, and invokes another macro

Lesson 15:
1) Example of developing a macro solution for a common task: Converting character variables to numeric.

Macros: %rename - generate a rename list
         %CharToNum - generate a list of assignment statements converting data step variables from character to numeric
         %DSCharToNum - convert all character variables in a dataset to numeric

Conclusion
Macro is a new programming language for the SAS programmer. It is easy to get off to a bad start. I hope this class will help some to avoid that fate.

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