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# SAS® Viya™ 3.1 Macro Language: Reference

SAS® Documentation

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**SAS® Viya™ 3.1 Macro Language: Reference**

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# Contents

*About This Book* . . . . . *vii*

PART 1 Understanding and Using the Macro Facility 1

***Chapter 1 • Introduction to the Macro Facility*** . . . . . **3**
Getting Started with the Macro Facility . . . . . 3
Using the Macro Facility in SAS Viya . . . . . 4
Replacing Text Strings Using Macro Variables . . . . . 8
Generating SAS Code Using Macros . . . . . 9
More Advanced Macro Techniques . . . . . 10
Other Features of the Macro Language . . . . . 11

***Chapter 2 • SAS Programs and Macro Processing*** . . . . . **13**
SAS Programs and Macro Processing . . . . . 13
How SAS Processes Statements without Macro Activity . . . . . 14
How SAS Processes Statements with Macro Activity . . . . . 15

***Chapter 3 • Macro Variables*** . . . . . **21**
Macro Variables . . . . . 21
Macro Variables Defined by the Macro Processor . . . . . 22
Macro Variables Defined by Users . . . . . 26
Using Macro Variables . . . . . 30
Displaying Macro Variable Values . . . . . 33
Referencing Macro Variables Indirectly . . . . . 33
Manipulating Macro Variable Values with Macro Functions . . . . . 35

***Chapter 4 • Macro Processing*** . . . . . **37**
Macro Processing . . . . . 37
Defining and Calling Macros . . . . . 37
How the Macro Processor Compiles a Macro Definition . . . . . 38
How the Macro Processor Executes a Compiled Macro . . . . . 40
Summary of Macro Processing . . . . . 46

***Chapter 5 • Scopes of Macro Variables*** . . . . . **47**
Scopes of Macro Variables . . . . . 47
Global Macro Variables . . . . . 48
Local Macro Variables . . . . . 49
Writing the Contents of Symbol Tables to the Log . . . . . 51
How Macro Variables Are Assigned and Resolved . . . . . 52
Examples of Macro Variable Scopes . . . . . 55
Special Cases of Scope with the CALL SYMPUT Routine . . . . . 63

***Chapter 6 • Macro Expressions*** . . . . . **71**
Macro Expressions . . . . . 71
Defining Arithmetic and Logical Expressions . . . . . 72
How the Macro Processor Evaluates Arithmetic Expressions . . . . . 74
How the Macro Processor Evaluates Logical Expressions . . . . . 76

***Chapter 7 • Macro Quoting*** . . . . . **79**
Macro Quoting . . . . . 80
Deciding When to Use a Macro Quoting Function and Which Function to Use . . . . . 83
%STR and %NRSTR Functions . . . . . 85
%BQUOTE and %NRBQUOTE Functions . . . . . 89
Referring to Already Quoted Variables . . . . . 90
Deciding How Much Text to Mask with a Macro Quoting Function . . . . . 90
%SUPERQ Function . . . . . 91
Summary of Macro Quoting Functions and the Characters That They Mask . . . . . 92
Unquoting Text . . . . . 93
How Macro Quoting Works . . . . . 95
Other Functions That Perform Macro Quoting . . . . . 96

***Chapter 8 • Interfaces with the Macro Facility*** . . . . . **99**
Interfaces with the Macro Facility . . . . . 99
DATA Step Interfaces . . . . . 100
Using SAS Language Functions in the DATA Step and Macro Facility . . . . . 104
Interfaces with the SQL Procedure . . . . . 105
Interfaces with the SAS Component Language . . . . . 106
SAS/CONNECT Interfaces . . . . . 108

***Chapter 9 • Storing and Reusing Macros*** . . . . . **111**
Storing and Reusing Macros . . . . . 111
Saving Macros in an Autocall Library . . . . . 112
Saving Macros Using the Stored Compiled Macro Facility . . . . . 115

***Chapter 10 • Macro Facility Error Messages and Debugging*** . . . . . **117**
General Macro Debugging Information . . . . . 118
Troubleshooting Your Macros . . . . . 119
Debugging Techniques . . . . . 132

***Chapter 11 • Writing Efficient and Portable Macros*** . . . . . **139**
Writing Efficient and Portable Macros . . . . . 139
Keeping Efficiency in Perspective . . . . . 140
Writing Efficient Macros . . . . . 140
Writing Portable Macros . . . . . 146

***Chapter 12 • Macro Language Elements*** . . . . . **153**
Macro Language Elements . . . . . 153
Macro Statements . . . . . 154
Macro Functions . . . . . 156
Automatic Macro Variables . . . . . 162
Interfaces with the Macro Facility . . . . . 165
Selected Autocall Macros Provided with SAS Software . . . . . 167
Selected System Options Used in the Macro Facility . . . . . 169

PART 2 Macro Language Dictionary 173

***Chapter 13 • AutoCall Macros*** . . . . . **175**
AutoCall Macros . . . . . 175
Dictionary . . . . . 175

***Chapter 14 • Automatic Macro Variables*** . . . . . **193**
Automatic Macro Variables . . . . . 194

Dictionary . . . . . 194

***Chapter 15 • DATA Step Call Routines for Macros*** . . . . . **227**
DATA Step Call Routines for Macros . . . . . 227
Dictionary . . . . . 227

***Chapter 16 • DATA Step Functions for Macros*** . . . . . **239**
DATA Step Functions for Macros . . . . . 239
Dictionary . . . . . 239

***Chapter 17 • Macro Functions*** . . . . . **249**
Macro Functions . . . . . 249
Dictionary . . . . . 250

***Chapter 18 • SQL Clauses for Macros*** . . . . . **287**
SQL Clauses for Macros . . . . . 287
Dictionary . . . . . 287

***Chapter 19 • Macro Statements*** . . . . . **291**
Macro Statements . . . . . 291
Dictionary . . . . . 292

***Chapter 20 • System Options for Macros*** . . . . . **331**
System Options for Macros . . . . . 331
Dictionary . . . . . 332

PART 3 Appendixes 363

***Appendix 1 • Reserved Words in the Macro Facility*** . . . . . **365**
Macro Facility Word Rules . . . . . 365
Reserved Words . . . . . 365

***Appendix 2 • SAS Macro Facility Error and Warning Messages*** . . . . . **367**
SAS Macro Error Messages . . . . . 367
SAS Macro Warning Messages . . . . . 399

***Appendix 3 • SAS Tokens*** . . . . . **407**
SAS Tokens . . . . . 407
List of Tokens . . . . . 407

***Appendix 4 • Syntax for Selected Functions Used with the %SYSFUNC Function*** . . . . . **409**
Summary Descriptions and Syntax . . . . . 409
Functions and Arguments for %SYSFUNC . . . . . 409

***Appendix 5 • Using the Macro Facility with the Linux Operating Environment*** . . . . . **415**
Automatic Macro Variables in Linux Environments . . . . . 415
Macro Functions in Linux Environments . . . . . 416
SAS System Options Used by the Macro Facility in Linux Environments . . . . . 417
Using Autocall Libraries in Linux Operating Environment . . . . . 417

***Recommended Reading*** . . . . . **419**
***Glossary*** . . . . . **421**
***Index*** . . . . . **427**

# About This Book

## Syntax Conventions for the SAS Language

### *Overview of Syntax Conventions for the SAS Language*

SAS uses standard conventions in the documentation of syntax for SAS language elements. These conventions enable you to easily identify the components of SAS syntax. The conventions can be divided into these parts:

- syntax components
- style conventions
- references to SAS libraries and external files

### *Syntax Components*

The components of the syntax for most language elements include a keyword and arguments. For some language elements only a keyword is necessary. For other language elements the keyword is followed by an equal sign (=).

*Note:* In most cases, example code in SAS documentation is written in lowercase with a monospace font. You can use uppercase, lowercase, or mixed case in the code that you write.

### *Style Conventions*

The style conventions that are used in documenting SAS syntax include uppercase bold, uppercase, and italic:

UPPERCASE BOLD
identifies SAS keywords such as the names of functions or statements. In the following example, the keyword ERROR is written in uppercase bold:

**ERROR**<message>;

UPPERCASE
identifies arguments that are literals. In the following example of the CMPMODEL= system option, the literals include BOTH, CATALOG, and XML:

**CMPMODEL** = BOTH | CATALOG | XML

*italics*
identifies arguments or values that you supply. Items in italics represent user-supplied values that are either non-literal arguments or nonliteral values that are assigned to an argument.

Items in italics can also be the generic name for a list of arguments from which you can choose (for example, *attribute-list*). If more than one of an item in italics can be used, the items are expressed as *item-1, ..., item-n*.

## References to SAS Libraries and External Files

Many SAS statements and other language elements refer to SAS libraries and external files. You can choose whether to make the reference through a logical name (a libref or fileref) or use the physical filename enclosed in quotation marks. If you use a logical name, you usually have a choice of using a SAS statement (LIBNAME or FILENAME) or the operating environment's control language to make the association. Several methods of referring to SAS libraries and external files are available, and some of these methods depend on your operating environment.

In the examples that use external files, SAS documentation uses the italicized phrase *file-specification*. In the examples that use SAS libraries, SAS documentation uses the italicized phrase *SAS-library*. Note that *SAS-library* is enclosed in quotation marks:

```
infile file-specification obs = 100;
libname libref 'SAS-library';
```

# Part 1

# Understanding and Using the Macro Facility

*Chapter 1*
***Introduction to the Macro Facility*** . . . . . *3*

*Chapter 2*
***SAS Programs and Macro Processing*** . . . . . *13*

*Chapter 3*
***Macro Variables*** . . . . . *21*

*Chapter 4*
***Macro Processing*** . . . . . *37*

*Chapter 5*
***Scopes of Macro Variables*** . . . . . *47*

*Chapter 6*
***Macro Expressions*** . . . . . *71*

*Chapter 7*
***Macro Quoting*** . . . . . *79*

*Chapter 8*
***Interfaces with the Macro Facility*** . . . . . *99*

*Chapter 9*
***Storing and Reusing Macros*** . . . . . *111*

*Chapter 10*
***Macro Facility Error Messages and Debugging*** . . . . . *117*

*Chapter 11*
***Writing Efficient and Portable Macros*** . . . . . *139*

*Chapter 12*
***Macro Language Elements*** . . . . . *153*

*Chapter 1*

# Introduction to the Macro Facility

**Getting Started with the Macro Facility** . . . . . **3**

**Using the Macro Facility in SAS Viya** . . . . . **4**

**Replacing Text Strings Using Macro Variables** . . . . . **8**

**Generating SAS Code Using Macros** . . . . . **9**
Defining Macros . . . . . 9
Inserting Comments in Macros . . . . . 10

**More Advanced Macro Techniques** . . . . . **10**
Generating Repetitive Pieces of Text Using %DO Loops . . . . . 10
Generating a Suffix for a Macro Variable Reference . . . . . 11

**Other Features of the Macro Language** . . . . . **11**

## Getting Started with the Macro Facility

This document is the macro facility language reference for SAS. It is a reference for the SAS macro language processor and defines the SAS macro language elements. This section introduces the SAS macro facility using simple examples and explanation.

The *macro facility* is a tool for extending and customizing SAS and for reducing the amount of text that you must enter to do common tasks. The macro facility enables you to assign a name to character strings or groups of SAS programming statements. You can work with the names that you created rather than with the text itself.

The SAS macro language is a string-based language. It does not support the use of hexadecimal character constants.

*Note:* The SAS macro language does not support using hexadecimal values to specify non-printable characters.

When you use a macro facility name in a SAS program or from a command prompt, the macro facility generates SAS statements and commands as needed. The rest of SAS receives those statements and uses them in the same way it uses the ones that you enter in the standard manner.

The macro facility has two components:

*macro processor*
is the portion of SAS that does the work

*macro language*
is the syntax that you use to communicate with the macro processor

When SAS compiles program text, two delimiters trigger macro processor activity:

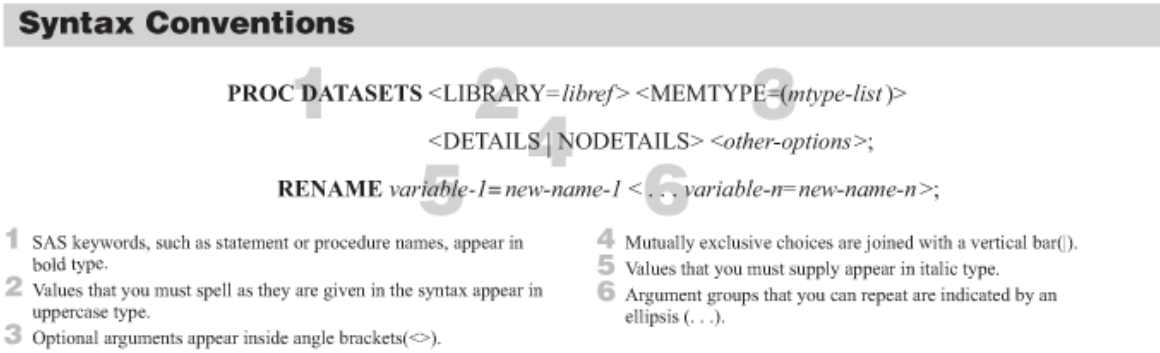
*&name*
refers to a macro variable. "Replacing Text Strings Using Macro Variables" on page 8 explains how to create a macro variable. The form *&name* is called a macro variable reference.

*%name*
refers to a macro. "Generating SAS Code Using Macros" on page 9 explains how to create a macro. The form *%name* is called a macro call.

The text substitution produced by the macro processor is completed before the program text is compiled and executed. The macro facility uses statements and functions that resemble the statements and functions that you use in the DATA step. An important difference, however, is that macro language elements can enable only text substitution and are not present during program or command execution.

*Note:* Three SAS statements begin with a % that are not part of the macro facility. These elements are the %INCLUDE, %LIST, and %RUN statements in *SAS Viya Statements: Reference*.

The following graphic explains the syntax used in this document:




## Using the Macro Facility in SAS Viya

The macro facility does not run within Cloud Analytic Services (CAS). The macro facility runs in a SAS client session within SAS Viya. You can use the macro facility to generate code for procedures, DATA steps, and global statements. Code generated by the macro facility can use LIBNAME engines. CAS uses caslibs and data connectors instead of LIBNAME statements.

All macros are created in and executed from a SAS client session. In this example the macro myMac1 contains a DATA step to add the X variable to the Work.Class data set. The DATA step created by myMac1 macro uses the V9 engine to read the V9 data set Class from the SASHELP library and outputs a V9 data set in the Work directory.

For the myMac2 macro, a CAS LIBNAME statement is entered, which assigns a caslib named Mycas. The macro myMac2 runs in the SAS client session to add the Y variable and outputs to the Mycas.Class table.

```
%macro myMac1;
    data class;
       set sashelp.class;
       x=1;
       put " **** ";
       put "This macro is running in the SAS-client session
            and creating a SAS data set in the Work library";
       put " **** ";
       put _hostname_ 'thread #' _threadid_;
    run;
  %mend myMac1;
  %myMac1;
  quit;

libname mycas cas;
/* macro 2 */
%macro myMac2;
    data mycas.class;
       set class;
       y=2;
       put " **** ";
       put "This macro is running in the SAS-client session
            and loading a CAS-session table in the Mycas library";
       put " **** ";
       put _hostname_ 'thread #' _threadid_;
    run;
  %mend myMac2;
  %myMac2;
  quit;
```

Here is a condensed version of the log. The following text is repeated for each of the 19 observations.

```
****
 This macro is running in the SAS-client session...
  ****
 rdcesx15179 thread #1
  ****
```

***Log 1.1*** *Creating the Work.Class Data Set and the Mycas.Class Table*

```
 58         /* MACROS  */
 59         /* macro 1 */
 60         %macro myMac1;
 61             data class;
 62                set sashelp.class;
 63                x=1;
 64                put " **** ";
 65                put "This macro is running in the SAS-client
                   session and creating a SAS data set in the
                   WORK library";
 66                put " **** ";
 67                put _hostname_ 'thread #' _threadid_;
 68             run;
 69           %mend myMac1;
 70           %myMac1;

  ****
 This macro is running in the SAS-client session and
 creating a SAS data set in the WORK library.
  ****
 rdcesx15179 thread #1
  ****
...

 NOTE: There were 19 observations read from the data set SASHELP.CLASS.
 NOTE: The data set WORK.CLASS has 19 observations and 6 variables.
 NOTE: DATA statement used (Total process time):
       real time           0.01 seconds
       cpu time            0.00 seconds


 71           quit;
 72
 73         libname mycas cas;
 NOTE: Libref MYCAS was successfully assigned as follows:
       Engine:        CAS
       Physical Name: f84824ee
 74
 75         /* macro 2 */
 76         %macro myMac2;
 77             data mycas.class;
 78                set class;
 79                y=2;
 80                put " **** ";
 81                put "This macro is running in the SAS-client
                   session and loading a CAS-session table in
                   the Mycas library";
 82                put " **** ";
 83                put _hostname_ 'thread #' _threadid_;
 84             run;
 85           %mend myMac2;
 86           %myMac2;

  ****
 This macro is running in the SAS-client session and loading a CAS-session table
in the Mycas library
  ****
 rdcesx15179 thread #1
  ****
 ...

 NOTE: There were 19 observations read from the data set WORK.CLASS.
 NOTE: The data set MYCAS.CLASS has 19 observations and 7 variables.
 NOTE: DATA statement used (Total process time):
       real time           0.04 seconds
       cpu time            0.01 seconds


 87           quit;
```

Here is the Work.Class data set with the X variable added.

***Figure 1.1*** *Work.Class Data Set*

| Obs | Name | Sex | Age | Height | Weight | x |
|---|---|---|---|---|---|---|
| 1 | Alfred | M | 14 | 69.0 | 112.5 | 1 |
| 2 | Alice | F | 13 | 56.5 | 84.0 | 1 |
| 3 | Barbara | F | 13 | 65.3 | 98.0 | 1 |
| 4 | Carol | F | 14 | 62.8 | 102.5 | 1 |
| 5 | Henry | M | 14 | 63.5 | 102.5 | 1 |
| 6 | James | M | 12 | 57.3 | 83.0 | 1 |
| 7 | Jane | F | 12 | 59.8 | 84.5 | 1 |
| 8 | Janet | F | 15 | 62.5 | 112.5 | 1 |
| 9 | Jeffrey | M | 13 | 62.5 | 84.0 | 1 |
| 10 | John | M | 12 | 59.0 | 99.5 | 1 |
| 11 | Joyce | F | 11 | 51.3 | 50.5 | 1 |
| 12 | Judy | F | 14 | 64.3 | 90.0 | 1 |
| 13 | Louise | F | 12 | 56.3 | 77.0 | 1 |
| 14 | Mary | F | 15 | 66.5 | 112.0 | 1 |
| 15 | Philip | M | 16 | 72.0 | 150.0 | 1 |
| 16 | Robert | M | 12 | 64.8 | 128.0 | 1 |
| 17 | Ronald | M | 15 | 67.0 | 133.0 | 1 |
| 18 | Thomas | M | 11 | 57.5 | 85.0 | 1 |
| 19 | William | M | 15 | 66.5 | 112.0 | 1 |

Here is the Mycas.Class table with the Y variable added.

***Figure 1.2*** *Mycas.Class Table*

| Obs | Name | Sex | Age | Height | Weight | x | y |
|---|---|---|---|---|---|---|---|
| 1 | Alfred | M | 14 | 69.0 | 112.5 | 1 | 2 |
| 2 | Alice | F | 13 | 56.5 | 84.0 | 1 | 2 |
| 3 | Barbara | F | 13 | 65.3 | 98.0 | 1 | 2 |
| 4 | Carol | F | 14 | 62.8 | 102.5 | 1 | 2 |
| 5 | Henry | M | 14 | 63.5 | 102.5 | 1 | 2 |
| 6 | James | M | 12 | 57.3 | 83.0 | 1 | 2 |
| 7 | Jane | F | 12 | 59.8 | 84.5 | 1 | 2 |
| 8 | Janet | F | 15 | 62.5 | 112.5 | 1 | 2 |
| 9 | Jeffrey | M | 13 | 62.5 | 84.0 | 1 | 2 |
| 10 | John | M | 12 | 59.0 | 99.5 | 1 | 2 |
| 11 | Joyce | F | 11 | 51.3 | 50.5 | 1 | 2 |
| 12 | Judy | F | 14 | 64.3 | 90.0 | 1 | 2 |
| 13 | Louise | F | 12 | 56.3 | 77.0 | 1 | 2 |
| 14 | Mary | F | 15 | 66.5 | 112.0 | 1 | 2 |
| 15 | Philip | M | 16 | 72.0 | 150.0 | 1 | 2 |
| 16 | Robert | M | 12 | 64.8 | 128.0 | 1 | 2 |
| 17 | Ronald | M | 15 | 67.0 | 133.0 | 1 | 2 |
| 18 | Thomas | M | 11 | 57.5 | 85.0 | 1 | 2 |
| 19 | William | M | 15 | 66.5 | 112.0 | 1 | 2 |

Although the macro facility does not exist within CAS, there are several macro variables in the client to help write the code that will run in CAS. For more information, see *SAS Cloud Analytic Services: Language Reference* and *SAS Cloud Analytic Services: Accessing and Manipulating Data*.

## Replacing Text Strings Using Macro Variables

*Macro variables* are an efficient way of replacing text strings in SAS code. The simplest way to define a macro variable is to use the %LET statement to assign the macro variable a name (subject to standard SAS naming conventions), and a value.

```
%let city=New Orleans;
```

Now you can use the macro variable CITY in SAS statements where you would like the text **`New Orleans`** to appear. You refer to the variable by preceding the variable name with an ampersand (&), as in the following TITLE statement:

```
title "Data for &city";
```

The macro processor resolves the reference to the macro variable CITY:

```
title "Data for New Orleans";
```

A macro variable can be defined within a macro definition or within a statement that is outside a macro definition (called *open code*).

*Note:* The title is enclosed in double quotation marks. In quoted strings in open code, the macro processor resolves macro variable references within double quotation marks but not within single quotation marks.

A %LET statement in open code (outside a macro definition) creates a global macro variable that is available for use anywhere (except in DATALINES or CARDS statements) in your SAS code during the SAS session in which the variable was created. There are also *local* macro variables, which are available for use only inside the macro definition where they are created. For more information about global and local macro variables, see Scope of Macro Variables on page 47.

Macro variables are not subject to the same length limits as SAS data set variables. The value that you want to assign to a macro variable can contain certain special characters (for example, semicolons, quotation marks, ampersands, and percent signs) or mnemonics (for example, AND, OR, or LT). You must use a macro quoting function to mask the special characters. Otherwise, the special character or mnemonic might be misinterpreted by the macro processor. For more information, see Macro Quoting on page 80.

Macro variables are useful for simple text substitution. They cannot perform conditional operations, DO loops, and other more complex tasks. For this type of work, you must define a macro.

# Generating SAS Code Using Macros

## *Defining Macros*

Macros enable you to substitute text in a program and to do many other things. A SAS program can contain any number of macros, and you can invoke a macro any number of times in a single program.

To help you learn how to define your own macros, this section presents a few examples that you can model your own macros after. Each of these examples is fairly simple; by mixing and matching the various techniques, you can create advanced, flexible macros that are capable of performing complex tasks.

Each macro that you define has a distinct name. When choosing a name for your macro, it is recommended that you avoid a name that is a SAS language keyword or call routine name. The name that you choose is subject to the standard SAS naming conventions. A macro name cannot contain double-byte character set (DBCS) characters. A macro definition is placed between a %MACRO statement and a %MEND (macro end) statement, as in the following example:

%MACRO *macro-name*;

%MEND *macro-name*;

The *macro-name* specified in the %MEND statement must match the *macro-name* specified in the %MACRO statement.

*Note:* Specifying the *macro-name* in the %MEND statement is not required, but it is recommended. It makes matching %MACRO and %MEND statements while debugging easier.

Here is an example of a simple macro definition:

```
%macro dsn;
   Newdata
%mend dsn;
```

This macro is named DSN. **`Newdata`** is the text of the macro. A string inside a macro is called *constant text* or *model text* because it is the model, or pattern, for the text that becomes part of your SAS program.

To call (or *invoke*) a macro, precede the name of the macro with a percent sign (%):

%*macro-name*

Although the call to the macro looks somewhat like a SAS statement, it does not have to end in a semicolon.

For example, here is how you might call the DSN macro:

```
title "Display of Data Set %dsn";
```

The macro processor executes the macro DSN, which substitutes the constant text in the macro into the TITLE statement:

```
title "Display of Data Set Newdata";
```

*Note:* The title is enclosed in double quotation marks. In quoted strings in open code, the macro processor resolves macro invocations within double quotation marks but not within single quotation marks.

The macro DSN is exactly the same as the following coding:

```
%let dsn=Newdata;

title "Display of Data Set &dsn";
```

The following code is the result:

```
title "Display of Data Set Newdata";
```

So, in this case, the macro approach does not have any advantages over the macro variable approach. However, DSN is an extremely simple macro. As you will see in later examples, macros can do much more than the macro DSN does.

### *Inserting Comments in Macros*

All code benefits from thorough commenting, and macro code is no exception. There are two forms that you can use to add comments to your macro code.

The first form is the same as comments in SAS code, beginning with **/*** and ending with ***/**. The second form begins with a **%*** and ends with a **;**. The following program uses both types of comments:

```
%macro comment;
/* Here is the type of comment used in other SAS code. */
   %let myvar=abc;

%* Here is a macro-type comment.;
   %let myvar2=xyz;

%mend comment;
```

You can use whichever type comment that you prefer in your macro code, or use both types as in the previous example.

The asterisk-style comment ( * *commentary* ; ) used in SAS code is not recommended within a macro definition. The asterisk-style will comment constant text appropriately and will execute any macro statements contained within the comment. This form of comment is not recommended because unmatched quotation marks contained within the comment text are not ignored and can cause unpredictable results.

## More Advanced Macro Techniques

### *Generating Repetitive Pieces of Text Using %DO Loops*

To generate repetitive pieces of text, use an iterative %DO loop. For example, the following macro, NAMES, uses an iterative %DO loop to create a series of names to be used in a DATA statement:

```
%macro names(name= ,number= );
   %do n=1 %to &number;
      &name&n
   %end;
%mend names;
```

The macro NAMES creates a series of names by concatenating the value of the parameter NAME and the value of the macro variable N. You supply the stopping value for N as the value of the parameter NUMBER, as in the following DATA statement:

```
data %names(name=dsn,number=5);
```

Submitting this statement produces the following complete DATA statement:

```
data dsn1 dsn2 dsn3 dsn4 dsn5;
```

*Note:* You can also execute a %DO loop conditionally with %DO %WHILE and %DO %UNTIL statements.

### *Generating a Suffix for a Macro Variable Reference*

Suppose that, when you generate a numbered series of names, you always want to put the letter X between the prefix and the number. The macro NAMESX inserts an X after the prefix you supply:

```
%macro namesx(name=,number=);
   %do n=1 %to &number;
      &name.x&n
   %end;
%mend namesx;
```

The period is a delimiter at the end of the reference &NAME. The macro processor uses the delimiter to distinguish the reference &NAME followed by the letter X from the reference &NAMEX. Here is an example of calling the macro NAMESX in a DATA statement:

```
data %namesx(name=dsn,number=3);
```

Submitting this statement produces the following statement:

```
data dsnx1 dsnx2 dsnx3;
```

For more information about using a period as a delimiter in a macro variable reference, see Macro Variables on page 21.

## Other Features of the Macro Language

Although subsequent sections go into far more detail on the various elements of the macro language, this section highlights some of the possibilities, with pointers to more information.

macro statements
: This section has illustrated only a few of the macro statements, such as %MACRO and %IF-%THEN. Many other macro statements exist, some of which are valid in open code, and others are valid only in macro definitions. For a complete list of macro statements, see “Macro Statements” on page 154.

macro functions
: Macro functions are functions defined by the macro facility. They process one or more arguments and produce a result. For example, the %SUBSTR function creates a substring of another string, when the %UPCASE function converts characters to uppercase. A special category of macro functions, the macro quoting functions, mask special characters so that they are not misinterpreted by the macro processor.

There are two special macro functions, %SYSFUNC and %QSYSFUNC, that provide access to SAS language functions or user-written functions generated with SAS/TOOLKIT. You can use %SYSFUNC and %QSYSFUNC with new functions in SAS software to obtain the values of SAS host, base, or graphics options. These functions also enable you to open and close SAS data sets, test data set attributes, or read and write to external files. Another special function is %SYSEVALF, which enables your macros to perform floating-point arithmetic.

For a list of macro functions, see "Macro Functions" on page 156. For a discussion of the macro quoting functions, see Macro Quoting on page 80. For the syntax of calling selected SAS functions with %SYSFUNC, see Syntax for Selected Functions with the %SYSFUNC Function on page 409.

autocall macros

Autocall macros are macros defined by SAS that perform common tasks such as the following:

- trimming leading blanks from a macro variable's value
- trailing trailing blanks from a macro variable's value
- returning the data type of a value

For a list of autocall macros, see "Selected Autocall Macros Provided with SAS Software" on page 167.

automatic macro variables

Automatic macro variables are macro variables created by the macro processor. For example, SYSDATE contains the date SAS is invoked. See Chapter 12, "Macro Language Elements," on page 153 for a list of automatic macro variables.

macro facility interfaces

Interfaces with the macro facility provide a dynamic connection between the macro facility and other parts of SAS, such as the following:

- DATA step
- SCL code
- SQL procedure
- SAS/CONNECT software

For example, you can create macro variables based on values within the DATA step using CALL SYMPUT and retrieve the value of a macro variable stored on a remote host using the %SYSRPUT macro statement. For more information about these interfaces, see Interfaces with the Macro Facility on page 99.

*Chapter 2*

# SAS Programs and Macro Processing

**SAS Programs and Macro Processing** . . . . . 13
**How SAS Processes Statements without Macro Activity** . . . . . 14
**How SAS Processes Statements with Macro Activity** . . . . . 15

## SAS Programs and Macro Processing

This section describes the typical pattern that SAS follows to process a program. These concepts are helpful for understanding how the macro processor works with other parts of SAS. However, they are not required for most macro programming. They are provided so that you can understand what is going on behind the scenes.

*Note:* The concepts in this section present a logical representation, not a detailed physical representation, of how SAS software works.

When you submit a program, it goes to an area of memory called the *input stack*. This is true for all program and command sources: the SAS windowing environment, the SCL SUBMIT block, the SCL COMPILE command, or from batch or noninteractive sessions. The input stackcontains a simple SAS program that displays sales data. The first line in the program is the top of the input stack.

```
data sales (drop=lastyr;
   infile in1;
   input m1-m12 lastyr;total=m12+lastyr;
run;
%let list=m1 m7 m12 total;
proc print;
   var &list;
run;
```

Once a program reaches the input stack, SAS transforms the stream of characters into individual tokens. These tokens are transferred to different parts of SAS for processing, such as the DATA step compiler and the macro processor. Knowing how SAS recognizes tokens and how they are transferred to different parts of SAS will help you understand how the various parts of SAS and the macro processor work together. Also, how to control the timing of macro execution in your programs. The following sections show you how a simple program is tokenized and processed.

## How SAS Processes Statements without Macro Activity

The process that SAS uses to extract words and symbols from the input stack is called *tokenization*. Tokenization is performed by a component of SAS called the *word scanner* The word scanner starts at the first character in the input stack and examines each character in turn. In doing so, the word scanner assembles the characters into tokens. There are four general types of tokens:

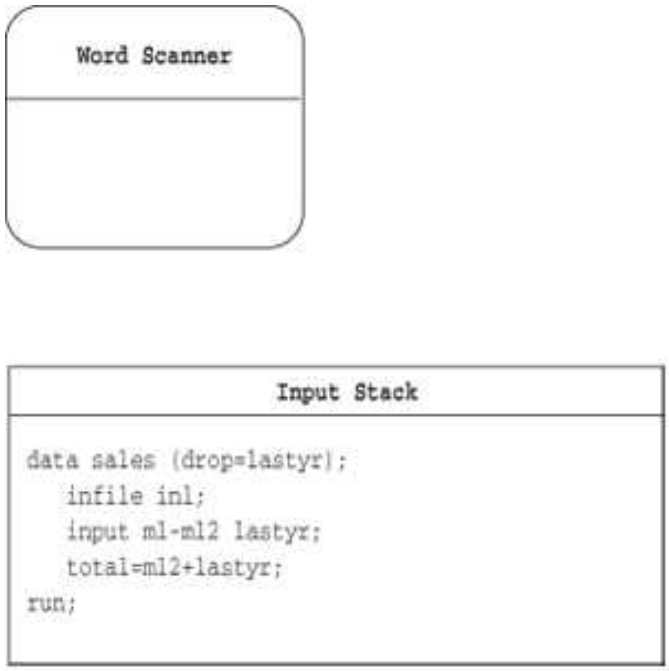
Literal
: a string of characters enclosed in quotation marks.

Number
: digits, date values, time values, and hexadecimal numbers.

Name
: a string of characters beginning with an underscore or letter.

Special
: any character or group of characters that have special meaning to SAS. Examples of special characters include: `* / + - ** ; $ ( ) . & % =`

***Figure 2.1*** *The Sample Program before Tokenization*



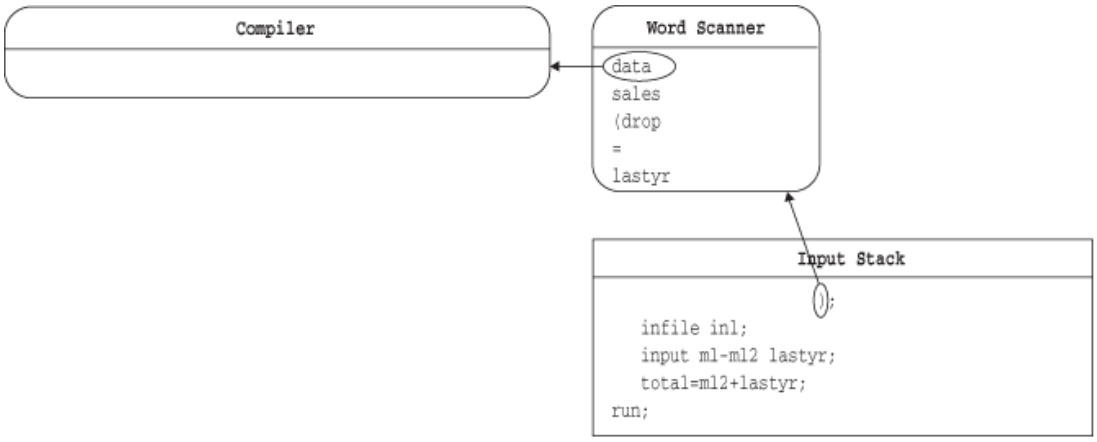

The first SAS statement in the input stack in the preceding figure contains eight tokens (four names and four special characters).

```
data sales(drop=lastyr);
```

When the word scanner finds a blank or the beginning of a new token, it removes a token from the input stack and transfers it to the bottom of the queue.

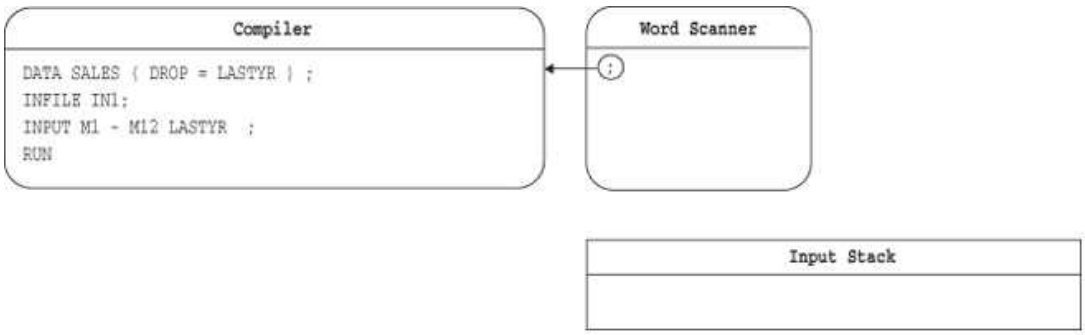
In this example, when the word scanner pulls the first token from the input stack, it recognizes the token as the beginning of a DATA step. The word scanner triggers the DATA step compiler, which begins to request more tokens. The compiler pulls tokens from the top of the queue, as shown in the following figure.

***Figure 2.2*** *The Word Scanner Obtains Tokens*




The compiler continues to pull tokens until it recognizes the end of the DATA step (in this case, the RUN statement), which is called a DATA step boundary, as shown in the following figure. When the DATA step compiler recognizes the end of a step, the step is executed, and the DATA step is complete.

***Figure 2.3*** *The Word Scanner Sends Tokens to the Compiler*



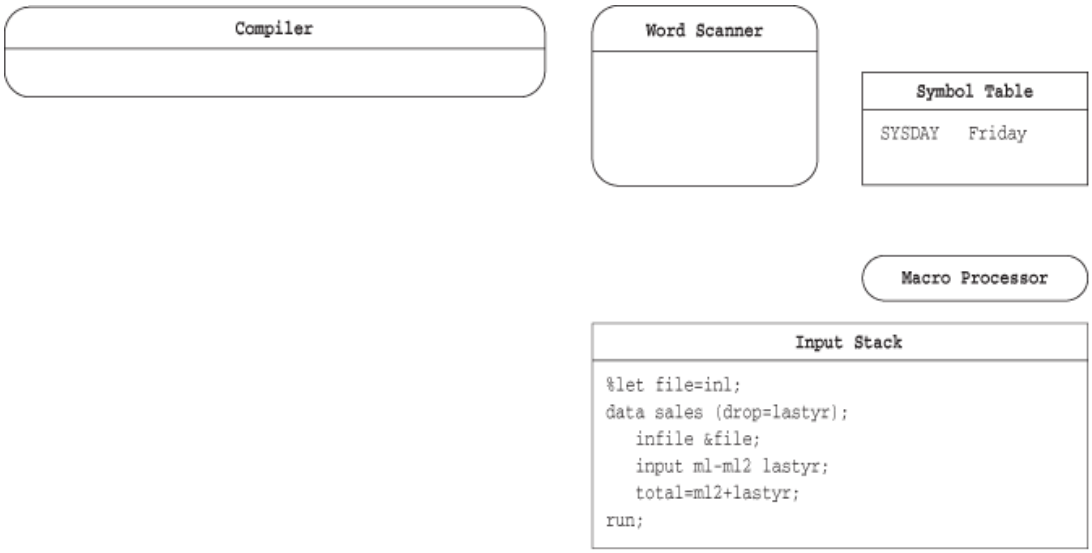

In most SAS programs with no macro processor activity, all information that the compiler receives comes from the submitted program.

## How SAS Processes Statements with Macro Activity

In a program with macro activity, the macro processor can generate text that is placed on the input stack to be tokenized by the word scanner. The example in this section shows you how the macro processor creates and resolves a macro variable. To illustrate how the compiler and the macro processor work together, the following figure contains the macro processor and the macro variable symbol table. SAS creates the symbol table at the beginning of a SAS session to hold the values of automatic and global macro variables.

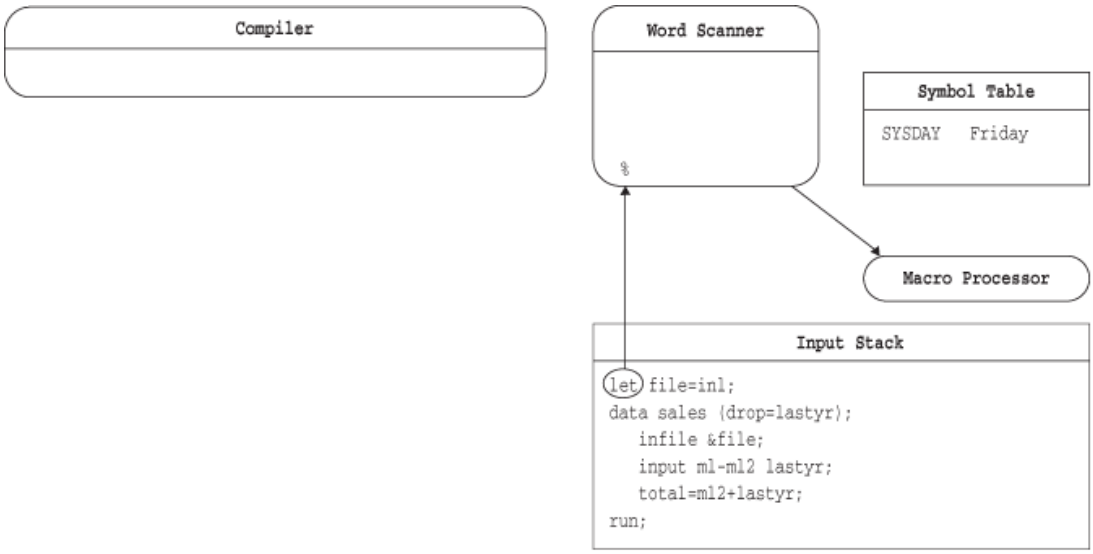
SAS creates automatic macro variables at the beginning of a SAS session. For the sake of illustration, the symbol table is shown with only one automatic macro variable, SYSDAY.

***Figure 2.4*** *The Macro Processor and Symbol Table*



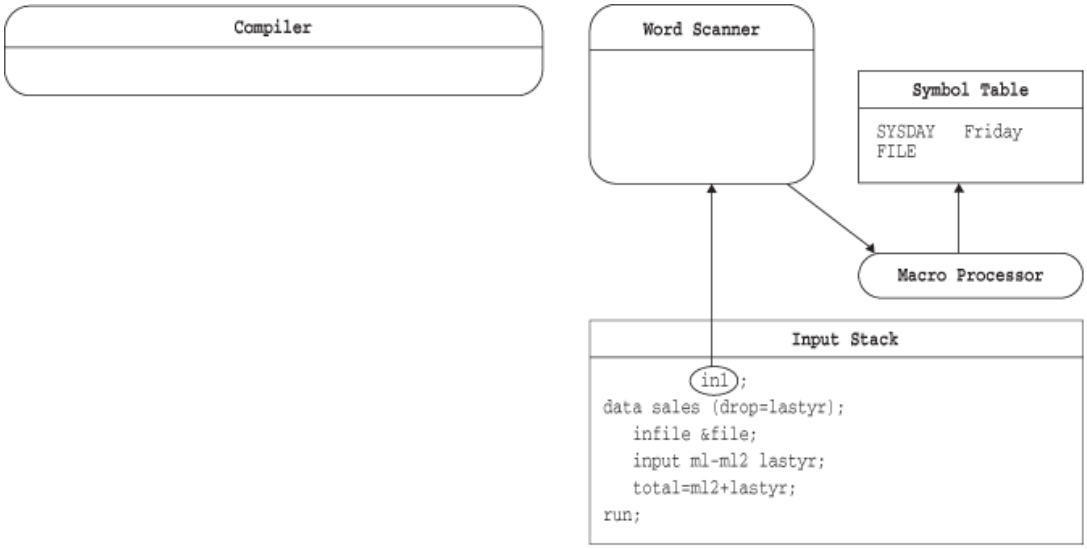

Whenever the word scanner encounters a macro trigger, it sends information to the macro processor. A macro trigger is either an ampersand (&) or percent sign (%) followed by a nonblank character. As it did in the previous example, the word scanner begins to process this program by examining the first characters in the input stack. In this case, the word scanner finds a percent sign (%) followed by a nonblank character. The word scanner recognizes this combination of characters as a potential macro language element, and triggers the macro processor to examine % and LET, as shown in the following figure.

***Figure 2.5*** *The Macro Processor Examines LET*



When the macro processor recognizes a macro language element, it begins to work with the word scanner. In this case, the macro processor removes the %LET statement, and writes an entry in the symbol table, as shown in the following figure.

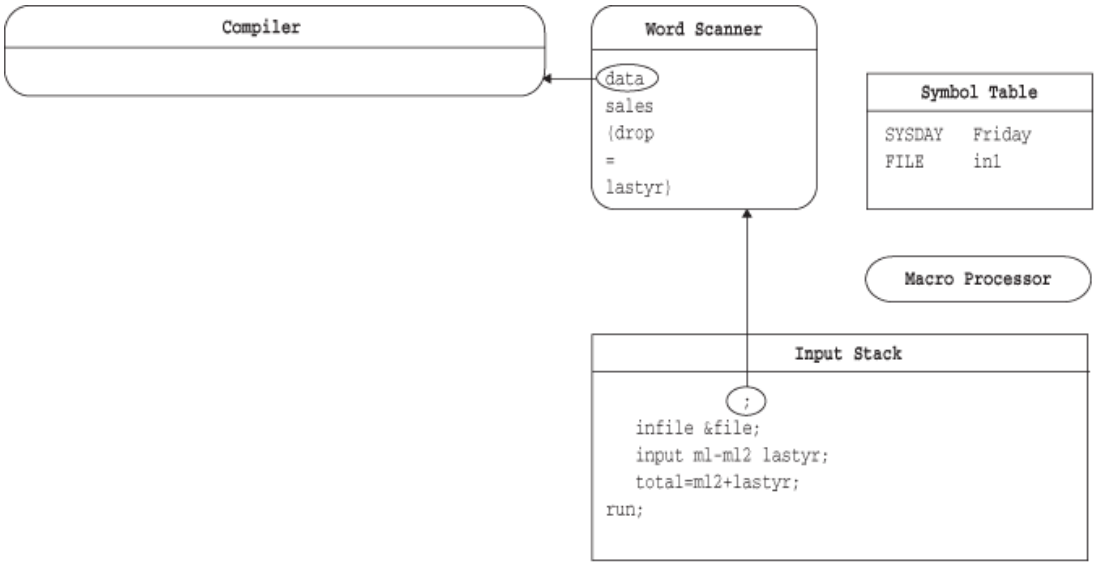
***Figure 2.6*** *The Macro Processor Writes to the Symbol Table*




From the time the word scanner triggers the macro processor until that macro processor action is complete, the macro processor controls all activity. When the macro processor is active, no activity occurs in the word scanner or the DATA step compiler.

When the macro processor is finished, the word scanner reads the next token (the DATA keyword in this example) and sends it to the compiler. The word scanner triggers the compiler, which begins to pull tokens from the top of the queue, as shown in the following figure.

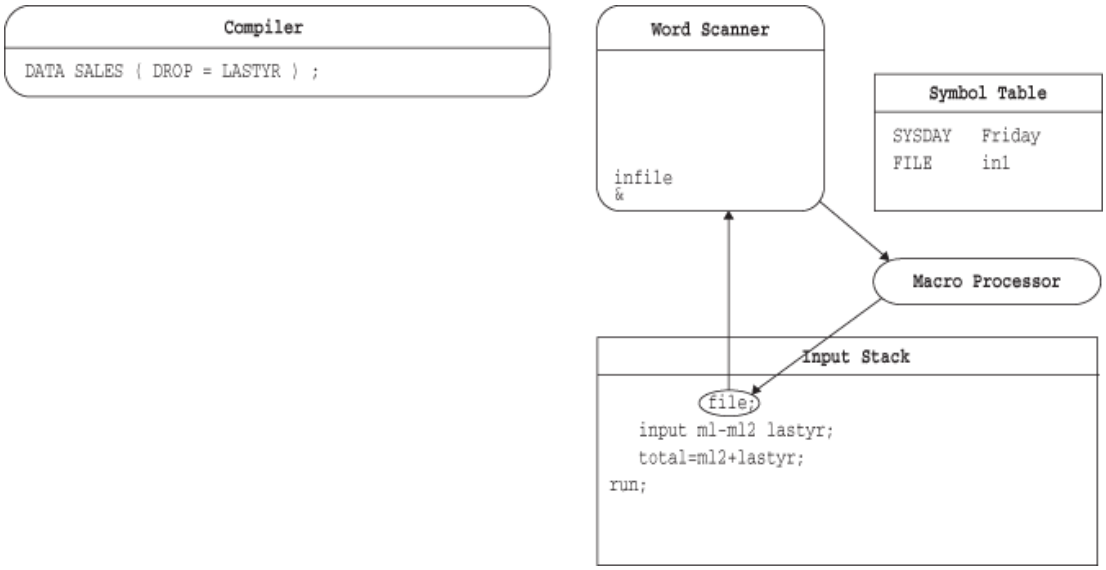
***Figure 2.7*** *The Word Scanner Resumes Tokenization*



As it processes each token, SAS removes the protection that the macro quoting functions provide to mask special characters and mnemonic operators. For more information, see Chapter 7, “Macro Quoting,” on page 79.

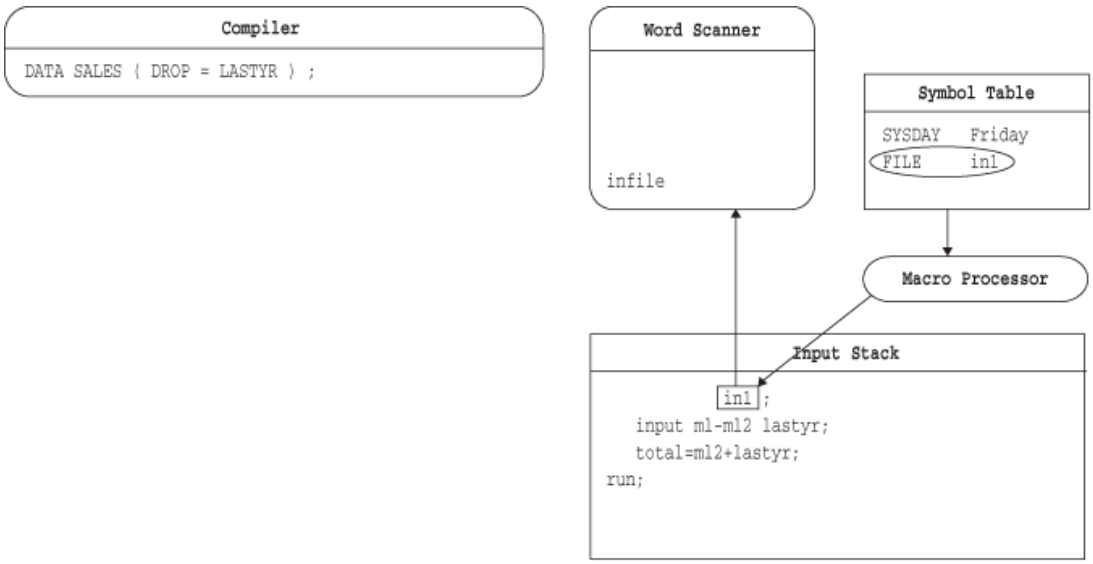
If the word scanner finds an ampersand followed by a nonblank character in a token, it triggers the macro processor to examine the next token, as shown in the following figure.

***Figure 2.8*** *The Macro Processor Examines &FILE*



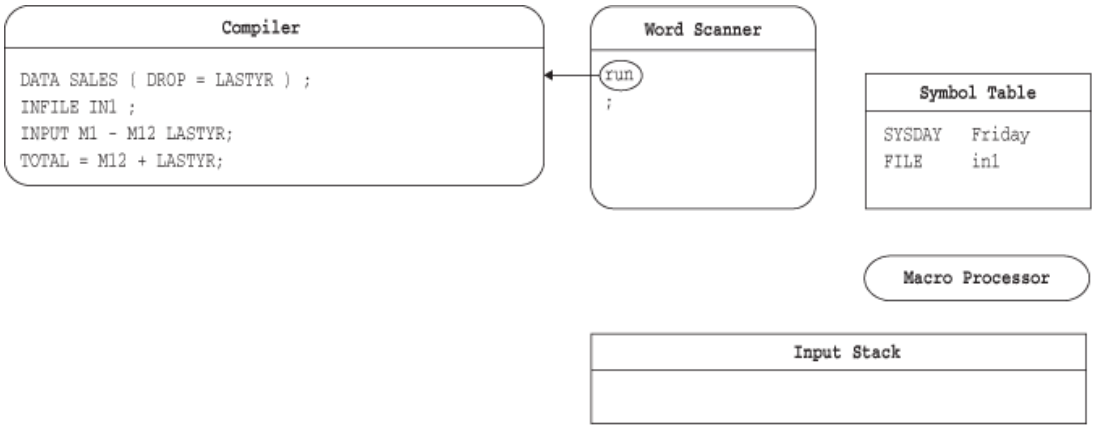

The macro processor examines the token and recognizes a macro variable that exists in the symbol table. The macro processor removes the macro variable name from the input stack and replaces it with the text from the symbol table, as shown in the following figure.

***Figure 2.9*** *The Macro Processor Generates Text to the Input Stack*




The compiler continues to request tokens, and the word scanner continues to supply them, until the entire input stack has been read as shown in the following figure.

***Figure 2.10*** *The Word Scanner Completes Processing*




If the end of the input stack is a DATA step boundary, as it is in this example, the compiler compiles and executes the step. SAS then frees the DATA step task. Any macro variables that were created during the program remain in the symbol table. If the end of the input stack is not a step boundary, the processed statements remain in the compiler. Processing resumes when more statements are submitted to the input stack.

*Chapter 3*

# Macro Variables

**Macro Variables** . . . . . **21**

**Macro Variables Defined by the Macro Processor** . . . . . **22**

**Macro Variables Defined by Users** . . . . . **26**
Overview for Defining Macro Variables . . . . . 26
Creating User-Defined Macro Variable Names . . . . . 27
Assigning Values to Macro Variables . . . . . 27

**Using Macro Variables** . . . . . **30**
Macro Variable Reference . . . . . 30
Combining Macro Variable References with Text . . . . . 31
Delimiting Macro Variable Names within Text . . . . . 32
Creating a Period to Follow Resolved Text . . . . . 32

**Displaying Macro Variable Values** . . . . . **33**

**Referencing Macro Variables Indirectly** . . . . . **33**
Using an Expression to Generate a Reference . . . . . 33
Generating a Series of Macro Variable References with a Single Macro Call . . . . . 34
Using More Than Two Ampersands . . . . . 34

**Manipulating Macro Variable Values with Macro Functions** . . . . . **35**

## Macro Variables

Macro variables are tools that enable you to dynamically modify the text in a SAS program through symbolic substitution. You can assign large or small amounts of text to macro variables, and after that, you can use that text by simply referencing the variable that contains it.

Macro variable values have a maximum length of 65,534 characters. The length of a macro variable is determined by the text assigned to it instead of a specific length declaration. So its length varies with each value that it contains. Macro variables contain only character data. However, the macro facility has features that enable a variable to be evaluated as a number when it contains character data that can be interpreted as a number. The value of a macro variable remains constant until it is specifically changed. Macro variables are independent of SAS data set variables.

*Note:* Only printable characters should be assigned to macro variables. Non-printable values that are assigned to macro variables can cause unpredictable results.

Macro variables defined by macro programmers are called *user-defined macro variables*. Those defined by the macro processor are called *automatic macro variables*. You can define and use macro variables anywhere in SAS programs, except within data lines.

When a macro variable is defined, the macro processor adds it to one of the program's macro variable symbol tables. The variable is held in the global symbol table, which the macro processor creates at the beginning of a SAS session when the following occurs:

- a macro variable is defined in a statement that is outside a macro definition (called *open code*)
- the variable is created automatically by the macro processor (except SYSPBUFF)

When a macro variable is defined within a macro and is not specifically defined as global, the variable is typically held in the macro's local symbol table. SAS creates the local symbol table when the macro starts executing. For more information about symbol tables, see Chapter 2, "SAS Programs and Macro Processing," on page 13 and Chapter 5, "Scopes of Macro Variables," on page 47.

When it is in the global symbol table, a macro variable exists for the remainder of the current SAS session. A variable in the global symbol table is called a *global macro variable*. This variable has global scope because its value is available to any part of the SAS session (except in CARDS or DATALINES statements). Other components of SAS might create global macro variables, but only those components created by the macro processor are considered *automatic macro variables*.

When it is in a local symbol table, a macro variable exists only during execution of the macro in which it is defined. A variable in a local symbol table is called a *local macro variable*. It has local scope because its value is available only while the macro is executing. Chapter 2, "SAS Programs and Macro Processing," on page 13 contains figures that illustrate a program with a global and a local symbol table.

You can use the %PUT statement to view all macro variables available in a current SAS session. For more information, see "%PUT Statement" on page 320 and also Chapter 10, "Macro Facility Error Messages and Debugging," on page 117.

## Macro Variables Defined by the Macro Processor

When you invoke SAS, the macro processor creates automatic macro variables that supply information related to the SAS session. Automatic variables are global except SYSPBUFF, which is local.

To use an automatic macro variable, reference it with an ampersand followed by the macro variable name (for example, &SYSJOBID). This FOOTNOTE statement contains references to the automatic macro variables SYSDAY and SYSDATE9:

```
footnote "Report for &sysday, &sysdate9";
```

If the current SAS session is invoked on December 16, 2011, macro variable resolution causes SAS to receive this statement:

```
FOOTNOTE "Report for Friday, 16DEC2011";
```

Automatic macro variables are often useful in conditional logic such as a %IF statement with actions determined by the value that is returned. For more information, see "%IF-%THEN/%ELSE Statement" on page 306.

You can assign values to automatic macro variables that have read and write status. However, you cannot assign a value to an automatic macro variable that has read-only

status. The following table lists the automatic macro variables that are created by the SAS macro processor and the read and write status.

Use %PUT _AUTOMATIC_ to view all available automatic macro variables.

There are also system-specific macro variables that are created only on a particular platform. These are documented in the host companion, and common ones are listed in Chapter 11, "Writing Efficient and Portable Macros," on page 139. Other SAS software products also provide macro variables, which are described in the documentation for the product that uses them. Neither of these types of macro variables are considered automatic macro variables.

***Table 3.1*** *Automatic Macro Variables by Category*

| Status | Variable | Contains |
|---|---|---|
| Read and Write | SYSBUFFR | Unmatched text from %INPUT |
| | SYSCC | The current condition code that SAS returns to your operating environment (the operating environment condition code) |
| | SYSCMD | Obsolete |
| | SYSDEVIC | Obsolete |
| | SYSDMG | Return code that reflects an action taken on a damaged data set |
| | SYSDSN | Name of most recent SAS data set in two fields |
| | SYSFILRC | Return code set by the FILENAME statement |
| | SYSLAST | Name of most recent SAS data set in one field |
| | SYSLCKRC | Return code set by the LOCK statement |
| | SYSLIBRC | Return code set by the LIBNAME statement |
| | SYSLOGAPPLNAME | Value of the LOGAPPLNAME option |
| | SYSMSG | Obsolete |
| | SYSPARM | Value specified with the SYSPARM= system option |
| | SYSPBUFF | Text of macro parameter values |
| | SYSRC | Various system-related return codes |
| Read-only | SYSADDRBITS | The number of bits of an address |

| Status | Variable | Contains |
|---|---|---|
| | SYSCHARWIDTH | The character width value |
| | SYSDATASTEPPHASE | Value of the current running phase of the DATA step |
| | SYSDATE | The character value representing the date on which a SAS job or session began executing (two-digit year) |
| | SYSDATE9 | The character value representing the date on which a SAS job or session began executing (four-digit year) |
| | SYSDAY | Day of week on which a SAS job or session began executing |
| | SYSENCODING | Name of the SAS session encoding |
| | SYSENDIAN | An indication of the byte order of the current session |
| | SYSENV | Foreground or background indicator |
| | SYSERR | Return code set by SAS procedures and the DATA step |
| | SYSERRORTEXT | Text of the last error message formatted for display on the log |
| | SYSHOSTINFOLONG | The operating environment information if the HOSTINFOLONG option is specified |
| | SYSHOSTNAME | The host name of the operating environment |
| | SYSINCLUDEFILEDEVICE | The device type of the current %INCLUDE file. |
| | SYSINCLUDEFILEDIR | The directory where the current %INCLUDE file was found. |
| | SYSINCLUDEFILEFILEREF | The fileref associated with the current %INCLUDE file or blank. |
| | SYSINCLUDEFILENAME | The filename of the current %INCLUDE file. |
| | SYSINDEX | Number of macros that have begun execution during this session |
| | SYSINFO | Return code information |
| | SYSJOBID | Name of current batch job or user ID (varies by host environment) |

| Status | Variable | Contains |
|---|---|---|
| | SYSMACRONAME | Name of current executing macro |
| | SYSMAXLONG | Returns the maximum long integer value allowed under Linux. |
| | SYSMENV | Current macro execution environment |
| | SYSNCPU | The current number of processors that SAS might use in computation |
| | SYSNOBS | The number of observations in the last data set created by a procedure or DATA step |
| | SYSODSESCAPECHAR | The value of the ODS ESCAPECHAR= from within the program |
| | SYSODSPATH | The value of the PATH variable in the Output Delivery System (ODS) |
| | SYSPRINTTOLIST | The path of the LIST file prior to redirection by the PRINTTO procedure |
| | SYSPRINTTOLOG | The path of the LOG file prior to redirection by the PRINTTO procedure |
| | SYSPROCESSID | The process ID of the current SAS process |
| | SYSPROCESSMODE | The name of the current SAS session run mode or server type |
| | SYSPROCESSNAME | The process name of the current SAS process |
| | SYSPROCNAME | The name of current procedure being processed |
| | SYSSCP | The abbreviation of an operating system |
| | SYSSCPL | The name of an operating system |
| | SYSSITE | The number assigned to your site |
| | SYSSIZEOFLONG | The length in bytes of a long integer in the current session |
| | SYSSIZEOFPTR | The size in bytes of a pointer |
| | SYSSIZEOFUNICODE | The length in bytes of a Unicode character in the current session |
| | SYSTCPIPHOSTNAME | The host names of the local and remote operating environments when multiple TCP/IP stacks are supported |

| Status | Variable | Contains |
|---|---|---|
| | SYSTIME | The character value of the time at which a SAS job or session began executing |
| | SYSTIMEZONE | The time zone name based on the TIMEZONE option |
| | SYSTIMEZONEIDENT | The time zone ID based on the TIMEZONE option |
| | SYSTIMEZONEOFFSET | The current time zone offset based on the TIMEZONE option |
| | SYSUSERID | The user ID or login of the current SAS process |
| | SYSVER | The release version of SAS software executing |
| | SYSVLONG | The release version and maintenance level of SAS software with a 2-digit year |
| | SYSVLONG4 | The release version and maintenance level of SAS software with a 4-digit year |
| | SYSWARNINGTEXT | Text of the last warning message formatted for display on the log |

# Macro Variables Defined by Users

## *Overview for Defining Macro Variables*

You can create your own macro variables, change their values, and define their scope. You can define a macro variable within a macro, and you can also specifically define it as a global variable, by defining it with the %GLOBAL statement. Macro variable names must start with a letter a-z or an underscore and can be followed by the letters a-z or digits 0-9 or underscores. You can assign any name to a macro variable as long as the name is not a reserved word. The prefixes AF, DMS, SQL, and SYS are not recommended because they are frequently used in SAS software when creating macro variables. Thus, using one of these prefixes can cause a name conflict with macro variables created by SAS software. For a complete list of reserved words in the macro language, see Appendix 1, “ Reserved Words in the Macro Facility,” on page 365. If you assign a macro variable name that is not valid, an error message is printed in the log.

You can use %PUT _ALL_ to view all user-created macro variables.

### *Creating User-Defined Macro Variable Names*

The simplest way to create a user-defined macro variable is to use the macro program statement %LET:

```
%let dsname=Newdata;
```

DSNAME is the name of the macro variable. **`Newdata`** is the value of the macro variable DSNAME. The following are the rules for creating a macro variable:

1. SAS macro variable names can be up to 32 characters in length.
2. The first character must begin with a letter a-z or an underscore. Subsequent characters can be the letters a-z, digits 0-9, or underscores.
3. A macro variable name cannot contain blanks.
4. A macro variable name cannot contain a character which can only be represented using a double-byte character set (DBCS).
5. A macro variable name cannot contain any special characters other than the underscore.
6. Macro variable names are case insensitive. For example, cat, Cat, and CAT all represent the same variable.
7. You can assign any name to a macro variable as long as the name is not a reserved word. The prefixes AF, DMS, SQL, and SYS are not recommended because they are frequently used in SAS software for automatic macro variables. Thus, using one of these prefixes can cause a name conflict with an automatic macro variable. For a complete list of reserved words in the macro language, see Appendix 1, " Reserved Words in the Macro Facility," on page 365. If you assign a macro variable name that is not valid, an error message is printed in the log.

### *Assigning Values to Macro Variables*

The simplest way to assign a value to a macro variable is to use the macro program statement %LET:

```
%let dsname=Newdata;
```

DSNAME is the name of the macro variable. **`Newdata`** is the value of the macro variable DSNAME. The value of a macro variable is simply a string of characters. The characters can include any letters, numbers, or printable symbols found on your keyboard, and blanks between characters. The case of letters is preserved in a macro variable value. Some characters, such as unmatched quotation marks, require special treatment, which is described later.

If a macro variable already exists, a value assigned to it replaces its current value. If a macro variable or its value contains macro triggers (% or &), the trigger is evaluated before the value is assigned. In the following example, **`&name`** is resolved to **`Cary`** and then it is assigned as the value of **`city`** in the following statements:

```
%let name=Cary;
%let city=&name;
```

Generally, the macro processor treats alphabetic characters, digits, and symbols (except & and %) as characters. It can also treat & and % as characters using a special treatment, which is described later. It does not make a distinction between character and numeric values as the rest of SAS does. (However, the "%EVAL Function" on page 251 and

"%SYSEVALF Function" on page 271 can evaluate macro variables as integers or floating point numbers.)

Macro variable values can represent text to be generated by the macro processor or text to be used by the macro processor. Values can range in length from 0 to 65,534 characters. If you omit the value argument, the value is null (0 characters). By default, leading and trailing blanks are not stored with the value.

In addition to the %LET statement, the following list contains other features of the macro language that create macro variables:

- iterative %DO statement
- %GLOBAL statement
- %INPUT statement
- INTO clause of the SELECT statement in SQL
- %LOCAL statement
- %MACRO statement
- SYMPUT and SYMPUTX routine and SYMPUTN routine in SCL

The following table describes how to assign a variety of types of values to macro variables.

***Table 3.2*** *Types of Assignments for Macro Variable Values*

| Assign | Values |
|---|---|
| Constant text | A character string. The following statements show several ways that the value **maple** can be assigned to macro variable STREET. In each case, the macro processor stores the five-character value **maple** as the value of STREET. The leading and trailing blanks are not stored.<br>`%let street=maple;`<br>`%let street=  maple;`<br>`%let street=maple  ;`<br>Note: Quotation marks are not required. If quotation marks are used, they become part of the value. |
| Digits | The appropriate digits. This example creates the macro variables NUM and TOTALSTR:<br>`%let num=123;`<br>`%let totalstr=100+200;`<br>The macro processor does not treat **123** as a number or evaluate the expression **100+200**. Instead, the macro processor treats all the digits as characters. |
| Arithmetic expressions | The %EVAL function, for example,<br>`%let num=%eval(100+200); / * produces 300 * /`<br>use the %SYSEVALF function, for example,<br>`%let num=%sysevalf(100+1.597); / * produces 101.597 * /`<br>For more information, see "Macro Evaluation Functions" on page 158. |

| Assign | Values |
|---|---|
| A null value | No assignment for the value argument, for example,<br>`%let country=;` |
| A macro variable reference | A macro variable reference, *&macro-variable*. For example,<br>`%let street=Maple;`<br>`%let num=123;`<br>`%let address=&num &street Avenue;`<br>This example shows multiple macro references that are part of a text expression. The macro processor attempts to resolve text expressions before it makes the assignment. Thus, the macro processor stores the value of macro variable ADDRESS as **`123 Maple Avenue`**.<br>You can treat ampersands and percent signs as literals by using the %NRSTR function to mask the character. This causes the macro processor to treat it as text instead of trying to interpret it as a macro call. For more information, see Chapter 12, "Macro Language Elements," on page 153 and Macro Quoting on page 80. |
| A macro invocation | A macro call, *%macro-name*. For example,<br>`%let status=%wait;`<br>When the %LET statement executes, the macro processor also invokes the macro WAIT. The macro processor stores the text produced by the macro WAIT as the value of STATUS.<br>To prevent the macro from being invoked when the %LET statement executes, use the %NRSTR function to mask the percent sign:<br>`%let status=%nrstr(%wait);`<br>The macro processor stores **`%wait`** as the value of STATUS. |
| Blanks and special characters | Macro quoting function %STR or %NRSTR around the value. This action masks the blanks or special characters so that the macro processor interprets them as text. For more information, see "Macro Quoting Functions" on page 159. "Macro Quoting Functions" on page 159 discuss macro quoting functions that require unmatched quotation marks and other symbols to be marked.<br>The definition of macro variable PLOTIT demonstrates using %STR to mask blanks and special characters (semicolons) in macro variable values. When a macro variable contains complete SAS statements, the statements are easier to read if you enter them on separate lines with indentions for statements within a DATA or PROC step. Using a macro quoting function retains the significant blanks in the macro variable value. |

| Assign | Values |
|---|---|
| Value from a DATA step | The SYMPUT routine. This example puts the number of observations in a data set into a FOOTNOTE statement where AGE is greater than 20:<br>`data _null_;`<br>`  set in.permdata end=final;`<br>`  if age>20 then n+1;`<br>`  if final then call symput('number',trim(left(n)));`<br>`run;`<br>`footnote "&number Observations have AGE>20";`<br>During the last iteration of the DATA step, the SYMPUT routine creates a macro variable named NUMBER whose value is the value of N. (SAS also issues a numeric-to-character conversion message.) The TRIM and the LEFT functions remove the extra space characters from the DATA step variable N before its value is assigned to the macro variable NUMBER.<br>For a discussion of SYMPUT, including information about preventing the numeric-character message, see "CALL SYMPUT Routine" on page 230. |

# Using Macro Variables

## *Macro Variable Reference*

After a macro variable is created, you typically use the variable by referencing it with an ampersand preceding its name (&*variable-name*), which is called a *macro variable reference*. These references perform symbolic substitutions when they resolve to their value. You can use these references anywhere in a SAS program. To resolve a macro variable reference that occurs within a literal string, enclose the string in double quotation marks. Macro variable references that are enclosed in single quotation marks are not resolved. Compare the following statements that assign a value to macro variable DSN and use it in a TITLE statement:

```
%let dsn=Newdata;
title1 "Contents of Data Set &dsn";
title2 'Contents of Data Set &dsn';
```

In the first TITLE statement, the macro processor resolves the reference by replacing &DSN with the value of macro variable DSN. In the second TITLE statement, the value for DSN does not replace &DSN. SAS sees the following statements:

```
TITLE1 "Contents of Data Set Newdata";
TITLE2 'Contents of Data Set &dsn';
```

You can refer to a macro variable as many times as you need to in a SAS program. The value remains constant until you change it. For example, this program refers to macro variable DSN twice:

```
%let dsn=Newdata;
data temp;
   set &dsn;
   if age>=20;
run;

proc print;
```

```
   title "Subset of Data Set &dsn";
run;
```

Each time the reference &DSN appears, the macro processor replaces it with **Newdata**. SAS sees the following statements:

```
DATA TEMP;
      SET NEWDATA;
      IF AGE>=20;
   RUN;

   PROC PRINT;
      TITLE "Subset of Data Set NewData";
   RUN;
```

*Note:* If you reference a macro variable that does not exist, a warning message is printed in the log. For example, if macro variable JERRY is misspelled as JERY, the following produces an unexpected result:

```
%let jerry=student;
data temp;
  x="produced by &jery";
run;
```

This code produces the following message:

```
WARNING:  Apparent symbolic reference JERY not resolved.
```

### *Combining Macro Variable References with Text*

It is often useful to place a macro variable reference next to leading or trailing text (for example, DATA=PERSNL&YR.EMPLOYES, where &YR contains two characters for a year), or to reference adjacent variables (for example, &MONTH&YR). You can reuse the same text in several places or to reuse a program because you can change values for each use.

To reuse the same text in several places, you can write a program with macro variable references representing the common elements. You can change all the locations with a single %LET statement, as shown:

```
%let name=sales;
   data new&name;
      set save.&name;
      more SAS statements
      if units>100;
   run;
```

After macro variable resolution, SAS sees these statements:

```
DATA NEWSALES;
      SET SAVE.SALES;
      more SAS statements
      IF UNITS>100;
   RUN;
```

Notice that macro variable references do not require the concatenation operator as the DATA step does. SAS forms the resulting words automatically.

### Delimiting Macro Variable Names within Text

Sometimes when you use a macro variable reference as a prefix, the reference does not resolve as you expect if you simply concatenate it. Instead, you might need to delimit the reference by adding a period to the end of it.

A period immediately following a macro variable reference acts as a delimiter. That is, a period at the end of a reference forces the macro processor to recognize the end of the reference. The period does not appear in the resulting text.

Continuing with the example above, suppose that you need another DATA step that uses the names Sales1, Sales2, and Insales.Temp. You might add the following step to the program:

```
/*  first attempt to add suffixes--incorrect  */
data &name1 &name2;
   set in&name.temp;
run;
```

After macro variable resolution, SAS sees these statements:

```
DATA &NAME1 &NAME2;
   SET INSALESTEMP;
RUN;
```

None of the macro variable references have resolved as you intended. The macro processor issues warning messages, and SAS issues syntax error messages. Why?

Because NAME1 and NAME2 are valid SAS names, the macro processor searches for those macro variables rather than for NAME, and the references pass into the DATA statement without resolution.

In a macro variable reference, the word scanner recognizes that a macro variable name has ended when it encounters a character that is not used in a SAS name. However, you can use a period ( . ) as a delimiter for a macro variable reference. For example, to cause the macro processor to recognize the end of the word NAME in this example, use a period as a delimiter between &NAME and the suffix:

```
/*  correct version  */
data &name.1 &name.2;
```

SAS now sees this statement:

```
DATA SALES1 SALES2;
```

### Creating a Period to Follow Resolved Text

Sometimes you need a period to follow the text resolved by the macro processor. For example, a two-level data set name needs to include a period between the libref and data set name.

When the character following a macro variable reference is a period, use two periods. The first is the delimiter for the macro reference, and the second is part of the text.

```
set in&name..temp;
```

After macro variable resolution, SAS sees this statement:

```
SET INSALES.TEMP;
```

You can end any macro variable reference with a delimiter, but the delimiter is necessary only if the characters that follow can be part of a SAS name. For example, both of these TITLE statements are correct:

```
title "&name.--a report";
   title "&name--a report";
```

They produce the following:

```
TITLE "sales--a report";
```

# Displaying Macro Variable Values

The simplest way to display macro variable values is to use the %PUT statement, which writes text to the log. For example, the following statements write the following result:

```
%let a=first;
%let b=macro variable;
%put &a ***&b***;
```

Here is the result:

```
first ***macro variable***
```

You can also use a "%PUT Statement" on page 320 to view available macro variables. %PUT provides several options that enable you to view individual categories of macro variables.

The system option SYMBOLGEN displays the resolution of macro variables. For this example, assume that macro variables PROC and DSET have the values GPLOT and Sashelp.Cars respectively.

```
options symbolgen;
title "%upcase(&proc) of %upcase(&dset)";
```

The SYMBOLGEN option prints to the log:

```
SYMBOLGEN:  Macro variable PROC resolves to gplot
SYMBOLGEN:  Macro variable DSET resolves to sashelp.cars
```

For more information about debugging macro programs, see Chapter 10, "Macro Facility Error Messages and Debugging," on page 117.

# Referencing Macro Variables Indirectly

## *Using an Expression to Generate a Reference*

The macro variable references shown so far have been direct macro references that begin with one ampersand: *&name*. However, it is also useful to be able to indirectly reference macro variables that belong to a series so that the name is determined when the macro variable reference resolves. The macro facility provides indirect macro variable referencing, which enables you to use an expression (for example, CITY&N) to generate a reference to one of a series of macro variables. For example, you could use the value of macro variable N to reference a variable in the series of macro variables named CITY1

to CITY20. If N has the value 8, the reference would be to CITY8. If the value of N is 3, the reference would be to CITY3.

Although for this example the type of reference that you want is CITY&N, the following example will not produce the value of &N appended to CITY:

```
%put &city&n;  /* incorrect */
```

This code produces a warning message saying that there is no macro variable CITY because the macro facility has tried to resolve &CITY and then &N and concatenate those values.

When you use an indirect macro variable reference, you must force the macro processor to scan the macro variable reference more than once. This process will resolve the desired reference on the second, or later, scan. To force the macro processor to rescan a macro variable reference, you use more than one ampersand in the macro variable reference. When the macro processor encounters multiple ampersands, its basic action is to resolve two ampersands to one ampersand. For example, for you to append the value of &N to CITY and then reference the appropriate variable name, do the following:

```
%put &&city&n;  /* correct */
```

If &N contains 6, when the macro processor receives this statement, it performs the following steps:

1. resolves && to &
2. passes CITY as text
3. resolves &N into 6
4. returns to the beginning of the macro variable reference, &CITY6, starts resolving from the beginning again, and prints the value of CITY6

### Generating a Series of Macro Variable References with a Single Macro Call

Using indirect macro variable references, you can generate a series of references with a single macro call by using an iterative %DO loop. The following example assumes that the macro variables CITY1 through CITY10 contain the respective values Cary, New York, Chicago, Los Angeles, Austin, Boston, Orlando, Dallas, Knoxville, and Asheville:

```
%macro listthem;
   %do n=1 %to 10; &&city&n
   %end;
%mend listthem;

%put %listthem;
```

This program writes the following to the log:

```
Cary    New York    Chicago    Los Angeles    Austin    Boston
Orlando      Dallas      Knoxville      Asheville
```

### Using More Than Two Ampersands

You can use any number of ampersands in an indirect macro variable reference, although using more than three is rare. Regardless of how many ampersands are used in this type of reference, the macro processor performs the following steps to resolve the reference.

```
%let var=city;
%let n=6;
%put &&&var&n;
```

1. It resolves the entire reference from left-to-right. If a pair of ampersands (&&) is encountered, the pair is resolved to a single ampersand, then the next part of the reference is processed. In this example, &&&VAR&N becomes &CITY6.
2. It returns to the beginning of the preliminary result and starts resolving again from left-to-right. When all ampersands have been fully processed, the resolution is complete. In this example, &CITY6 resolves to Boston, and the resolution process is finished.

*Note:* A macro call cannot be part of the resolution during indirect macro variable referencing.

**TIP** In some cases, using indirect macro references with triple ampersands increases the efficiency of the macro processor. For more information, see Chapter 11, "Writing Efficient and Portable Macros," on page 139.

## Manipulating Macro Variable Values with Macro Functions

When you define macro variables, you can include macro functions in the expressions to manipulate the value of the variable before the value is stored. For example, you can use functions that scan other values, evaluate arithmetic and logical expressions, and remove the significance of special characters such as unmatched quotation marks.

To scan for words in macro variable values, use the %SCAN function:

```
%let address=123 maple avenue;
%let frstword=%scan(&address,1);
```

The first %LET statement assigns the string **`123 maple avenue`** to macro variable ADDRESS. The second %LET statement uses the %SCAN function to search the source (first argument) and retrieve the first word (second argument). Because the macro processor executes the %SCAN function before it stores the value, the value of FRSTWORD is the string **`123`**.

For more information about %SCAN, see "%SCAN and %QSCAN Functions" on page 258. For more information about macro functions, see Chapter 12, "Macro Language Elements," on page 153.

*Chapter 4*

# Macro Processing

**Macro Processing** . . . . . 37
**Defining and Calling Macros** . . . . . 37
**How the Macro Processor Compiles a Macro Definition** . . . . . 38
**How the Macro Processor Executes a Compiled Macro** . . . . . 40
**Summary of Macro Processing** . . . . . 46

## Macro Processing

This section describes macro processing and shows the typical pattern that SAS follows to process a program containing macro elements. For most macro programming, you do not need this level of detail. It is provided to help you understand what is going on behind the scenes.

## Defining and Calling Macros

*Macros* are compiled programs that you can call in a submitted SAS program or from a SAS command prompt. Like macro variables, you generally use macros to generate text. However, macros provide additional capabilities:

- Macros can contain programming statements that enable you to control how and when text is generated.
- Macros can accept parameters. You can write generic macros that can serve a number of uses.

To compile a macro, you must submit a macro definition. The following is the general form of a macro definition:

%MACRO *macro_name*;
<*macro_text*>
%MEND <*macro_name*>;

*macro_name* is a unique SAS name that identifies the macro and *macro_text* is any combination of macro statements, macro calls, text expressions, or constant text.

When you submit a macro definition, the macro processor compiles the definition and produces a member in the session catalog. The member consists of compiled macro program statements and text. The distinction between compiled items and noncompiled (text) items is important for macro execution. Examples of text items include:

- macro variable references
- nested macro calls
- macro functions, except %STR and %NRSTR
- arithmetic and logical macro expressions
- text to be written by %PUT statements
- model text for SAS statements and windowing environment commands

When you want to call the macro, you use the form

%*macro_name*.

*Note:* If your macro_text contains passwords that you want to prevent from being revealed in the log, redirect the log to a file. For more information, see "PRINTTO" in *SAS Viya Data Management and Utility Procedures Guide*.

## How the Macro Processor Compiles a Macro Definition

When you submit a SAS program, the contents of the program goes to an area of memory called the input stack. The example program in the following figure contains a macro definition, a macro call, and a PROC PRINT step. This section illustrates how the macro definition in the example program is compiled and stored.

***Figure 4.1*** *The Macro APP*

**Input Stack**

```
%macro app(goal);
   %if &sysday=Friday %then
      %do;
         data thisweek;
           set lastweek;
           if totsales > &goal
             then bonus = .03;
           else bonus = 0;
      %end;
%mend app;
%app(10000)
proc print;
run;
```

Using the same process described in Chapter 2, "SAS Programs and Macro Processing," on page 13 the word scanner begins tokenizing the program. When the word scanner detects % followed by a nonblank character in the first token, it triggers the macro

processor. The macro processor examines the token and recognizes the beginning of a macro definition. The macro processor pulls tokens from the input stack and compiles until the %MEND statement terminates the macro definition (Figure 4.2 on page 39).

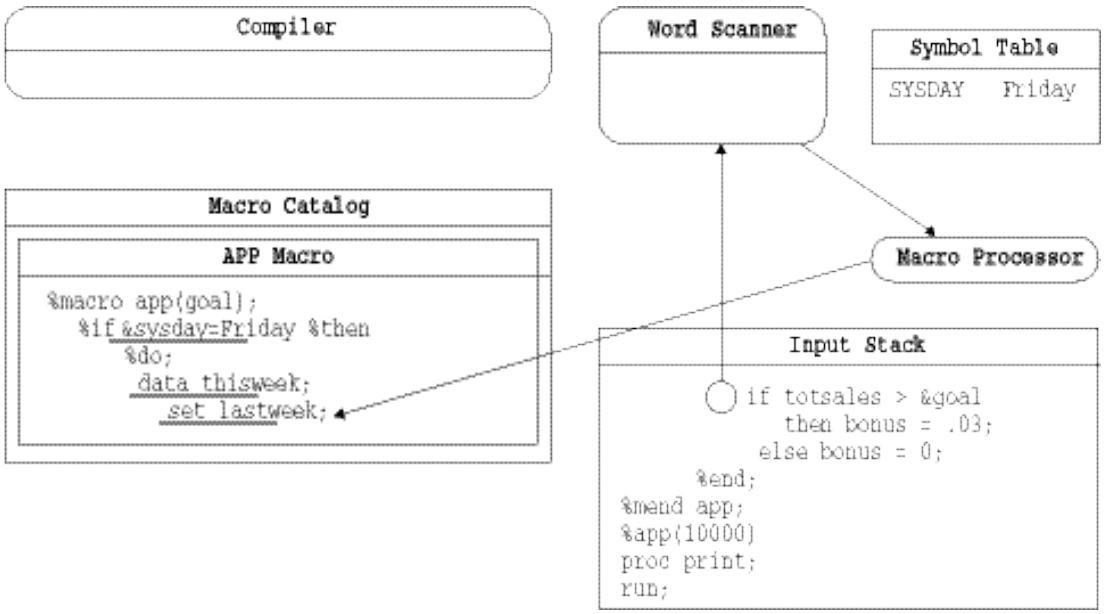
During macro compilation, the macro processor does the following:

- creates an entry in the session catalog
- compiles and stores all macro program statements for that macro as macro instructions
- stores all noncompiled items in the macro as text

  *Note:* Text items are underlined in the illustrations in this section.

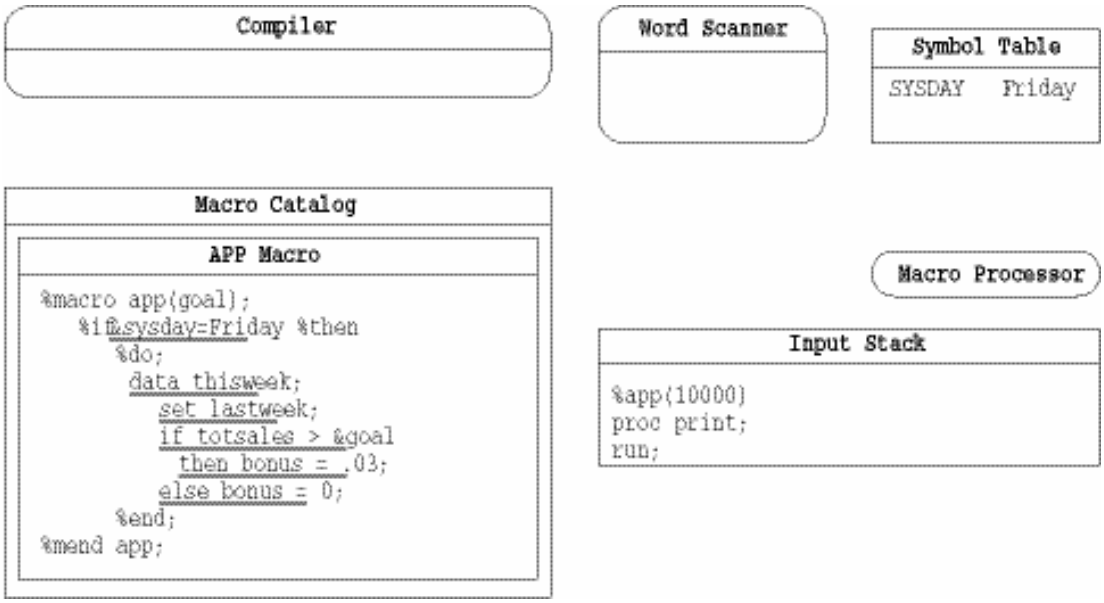
If the macro processor detects a syntax error while compiling the macro, it checks the syntax in the rest of the macro and issues messages for any additional errors that it finds. However, the macro processor does not store the macro for execution. A macro that the macro processor compiles but does not store is called a *dummy macro*.

***Figure 4.2*** *Macro APP in the Input Stack*




In this example, the macro definition is compiled and stored successfully. (See the following figure.) For the sake of illustration, the compiled APP macro looks like the original macro definition that was in the input stack. The entry would actually contain compiled macro instructions with constant text. The constant text in this example is underlined.

***Figure 4.3*** *The Compiled Macro APP*



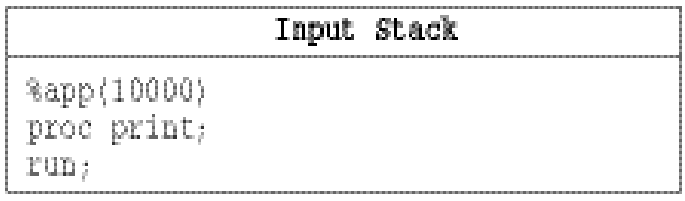

## How the Macro Processor Executes a Compiled Macro

Macro execution begins with the macro processor opening the SASMACR catalog to read the appropriate macro entry. As the macro processor executes the compiled instructions in the macro entry, it performs a series of simple repetitive actions. During macro execution, the macro processor does the following:

- executes compiled macro program instructions
- places noncompiled constant text on the input stack
- waits for the word scanner to process the generated text
- resumes executing compiled macro program instructions

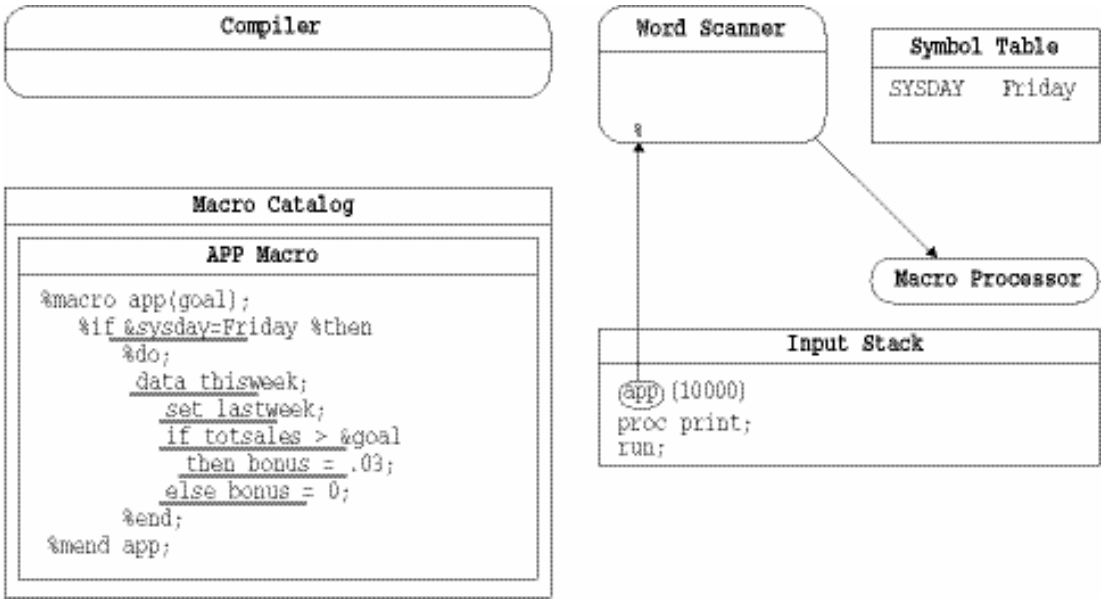
To continue the example from the previous section, the following figure shows the lines remaining in the input stack after the macro processor compiles the macro definition APP.

***Figure 4.4*** *The Macro Call in the Input Stack*




The word scanner examines the input stack and detects % followed by a nonblank character in the first token. It triggers the macro processor to examine the token.

***Figure 4.5*** *Macro Call Entering Word Queue*




The macro processor recognizes a macro call and begins to execute macro APP, as follows:

1. The macro processor creates a local symbol table for the macro. The macro processor examines the previously compiled definition of the macro. If there are any parameters, variable declarations, or computed GOTO statements in the macro definition, the macro processor adds entries for the parameters and variables to the newly created local symbol table.
2. The macro processor further examines the previously compiled macro definition for parameters to the macro. If no parameters were defined in the macro definition, the macro processor begins to execute the compiled instructions of the macro. If any parameters were contained in the definition, the macro processor removes tokens from the input stack to obtain values for positional parameters and non-default values for keyword parameters. The values for parameters found in the input stack are placed in the appropriate entry in the local symbol table.

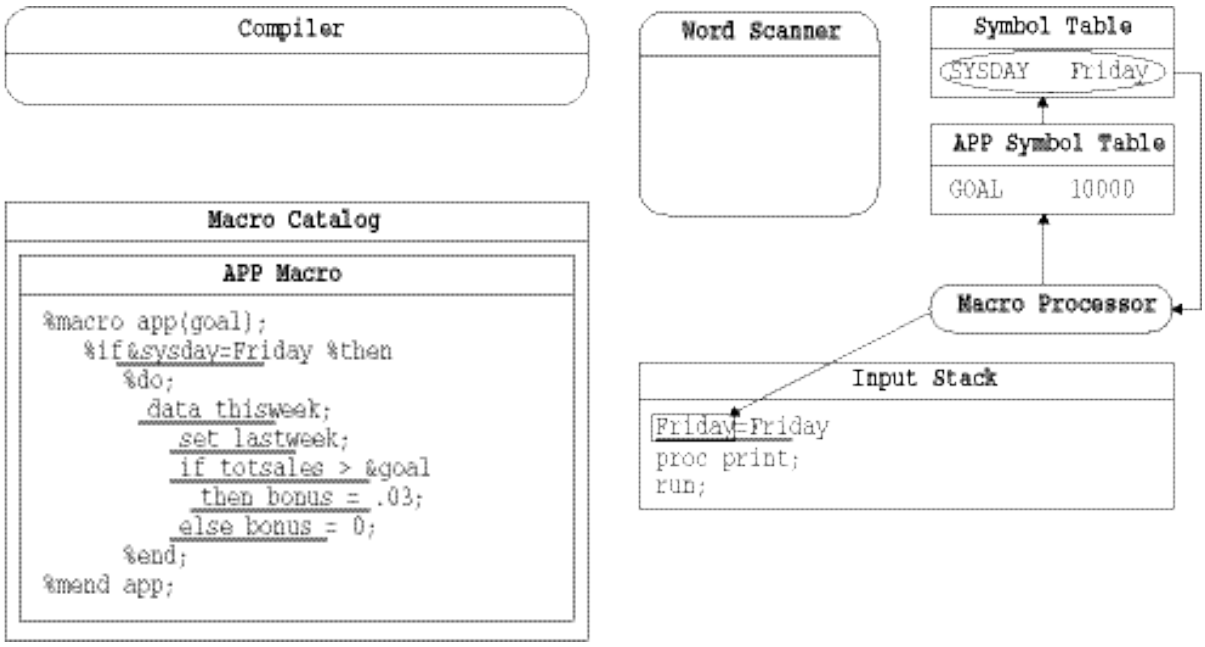
   *Note:* Before executing any compiled instructions, the macro processor removes only enough tokens from the input stack to ensure that any tokens that are supplied by the user and pertain to the macro call have been removed.

3. The macro processor encounters the compiled %IF instruction and recognizes that the next item will be text containing a condition.
4. The macro processor places the text **`&sysday=Friday`** on the input stack ahead of the remaining text in the program. (See the following figure). The macro processor waits for the word scanner to tokenize the generated text.

***Figure 4.6*** *Text for %IF Condition on Input Stack*

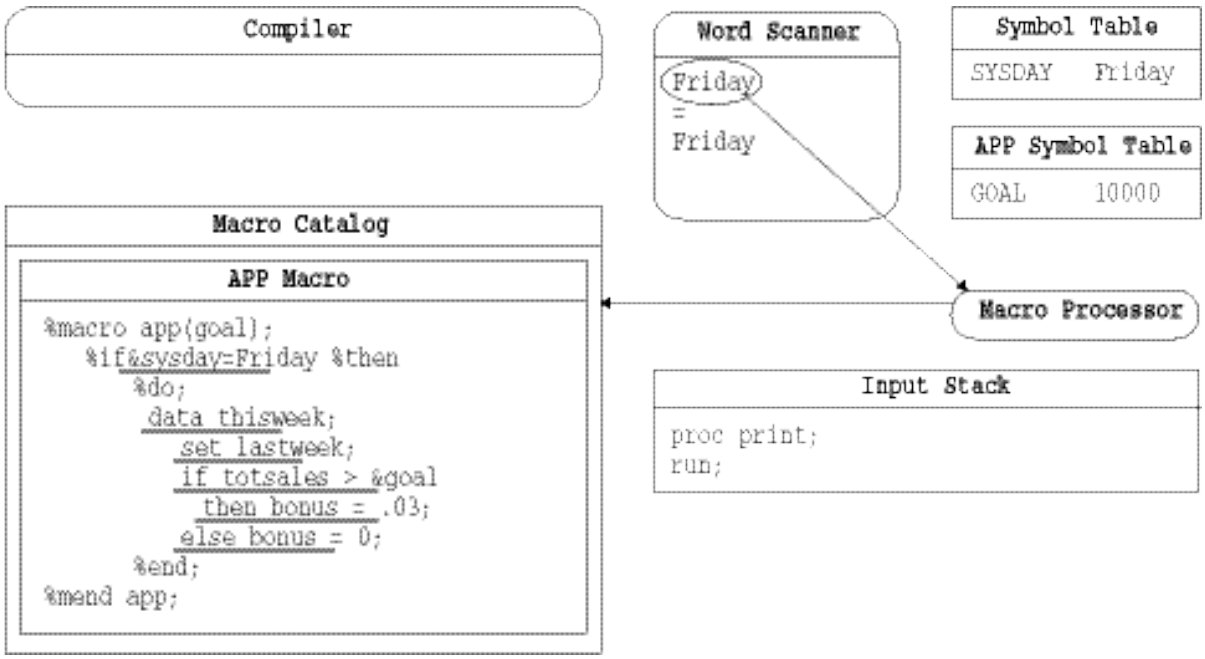
1. The word scanner starts tokenizing the generated text, recognizes an ampersand followed by nonblank character in the first token, and triggers the macro processor.
2. The macro processor examines the token and finds a possible macro variable reference, &SYSDAY. The macro processor first searches the local APP symbol table for a matching entry and then the global symbol table. When the macro processor finds the entry in the global symbol table, it replaces macro variable in the input stack with the value **`Friday`**. (See the following figure.)
3. The macro processor stops and waits for the word scanner to tokenize the generated text.

***Figure 4.7*** *Input Stack After Macro Variable Reference Is Resolved*




1. The word scanner then read **`Friday=Friday`** from the input stack.
2. The macro processor evaluates the expression **`Friday=Friday`** and, because the expression is true, proceeds to the %THEN and %DO instructions.

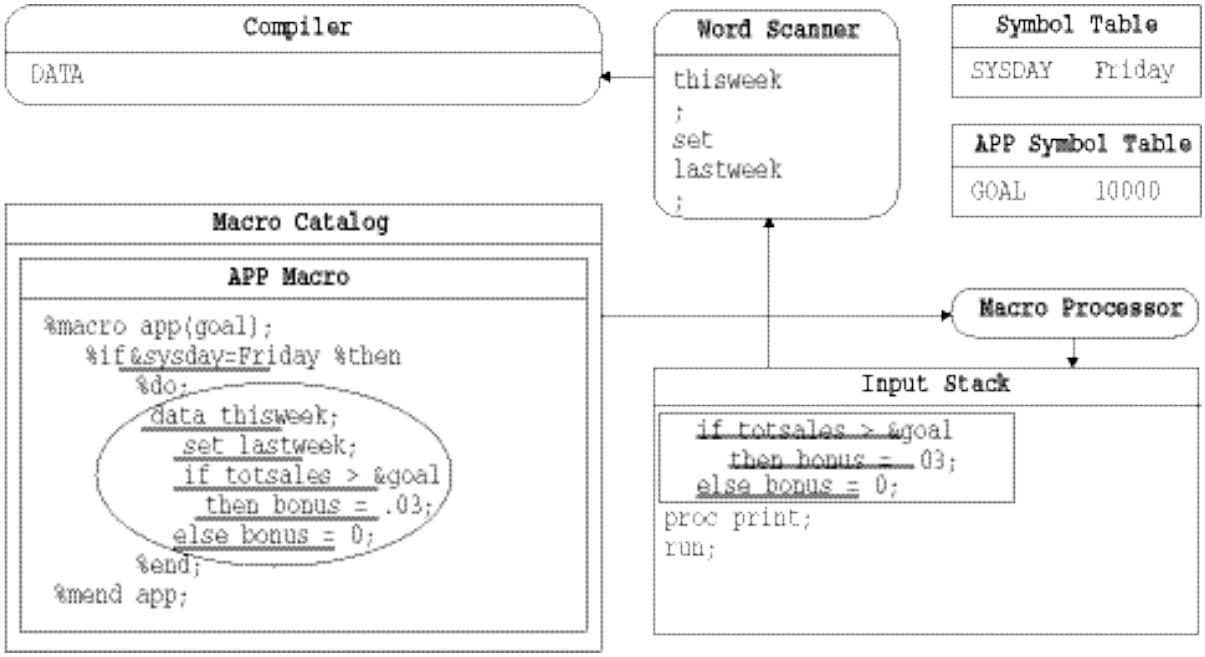
***Figure 4.8*** *Macro Processor Receives the Condition*




1. The macro processor executes the compiled %DO instructions and recognizes that the next item is text.

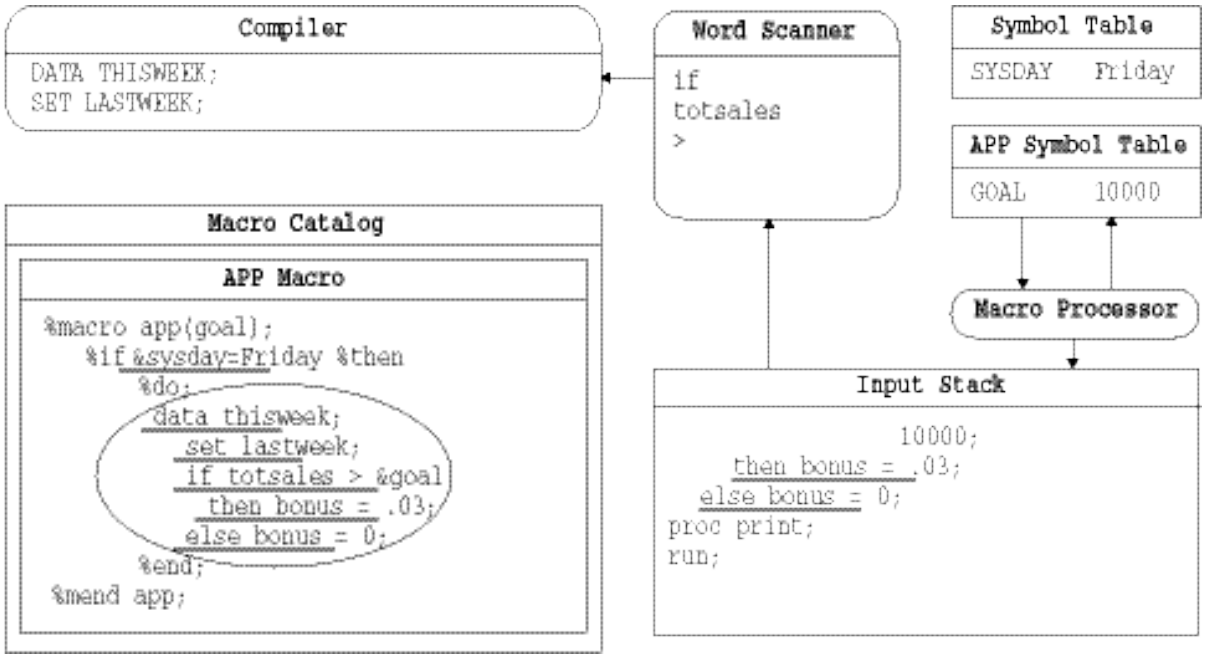
2. The macro processor places the text on top of the input stack and waits for the word scanner to begin tokenization.
3. The word scanner reads the generated text from the input stack, and tokenizes it.
4. The word scanner recognizes the beginning of a DATA step, and triggers the compiler to begin accepting tokens. The word scanner transfers tokens to the compiler from the top of the stack.

***Figure 4.9*** *Generated Text on Top of Input Stack*



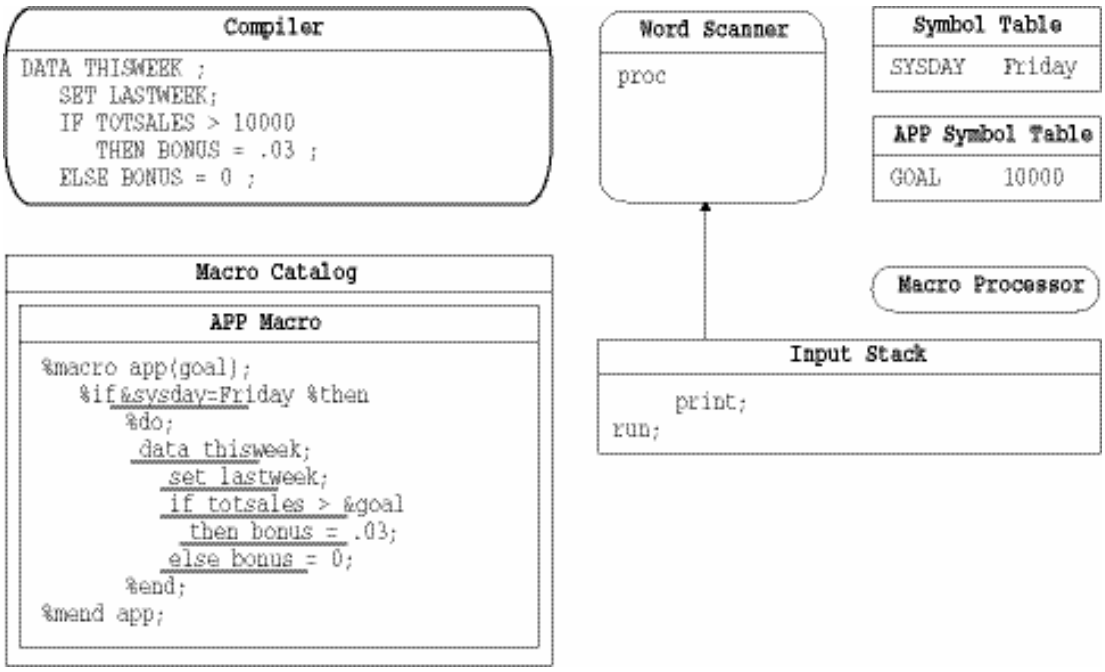

1. When the word scanner detects & followed by a nonblank character (the macro variable reference &GOAL), it triggers the macro processor.
2. The macro processor looks in the local APP symbol table and resolves the macro variable reference &GOAL to `10000`. The macro processor places the value on top of the input stack, ahead of the remaining text in the program.

***Figure 4.10*** *The Word Scanner Reads Generated Text*




1. The word scanner resumes tokenization. When it has completed tokenizing the generated text, it triggers the macro processor.
2. The macro processor resumes processing the compiled macro instructions. It recognizes the end of the %DO group at the %END instruction and proceeds to %MEND.
3. the macro processor executes the %MEND instruction, removes the local symbol table APP, and macro APP ceases execution.
4. The macro processor triggers the word scanner to resume tokenization.
5. The word scanner reads the first token in the input stack (PROC), recognizes the beginning of a step boundary, and triggers the DATA step compiler.
6. The compiled DATA step is executed, and the DATA step compiler is cleared.
7. The word scanner signals the PRINT procedure (a separate executable not illustrated), which pulls the remaining tokens.

***Figure 4.11*** *The Remaining Statements Are Compiled and Executed*




## Summary of Macro Processing

The previous sections illustrate the relationship between macro compilation and execution and DATA step compilation and execution. The relationship contains a pattern of simple repetitive actions. These actions begin when text is submitted to the input stack and the word scanner begins tokenization. At times the word scanner waits for the macro processor to perform an activity, such as searching the symbol tables or compiling a macro definition. If the macro processor generates text during its activity, then it pauses while the word scanner tokenizes the text and sends the tokens to the appropriate target. These tokens might trigger other actions in parts of SAS, such as the DATA step compiler, the command processor, or a SAS procedure. If any of these actions occur, the macro processor waits for these actions to be completed before resuming its activity. When the macro processor stops, the word scanner resumes tokenization. This process continues until the entire program has been processed.

*Chapter 5*

# Scopes of Macro Variables

**Scopes of Macro Variables** . . . . . **47**

**Global Macro Variables** . . . . . **48**

**Local Macro Variables** . . . . . **49**

**Writing the Contents of Symbol Tables to the Log** . . . . . **51**

**How Macro Variables Are Assigned and Resolved** . . . . . **52**

**Examples of Macro Variable Scopes** . . . . . **55**
Changing the Values of Existing Macro Variables . . . . . 55
Creating Local Variables . . . . . 56
Forcing a Macro Variable to Be Local . . . . . 59
Creating Global Macro Variables . . . . . 61
Creating Global Variables Based on the Value of Local Variables . . . . . 63

**Special Cases of Scope with the CALL SYMPUT Routine** . . . . . **63**
Overview of CALL SYMPUT Routine . . . . . 63
Example Using CALL SYMPUT with Complete DATA Step and a Nonempty Local Symbol Table . . . . . 64
Example Using CALL SYMPUT with an Incomplete DATA Step . . . . . 66
Example Using CALL SYMPUT with a Complete DATA Step and an Empty Local Symbol Table . . . . . 68
Example Using CALL SYMPUT with SYSPBUFF and an Empty Local Symbol Table . . . . . 69

## Scopes of Macro Variables

Every macro variable has a *scope*. A macro variable's scope determines how it is assigned values and how the macro processor resolves references to it.

Two types of scopes exist for macro variables: *global* and *local*. Global macro variables exist for the duration of the SAS session and can be referenced anywhere (except CARDS and DATALINES) in the program—either inside or outside a macro. Local macro variables exist only during the execution of the macro in which the variables are created and have no meaning outside the defining macro.

Scopes can be nested, like boxes within boxes. For example, suppose you have a macro A that creates the macro variable LOC1 and a macro B that creates the macro variable LOC2. If the macro B is nested (executed) within the macro A, LOC1 is local to both A and B. However, LOC2 is local only to B.

Macro variables are stored in *symbol tables*, which list the macro variable name and its value. There is a global symbol table, which stores all global macro variables. Local macro variables are stored in a local symbol table that is created at the beginning of the execution of a macro.

You can use the %SYMEXIST function to indicate whether a macro variable exists. For more information, see "%SYMEXIST Function" on page 268.

# Global Macro Variables

The following code illustrates the global symbol table during execution of the following program:

```
%let county=Clark;

%macro concat;
   data _null_;
      length longname $20;
      longname="&county"||" County";
      put longname;
   run;
%mend concat;

%concat
```

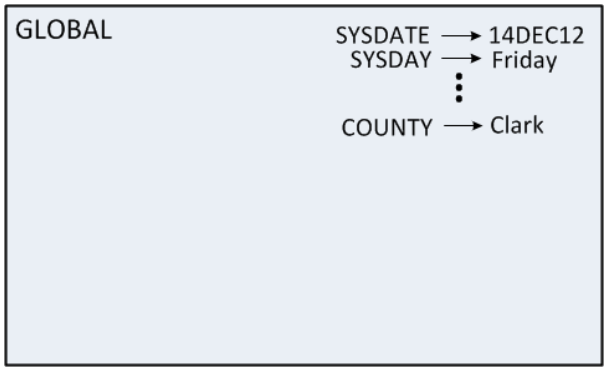
Calling the macro CONCAT produces the following statements:

```
data _null_;
      length longname $20;
      longname="Clark"||" County";
      put longname;
run;
```

The PUT statement writes the following to the log:

```
Clark County
```

***Figure 5.1*** *Global Symbol Table*




Global macro variables include the following:

- all automatic macro variables except SYSPBUFF. For more information about SYSPBUFF and other automatic macro variables, see "Automatic Macro Variables" on page 162.
- macro variables created outside of any macro.
- macro variables created in %GLOBAL statements. For more information about the %GLOBAL statement, see "Creating Global Macro Variables" on page 61.
- most macro variables created by the CALL SYMPUT routine. For more information about the CALL SYMPUT routine, see "Special Cases of Scope with the CALL SYMPUT Routine" on page 63.

You can create global macro variables anytime during a SAS session or job. Except for some automatic macro variables, you can change the values of global macro variables anytime during a SAS session or job.

In most cases, once you define a global macro variable, its value is available to you anywhere in the SAS session or job and can be changed anywhere. So, a macro variable referenced inside a macro definition is global if a global macro variable already exists by the same name. This action assumes that the variable is not specifically defined as local with the %LOCAL statement or in a parameter list. The new macro variable definition simply updates the existing global one. The following are exceptions that prevent you from referencing the value of a global macro variable:

- when a macro variable exists both in the global symbol table and in the local symbol table, you cannot reference the global value from within the macro that contains the local macro variable. In this case, the macro processor finds the local value first and uses it instead of the global value.
- if you create a macro variable in the DATA step with the SYMPUT routine, you cannot reference the value with an ampersand until the program reaches a step boundary. For more information about macro processing and step boundaries, see Chapter 4, "Macro Processing," on page 37.

You can create a read-only global macro variable and assign a specified value to it using the READONLY option in a %GLOBAL statement. Existing macro variables cannot be made read-only. The value of the variable cannot be changed, and the variable cannot be deleted. All read-only macro variables persist until the scope in which they exist is deleted. For more information, see "%GLOBAL Statement" on page 303.

You can use the %SYMGLOBL function to indicate whether an existing macro variable resides in the global symbol table. For more information, see "%SYMGLOBL Function" on page 269.

## Local Macro Variables

Local macro variables are defined within an individual macro. Each macro that you invoke creates its own local symbol table. Local macro variables exist only as long as a particular macro executes. When the macro stops executing, all local macro variables for that macro cease to exist.

The following code illustrates the local symbol table during the execution of the following program.

```
%macro holinfo(day,date);
   %let holiday=Christmas;
   %put *** Inside macro: ***;
```

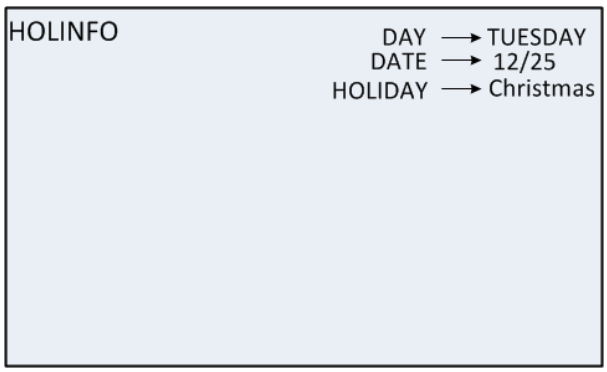
```
   %put *** &holiday occurs on &day, &date, 2012. ***;
%mend holinfo;

%holinfo(Tuesday,12/25)

%put *** Outside macro: ***;
%put *** &holiday occurs on &day, &date, 2012. ***;
```

The %PUT statements write the following to the log:

```
*** Inside macro: ***
*** Christmas occurs on Tuesday, 12/25, 2012. ***
66
67   %put *** Outside macro: ***;
*** Outside macro: ***
68   %put *** &holiday occurs on &day, &date, 2012. ***;
WARNING: Apparent symbolic reference HOLIDAY not resolved.
WARNING: Apparent symbolic reference DAY not resolved.
WARNING: Apparent symbolic reference DATE not resolved.
*** &holiday occurs on &day, &date, 2012. ***
```

As you can see from the log, the local macro variables DAY, DATE, and HOLIDAY resolve inside the macro. But outside the macro, they do not exist and therefore do not resolve.

***Figure 5.2*** *Local Symbol Table*




A macro's local symbol table is empty until the macro creates at least one macro variable. A local symbol table can be created by any of the following:

- the presence of one or more macro parameters
- a %LOCAL statement
- macro statements that define macro variables, such as %LET and the iterative %DO statement (if the variable does not already exist globally or a %GLOBAL statement is not used)

*Note:* Macro parameters are always local to the macro that defines them. You cannot make macro parameters global. (Although, you can assign the value of the parameter to a global variable. For more information, see "Creating Global Variables Based on the Value of Local Variables" on page 63.)

When you invoke one macro inside another, you create nested scopes. Because you can have any number of levels of nested macros, your programs can contain any number of levels of nested scopes.

You can create a read-only local macro variable and assign a specified value to it using the READONLY option in a %LOCAL statement. Existing macro variables cannot be made read-only. The value of the variable cannot be changed, and the variable cannot be deleted. All read-only macro variables persist until the scope in which they exist is deleted. For more information, see "%LOCAL Statement" on page 312.

You can use the %SYMLOCAL function to indicate whether an existing macro variable resides in an enclosing local symbol table. For more information, see the "%SYMLOCAL Function" on page 270.

## Writing the Contents of Symbol Tables to the Log

While developing your macros, you might find it useful to write all or part of the contents of the global and local symbol tables to the log. To do so, use the %PUT statement with one of the following options:

_ALL_
: describes all currently defined macro variables, regardless of scope. This output includes user-defined global and local variables as well as automatic macro variables. Scopes are listed in the order of innermost to outermost.

_AUTOMATIC_
: describes all automatic macro variables. The scope is listed as AUTOMATIC. All automatic macro variables are global except SYSPBUFF. For more information about specific automatic macro variables, see "Automatic Macro Variables" on page 162.

_GLOBAL_
: describes all global macro variables that were not created by the macro processor. The scope is listed as GLOBAL. Automatic macro variables are not listed.

_LOCAL_
: describes user-defined local macro variables defined within the currently executing macro. The scope is listed as the name of the macro in which the macro variable is defined.

_READONLY_
: describes all user-defined read-only macro variables, regardless of scope. The scope is either GLOBAL, for global macro variables, or the name of the macro in which the macro variable is defined.

_USER_
: describes all user-defined macro variables, regardless of scope. The scope is either GLOBAL, for global macro variables, or the name of the macro in which the macro variable is defined.

_WRITABLE_
: describes all user-defined read and write macro variables, regardless of scope. The scope is either GLOBAL, for global macro variables, or the name of the macro in which the macro variable is defined.

For example, consider the following program:

```
%let origin=North America;

%macro dogs(type=);
   data _null_;
      set all_dogs;
```

```
      where dogtype="&type" and dogorig="&origin";
      put breed " is for &type.";
   run;

   %put _user_;
%mend dogs;

%dogs(type=work)
```

The %PUT statement preceding the %MEND statement writes to the log the scopes, names, and values of all user-generated macro variables:

```
DOGS   TYPE   work
GLOBAL   ORIGIN   North America
```

Because TYPE is a macro parameter, TYPE is local to the macro DOGS, with value **work**. Because ORIGIN is defined in open code, it is global.

## How Macro Variables Are Assigned and Resolved

Before the macro processor creates a variable, assigns a value to a variable, or resolves a variable, it searches the symbol tables to determine whether the variable already exists. The search begins with the most local scope and, if necessary, moves outward to the global scope. The request to assign or resolve a variable comes from a macro variable reference in open code (outside a macro) or within a macro.

The following figure illustrates the search order the macro processor uses when it receives a macro variable reference that requests a variable be created or assigned. The figure below illustrates the process for resolving macro variable references. Both of these figures represent the most basic type of search and do not apply in special cases, such as when a %LOCAL statement is used or the variable is created by CALL SYMPUT.

***Figure 5.3*** *Search Order When Assigning or Creating Macro Variables*

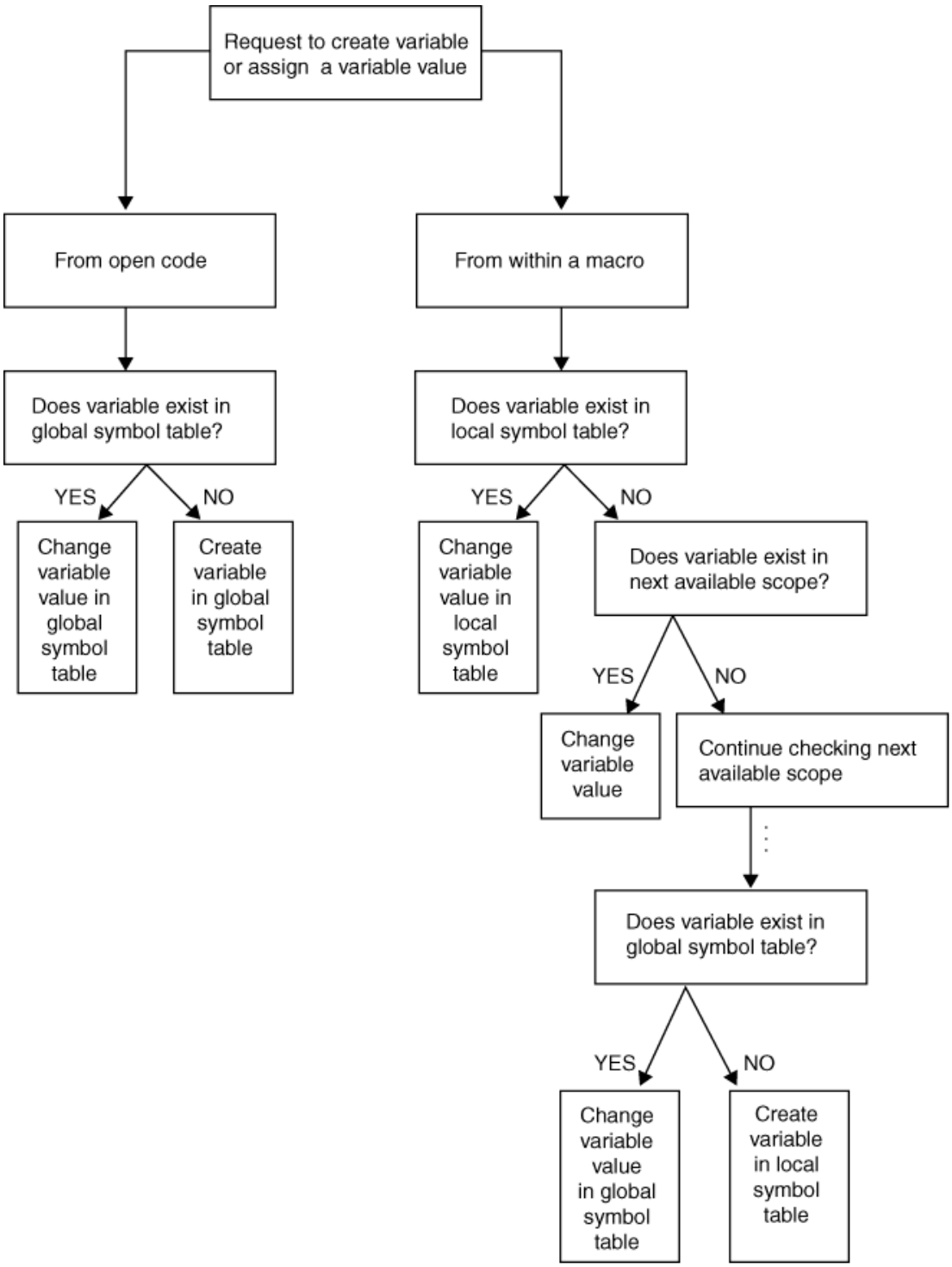
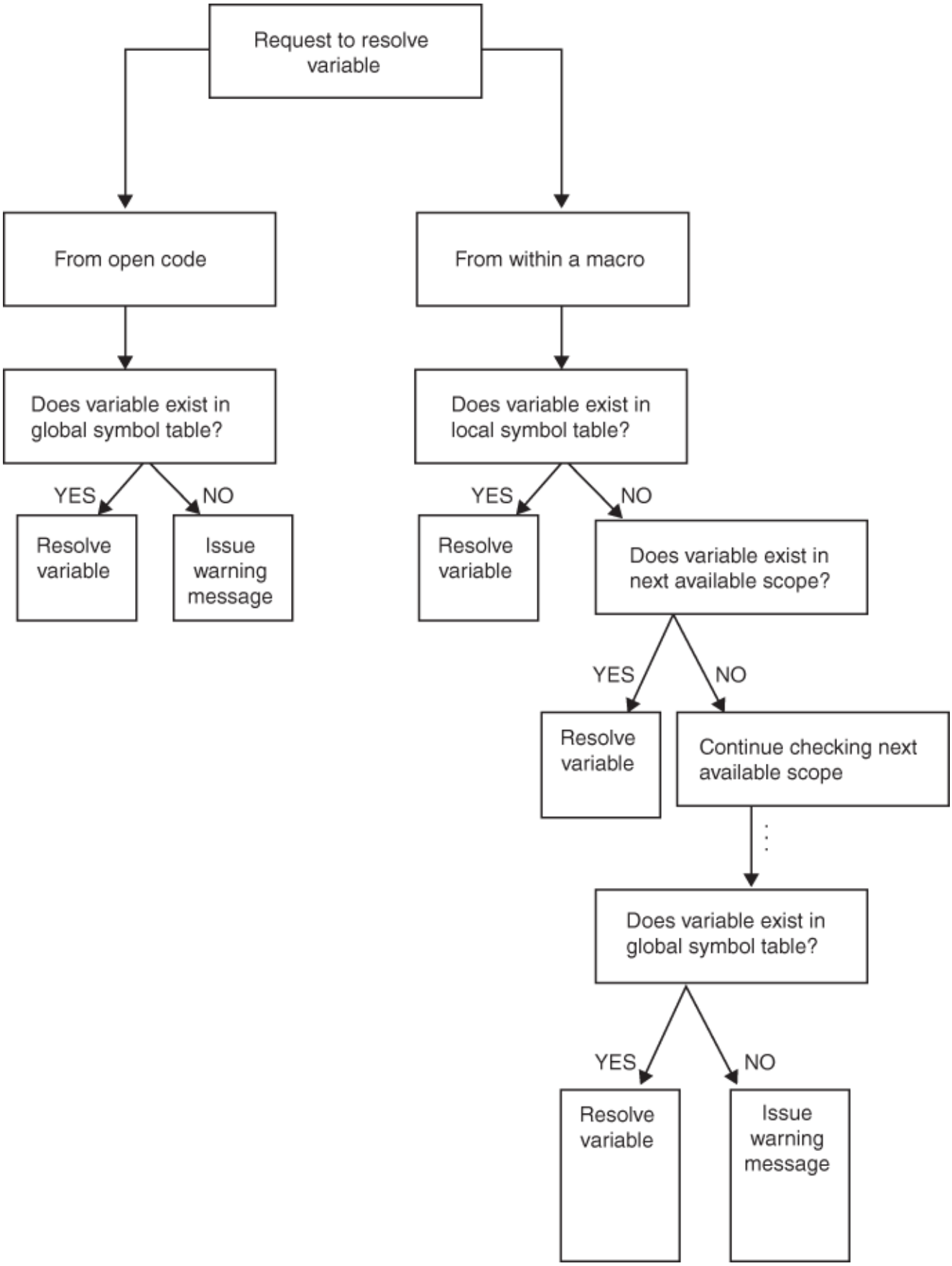


***Figure 5.4*** *Search Order When Resolving Macro Variable References*



# Examples of Macro Variable Scopes

## Changing the Values of Existing Macro Variables

When the macro processor executes a macro program statement that can create a macro variable (such as a %LET statement), the macro processor attempts to change the value of an existing macro variable rather than create a new macro variable. The %GLOBAL and %LOCAL statements are exceptions.

To illustrate, consider the following %LET statements. Both statements assign values to the macro variable NEW:

```
%let new=inventry;
%macro name1;
   %let new=report;
%mend name1;
```

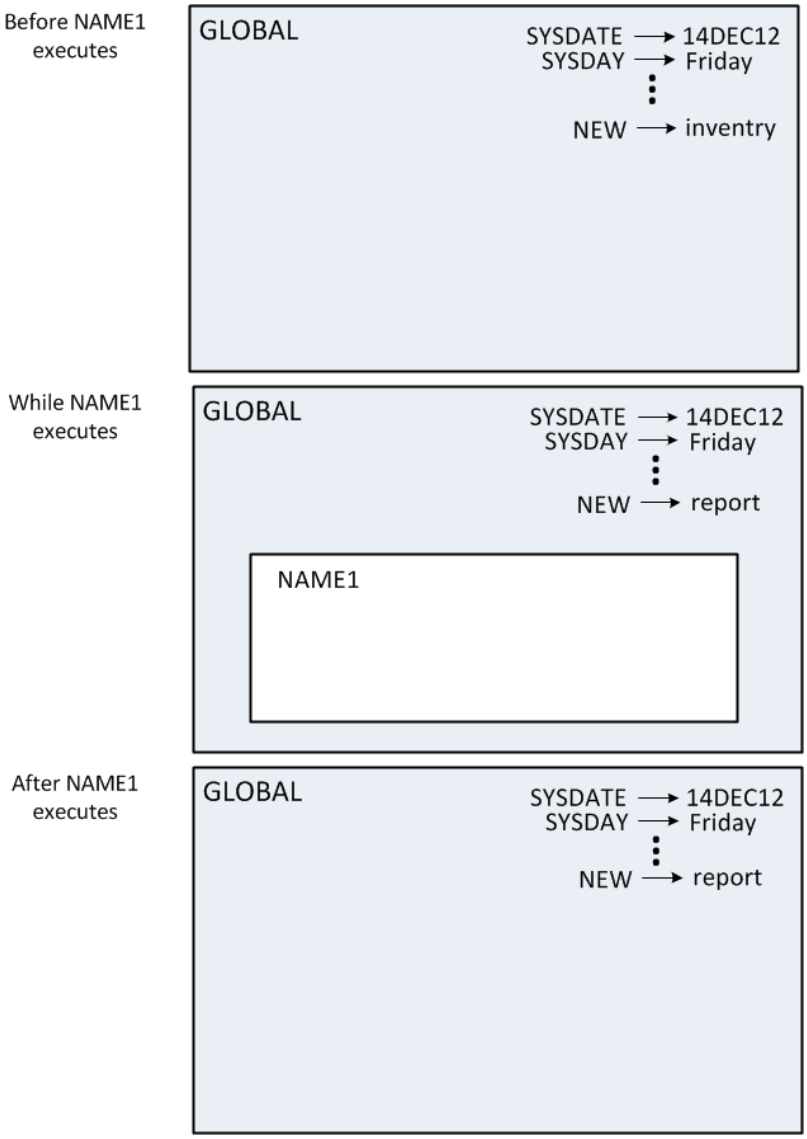
Suppose you submit the following statements:

```
%name1

data &new;

data report;
```

Because NEW exists as a global variable, the macro processor changes the value of the variable rather than creating a new one. The macro NAME1's local symbol table remains empty.

The following figure illustrates the contents of the global and local symbol tables before, during, and after NAME1's execution.

***Figure 5.5*** *Snapshots of Symbol Tables*




## *Creating Local Variables*

When the macro processor executes a macro program statement that can create a macro variable, the macro processor creates the variable in the local symbol table if no macro variable with the same name is available to it. Consider the following example:

```
%let new=inventry;
%macro name2;
   %let new=report;
   %let old=warehse;
%mend name2;

%name2

data &new;
   set &old;
```

```
run;
```

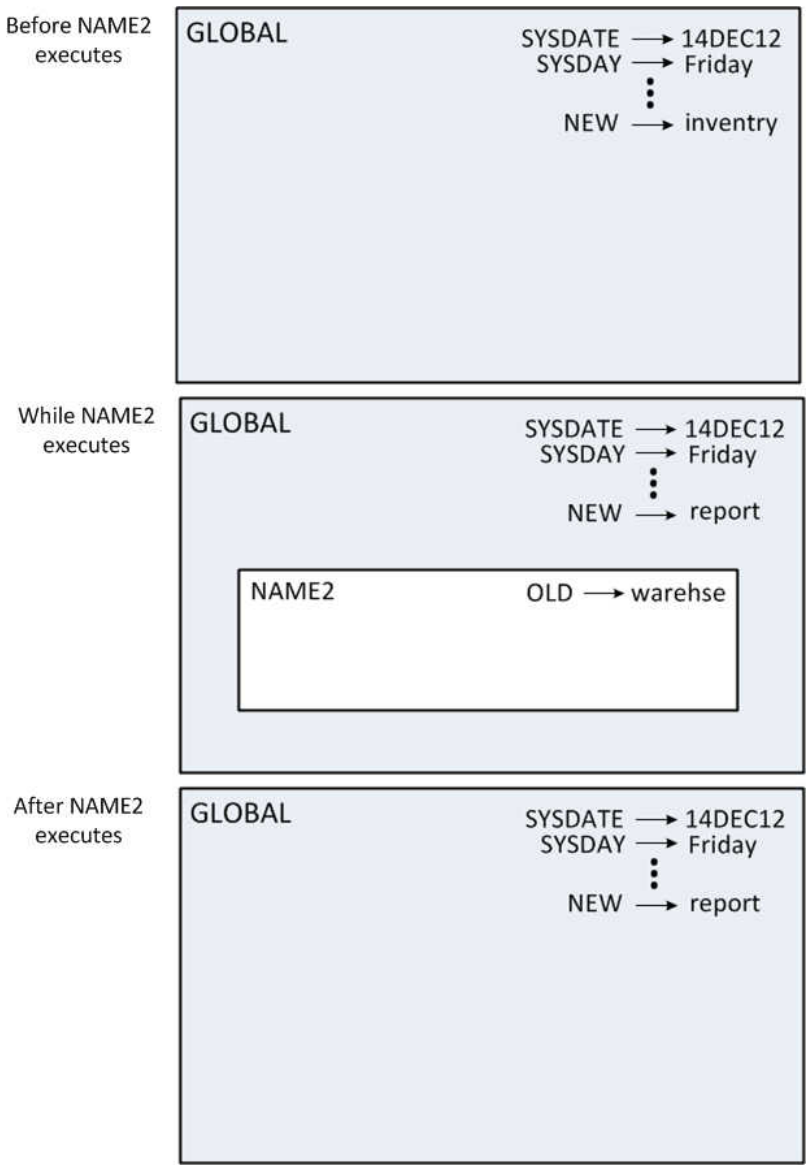
After NAME2 executes, the SAS compiler sees the following statements:

```
data report;
   set &old;
run;
```

The macro processor encounters the reference &OLD after macro NAME2 has finished executing. Thus, the macro variable OLD no longer exists. The macro processor is not able to resolve the reference and issues a warning message.

The following figure illustrates the contents of the global and local symbol tables at various stages.

***Figure 5.6*** *Symbol Tables at Various Stages*




But suppose you place the SAS statements inside the macro NAME2, as in the following program:

```
%let new=inventry;
```

```
%macro name2;
   %let new=report;
   %let old=warehse;
   data &new;
      set &old;
   run;
%mend name2;

%name2
```

In this case, the macro processor generates the SET statement during the execution of NAME2, and it locates OLD in NAME2's local symbol table. Therefore, executing the macro produces the following statements:

```
data report;
   set warehse;
run;
```

The same rule applies regardless of how many levels of nesting exist. Consider the following example:

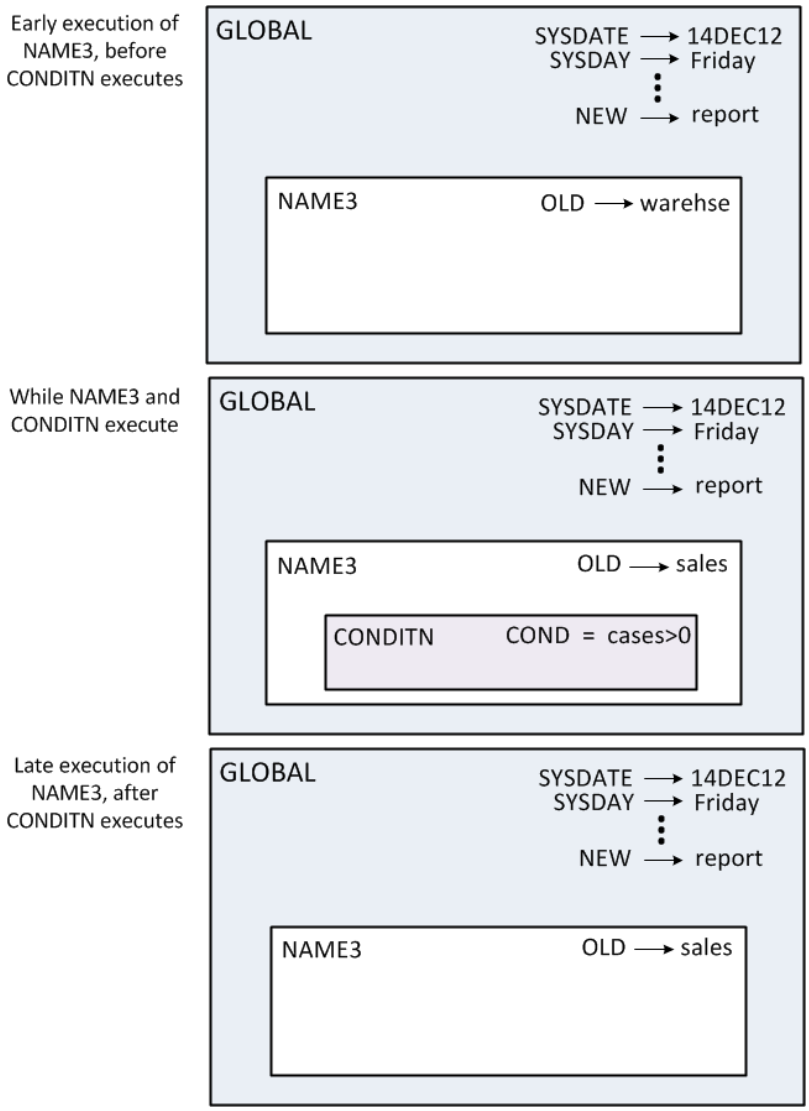
```
%let new=inventry;
%macro conditn;
   %let old=sales;
   %let cond=cases>0;
%mend conditn;

%macro name3;
   %let new=report;
   %let old=warehse;
   %conditn
      data &new;
         set &old;
         if &cond;
      run;
%mend name3;

%name3
```

The macro processor generates these statements:

```
data report;
   set sales;
   if &cond;
run;
```

CONDITN finishes executing before the macro processor reaches the reference &COND, so no variable named COND exists when the macro processor attempts to resolve the reference. Thus, the macro processor issues a warning message and generates the unresolved reference as part of the constant text and issues a warning message. The following figure shows the symbol tables at each step.

***Figure 5.7*** *Symbol Tables Showing Two Levels of Nesting*




Notice that the placement of a macro invocation is what creates a nested scope, not the placement of the macro definition. For example, invoking CONDITN from within NAME3 creates the nested scope. It is not necessary to define CONDITN within NAME3.

## *Forcing a Macro Variable to Be Local*

At times that you need to ensure that the macro processor creates a local macro variable rather than changing the value of an existing macro variable. In this case, use the %LOCAL statement to create the macro variable.

Always make all macro variables created within macros local when you do not need their values after the macro stops executing. Debugging the large macro programs is easier if you minimize the possibility of inadvertently changing a macro variable's value. Also, local macro variables do not exist after their defining macro finishes executing, but global variables exist for the duration of the SAS session. Therefore, local variables use less overall storage.

Suppose you want to use the macro NAMELST to create a list of names for a VAR statement, as shown here:

```
%macro namelst(name,number);
   %do n=1 %to &number;
      &name&n
   %end;
%mend namelst;
```

You invoke NAMELST in this program:

```
%let n=North State Industries;

proc print;
   var %namelst(dept,5);
   title "Quarterly Report for &n";
run;
```

After macro execution, the SAS compiler sees the following statements:

```
proc print;
   var dept1 dept2 dept3 dept4 dept5;
   title "Quarterly Report for 6";
run;
```

The macro processor changes the value of the global variable N each time it executes the iterative %DO loop. (After the loop stops executing, the value of N is 6, as described in "%DO Statement" on page 297.) To prevent conflicts, use a %LOCAL statement to create a local variable N, as shown here:

```
%macro namels2(name,number);
   %local n;
   %do n=1 %to &number;
      &name&n
   %end;
%mend namels2;
```

Now execute the same program:

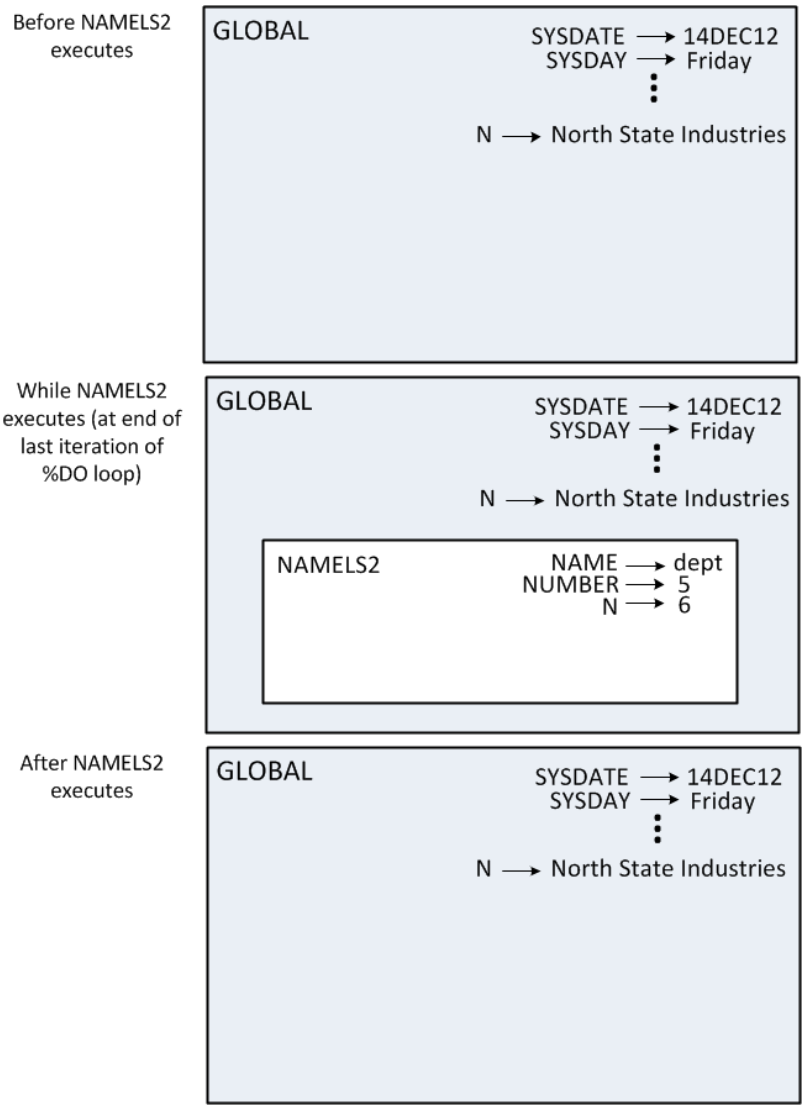
```
%let n=North State Industries;

proc print;
   var %namels2(dept,5);
   title "Quarterly Report for &n";
run;
```

The macro processor generates the following statements:

```
proc print;
   var dept1 dept2 dept3 dept4 dept5;
   title "Quarterly Report for North State Industries";
run;
```

The following figure shows the symbol tables before NAMELS2 executes, when NAMELS2 is executing, and when the macro processor encounters the reference &N in the TITLE statement.

***Figure 5.8*** *Symbol Tables for Global and Local Variables with the Same Name*




## *Creating Global Macro Variables*

The %GLOBAL statement creates a global macro variable if a variable with the same name does not already exist there, regardless of what scope is current.

For example, in the following program, the macro CONDITN contains a %GLOBAL statement that creates the macro variable COND as a global variable:

```
%macro conditn;
   %global cond;
   %let old=sales;
   %let cond=cases>0;
%mend conditn;
```

Here is the rest of the program:

```
%let new=inventry;

%macro name4;
```

```
   %let new=report;
   %let old=warehse;
   %conditn
   data &new;
      set &old;
      if &cond;
   run;
%mend name4;

%name4
```

Invoking NAME4 generates these statements:

```
data report;
   set sales;
   if cases>0;
run;
```

Suppose you want to put the SAS DATA step statements outside NAME4. In this case, all the macro variables must be global for the macro processor to resolve the references. You cannot add OLD to the %GLOBAL statement in CONDITN because the %LET statement in NAME4 has already created OLD as a local variable to NAME4 by the time CONDITN begins to execute. (You cannot use the %GLOBAL statement to make an existing local variable global.)

Thus, to make OLD global, use the %GLOBAL statement before the variable reference appears anywhere else, as shown here in the macro NAME5:

```
%let new=inventry;

%macro conditn;
   %global cond;
   %let old=sales;
   %let cond=cases>0;
%mend conditn;

   %macro name5;
      %global old;
      %let new=report;
      %let old=warehse;
      %conditn
   %mend name5;

%name5

data &new;
   set &old;
   if &cond;
run;
```

Now the %LET statement in NAME5 changes the value of the existing global variable OLD rather than creating OLD as a local variable. The SAS compiler sees the following statements:

```
data report;
   set sales;
   if cases>0;
run;
```

### Creating Global Variables Based on the Value of Local Variables

To use a local variable such as a parameter outside a macro, use a %LET statement to assign the value to a global variable with a different name, as in this program:

```
%macro namels3(name,number);
   %local n;
   %global g_number;
   %let g_number=&number;
   %do n=1 %to &number;
      &name&n
   %end;
%mend namels3;
```

Now invoke the macro NAMELS3 in the following the program:

```
%let n=North State Industries;

proc print;
   var %namels3(dept,5);
   title "Quarterly Report for &n";
   footnote "Survey of &g_number Departments";
run;
```

The compiler sees the following statements:

```
proc print;
   var dept1 dept2 dept3 dept4 dept5;
   title "Quarterly Report for North State Industries";
   footnote "Survey of 5 Departments";
run;
```

## Special Cases of Scope with the CALL SYMPUT Routine

### Overview of CALL SYMPUT Routine

Most problems with CALL SYMPUT involve the lack of a precise step boundary between the CALL SYMPUT statement that creates the macro variable and the macro variable reference that uses that variable. (For more information, see "CALL SYMPUT Routine" on page 230.) However, a few special cases exist that involve the scope of a macro variable created by CALL SYMPUT. These cases are good examples of why you should always assign a scope to a variable before assigning a value rather than relying on SAS to do it for you.

Two rules control where CALL SYMPUT creates its variables:

1. CALL SYMPUT creates the macro variable in the current symbol table available while the DATA step is executing, provided that symbol table is not empty. If it is empty (contains no local macro variables), usually CALL SYMPUT creates the variable in the closest nonempty symbol table.
2. However, there are three cases where CALL SYMPUT creates the variable in the local symbol table, even if that symbol table is empty:

- If CALL SYMPUT is used after a PROC SQL, the variable will be created in a local symbol table.
- If the macro variable SYSPBUFF is created at macro invocation time, the variable will be created in the local symbol table.
- If the executing macro contains a computed %GOTO statement, the variable will be created in the local symbol table. A computed %GOTO statement is one that uses a label that contains an & or a % in it. That is, a computed %GOTO statement contains a macro variable reference or a macro call that produces a text expression. Here is an example of a computed %GOTO statement:

```
%goto &home;
```

The symbol table that is currently available to a DATA step is the one that exists when SAS determines that the step is complete. (SAS considers a DATA step to be complete when it encounters a RUN statement, a semicolon after data lines, or the beginning of another step.)

If an executing macro contains a computed %GOTO statement, or if the macro variable SYSPBUFF is created at macro invocation time, but the local symbol table is empty, CALL SYMPUT behaves as if the local symbol table was not empty, and creates a local macro variable.

You might find it helpful to use the %PUT statement with the _USER_ option to determine what symbol table the CALL SYMPUT routine has created the variable in.

### *Example Using CALL SYMPUT with Complete DATA Step and a Nonempty Local Symbol Table*

Consider the following example, which contains a complete DATA step with a CALL SYMPUT statement inside a macro:

```
%macro env1(param1);
   data _null_;
      x = 'a token';
      call symput('myvar1',x);
   run;
%mend env1;

%env1(10)

data temp;
   y = "&myvar1";
run;
```

When you submit these statements, you receive an error message:

```
WARNING:   Apparent symbolic reference MYVAR1 not resolved.
```

This message appears for the following reasons:

- the DATA step is complete within the environment of ENV1 (that is, the RUN statement is within the macro)
- the local symbol table of ENV1 is not empty (it contains parameter PARAM1)

Therefore, the CALL SYMPUT routine creates MYVAR1 as a local variable for ENV1, and the value is not available to the subsequent DATA step, which expects a global macro variable.

To see the scopes, add a %PUT statement with the _USER_ option to the macro, and a similar statement in open code. Now invoke the macro as before:

```
%macro env1(param1);
   data _null_;
      x = 'a token';
      call symput('myvar1',x);
   run;

   %put ** Inside the macro: **;
   %put _user_;
%mend env1;

%env1(10)

%put ** In open code: **;
%put _user_;

data temp;
   y = "&myvar1";  /* ERROR - MYVAR1 is not available in open code. */
run;
```

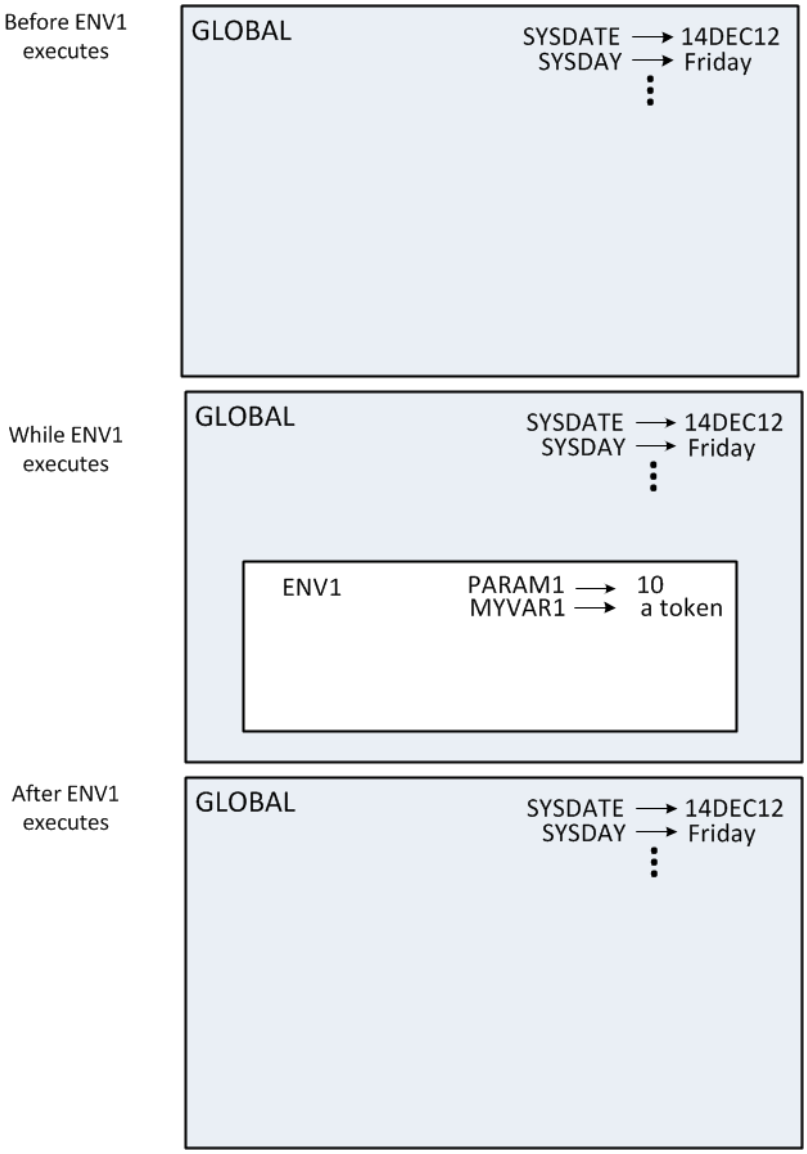
When the %PUT _USER_ statements execute, they write the following information to the log:

```
** Inside the macro: **
ENV1    MYVAR1    a token
ENV1    PARAM1    10

** In open code: **
```

The MYVAR1 macro variable is created by CALL SYMPUT in the local ENV1 symbol table. The %PUT _USER_ statement in open code writes nothing to the log, because no global macro variables are created.

The following figure shows all of the symbol tables in this example.

***Figure 5.9*** *The Symbol Tables with the CALL SYMPUT Routine Generating a Complete DATA Step*




## *Example Using CALL SYMPUT with an Incomplete DATA Step*

In the macro ENV2, shown here, the DATA step is not complete within the macro because there is no RUN statement:

```
%macro env2(param2);
   data _null_;
      x = 'a token';
      call symput('myvar2',x);
%mend env2;

%env2(20)
run;

data temp;
   y="&myvar2";
```

```
run;
```

These statements execute without errors. The DATA step is complete only when SAS encounters the RUN statement (in this case, in open code). Thus, the current scope of the DATA step is the global scope. CALL SYMPUT creates MYVAR2 as a global macro variable, and the value is available to the subsequent DATA step.

Again, use the %PUT statement with the _USER_ option to illustrate the scopes:

```
%macro env2(param2);
   data _null_;
      x = 'a token';
      call symput('myvar2',x);

   %put ** Inside the macro: **;
   %put _user_;
%mend env2;

%env2(20)

run;

%put ** In open code: **;
%put _user_;

data temp;
   y="&myvar2";
run;
```

When the %PUT _USER_ statement within ENV2 executes, it writes the following to the log:

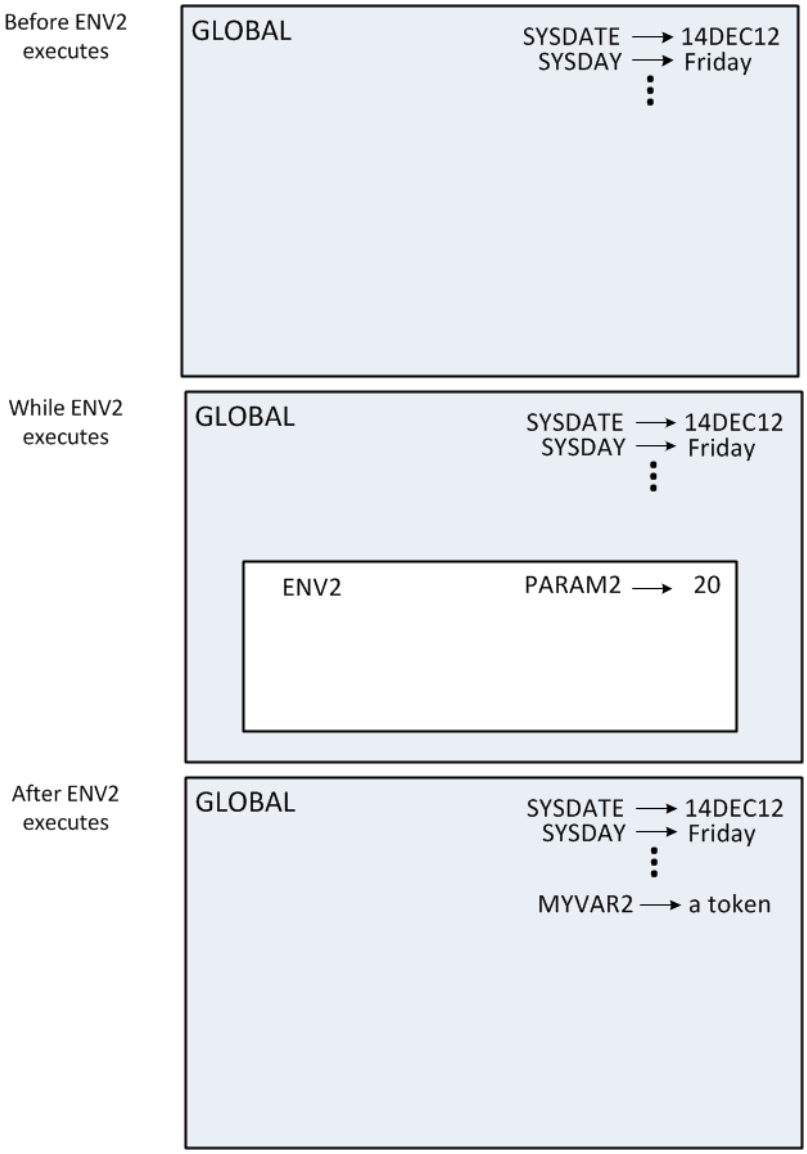
```
** Inside the macro: **
ENV2   PARAM2   20
```

The %PUT _USER_ statement in open code writes the following to the log:

```
** In open code: **
GLOBAL   MYVAR2   a token
```

The following figure shows all the scopes in this example.

***Figure 5.10*** *The Symbol Tables with the CALL SYMPUT Routine Generating an Incomplete DATA Step*




## *Example Using CALL SYMPUT with a Complete DATA Step and an Empty Local Symbol Table*

In the following example, ENV3 does not use macro parameters. Therefore, its local symbol table is empty:

```
%macro env3;
   data _null_;
      x = 'a token';
      call symput('myvar3',x);
   run;

   %put ** Inside the macro: **;
   %put _user_;
%mend env3;
```

```
%env3

%put ** In open code: **;
%put _user_;

data temp;
   y="&myvar3";
run;
```

In this case, the DATA step is complete and executes within the macro, but the local symbol table is empty. So, CALL SYMPUT creates MYVAR3 in the closest available nonempty symbol table—the global symbol table. Both %PUT statements show that MYVAR3 exists in the global symbol table:

```
** Inside the macro: **
GLOBAL    MYVAR3   a token

** In open code: **
GLOBAL    MYVAR3   a token
```

### *Example Using CALL SYMPUT with SYSPBUFF and an Empty Local Symbol Table*

In the following example, the presence of the SYSPBUFF automatic macro variable causes CALL SYMPUT to behave as if the local symbol table were not empty, even though the macro ENV4 has no parameters or local macro variables:

```
%macro env4 /parmbuff;
 data _null_;
      x = 'a token';
      call symput('myvar4',x);
   run;

   %put ** Inside the macro: **;
   %put _user_;
   %put &syspbuff;
%mend env4;

%env4

%put ** In open code: **;
%put _user_;
%put &syspbuff;

data temp;
   y="&myvar4";  /* ERROR - MYVAR4 is not available in open code */
run;
```

The presence of the /PARMBUFF specification causes the SYSPBUFF automatic macro variable to be created. So, when you call macro ENV4, CALL SYMPUT creates the macro variable MYVAR4 in the local symbol table (that is, in ENV4's). This action happens even though the macro ENV4 has no parameters and no local variables.

The results of the %PUT statements prove the following:

- the score of MYVAR4 is listed as ENV4
- the reference to SYSPBUFF does not resolve in the open code %PUT statement because SYSPBUFF is local to ENV4

```
** Inside the macro: **
b ENV4     MYVAR4    a token

** In open code: **
WARNING: Apparent symbolic reference SYSPBUFF not resolved.
```

For more information, see “SYSPBUFF Automatic Macro Variable” on page 214.

*Chapter 6*

# Macro Expressions

**Macro Expressions** . . . . . **71**

**Defining Arithmetic and Logical Expressions** . . . . . **72**
Evaluating Arithmetic and Logical Expressions . . . . . 72
Operands and Operators . . . . . 73

**How the Macro Processor Evaluates Arithmetic Expressions** . . . . . **74**
Evaluating Numeric Operands . . . . . 74
Evaluating Floating-Point Operands . . . . . 75

**How the Macro Processor Evaluates Logical Expressions** . . . . . **76**
Comparing Numeric Operands in Logical Expressions . . . . . 76
Comparing Floating-Point or Missing Values . . . . . 76
Comparing Character Operands in Logical Expressions . . . . . 77

## Macro Expressions

There are three types of macro expressions: text, logical, and arithmetic. A *text expression* is any combination of text, macro variables, macro functions, or macro calls. Text expressions are resolved to generate text. Here are some examples of text expressions:

- &BEGIN
- %GETLINE
- &PREFIX.PART&SUFFIX
- %UPCASE(&ANSWER)

*Logical expressions* and *arithmetic expressions* are sequences of operators and operands forming sets of instructions that are evaluated to produce a result. An arithmetic expression contains an arithmetic operator. A logical expression contains a logical operator. The following table shows examples of simple arithmetic and logical expressions:

***Table 6.1*** *Arithmetic and Logical Expressions*

| Arithmetic Expressions | Logical Expressions |
|---|---|
| 1 + 2 | &DAY = FRIDAY |

| Arithmetic Expressions | Logical Expressions |
|---|---|
| 4 * 3 | A < a |
| 4 / 2 | 1 < &INDEX |
| 00FFx - 003Ax | &START NE &END |

# Defining Arithmetic and Logical Expressions

## *Evaluating Arithmetic and Logical Expressions*

You can use arithmetic and logical expressions in specific macro functions and statements. (See the following table.) The arithmetic and logical expressions in these functions and statements enable you to control the text generated by a macro when it is executed.

***Table 6.2*** *Macro Language Elements That Evaluate Arithmetic and Logical Expressions*

| |
|---|
| %DO*macro-variable=expression* %TO *expression*<%BY *expression*>; |
| %DO %UNTIL(*expression*); |
| %DO %WHILE(*expression*); |
| %EVAL (*expression*); |
| %IF *expression* %THEN *statement*; |
| %QSCAN(*argument,expression*<,*delimiters*>) |
| %QSUBSTR(*argument,expression*<,expression>) |
| %SCAN(*argument,expression*,<delimiters>) |
| %SUBSTR(*argument,expression*<,expression>) |
| %SYSEVALF(*expression,conversion-type*) |

You can use text expressions to generate partial or complete arithmetic or logical expressions. The macro processor resolves text expressions before it evaluates the arithmetic or logical expressions. For example, when you submit the following statements, the macro processor resolves the macro variables &A, &B, and &OPERATOR in the %EVAL function, before it evaluates the expression 2 + 5:

```
%let A=2;
%let B=5;
%let operator=+;
```

```
%put The result of &A &operator &B is %eval(&A &operator
&B).;
```

When you submit these statements, the %PUT statement writes the following to the log:

```
The result of 2 + 5 is 7.
```

## Operands and Operators

*Operands* in arithmetic or logical expressions are always text. However, an operand that represents a number can be temporarily converted to a numeric value when an expression is evaluated. By default, the macro processor uses integer arithmetic, and only integers and hexadecimal values that represent integers can be converted to a numeric value. Operands that contain a period character (for example 1.0) are not converted. The exception is the %SYSEVALF function. It interprets a period character in its argument as a decimal point and converts the operand to a floating-point value on your operating system.

*Note:* The values of numeric expressions are restricted to the range of –2**64 to 2**64–1.

*Operators* in macro expressions are a subset of the operators in the DATA step (Table 6.3 on page 73). However, in the macro language, there is no MAX or MIN operator, and it does not recognize ':', as does the DATA step. The order in which operations are performed when an expression is evaluated is the same in the macro language as in the DATA step. Operations within parentheses are performed first.

*Note:* Expressions in which comparison operators surround a macro expression, as in 10<&X<20, might be the equivalent of a DATA step compound expression (depending on the expression resolution). To be safe, specify the connecting operator, as in the expression 10<&X AND &X<20.

*Note:* Datetime constants are internally converted using the BEST12. format.

***Table 6.3*** *Macro Language Operators*

| Operator | Mnemonic | Precedence | Definition | Example |
|---|---|---|---|---|
| ** | | 1 | exponentiation | 2**4 |
| + | | 2 | positive prefix | +(A+B) |
| - | | 2 | negative prefix | -(A+B) |
| ¬^~ | NOT | 3 | logical not* | NOT A |
| * | | 4 | multiplication | A*B |
| / | | 4 | division | A/B |
| + | | 5 | addition | A+B |
| - | | 5 | subtraction | A-B |
| < | LT | 6 | less than | A<B |
| <= | LE | 6 | less than or equal | A<=B |

| Operator | Mnemonic | Precedence | Definition | Example |
|---|---|---|---|---|
| = | EQ | 6 | equal | A=B |
| # | IN | 6 | equal to one of a list** | A#B C D E |
| ¬= ^= ~= | NE | 6 | not equal* | A NE B |
| > | GT | 6 | greater than | A>B |
| >= | GE | 6 | greater than or equal | A>=B |
| & | AND | 7 | logical and | A=B & C=D |
| \| | OR | 8 | logical or | A=B \| C=D |

*The symbol to use depends on your keyboard.

** The default delimiter for list elements is a blank..

** Before using the IN (#) operator, see "MINOPERATOR System Option" on page 347.

** When you use the IN operator, both operands must contain a value. If the operand contains a null value, an error is generated.

***CAUTION:***

**Integer expressions that contain exponential, multiplication, or division operators and that use or compute values outside the range -9,007,199,254,740,992 to 9,007,199,254,740,992 might get inexact results.**

# How the Macro Processor Evaluates Arithmetic Expressions

## *Evaluating Numeric Operands*

The macro facility is a string handling facility. However, in specific situations, the macro processor can evaluate operands that represent numbers as numeric values. The macro processor evaluates an expression that contains an arithmetic operator and operands that represent numbers. Then, it temporarily converts the operands to numeric values and performs the integer arithmetic operation. The result of the evaluation is text.

By default, arithmetic evaluation in most macro statements and functions is performed with integer arithmetic. The exception is the %SYSEVALF function. For more information, see "Evaluating Floating-Point Operands" on page 75. The following macro statements illustrate integer arithmetic evaluation:

```
%let a=%eval(1+2);
%let b=%eval(10*3);
%let c=%eval(4/2);
%let i=%eval(5/3);
%put The value of a is &a;
%put The value of b is &b;
%put The value of c is &c;
```

```
%put The value of I is &i;
```

When you submit these statements, the following messages appear in the log:

```
The value of a is 3
The value of b is 30
The value of c is 2
The value of I is 1
```

Notice the result of the last statement. If you perform division on integers that would ordinarily result in a fraction, integer arithmetic discards the fractional part.

When the macro processor evaluates an integer arithmetic expression that contains a character operand, it generates an error. Only operands that contain characters that represent integers or hexadecimal values are converted to numeric values. The following statement shows an incorrect usage:

```
%let d=%eval(10.0+20.0);   /*INCORRECT*/
```

The %EVAL function supports only integer arithmetic. The macro processor does not convert a value containing a period character to a number, and the operands are evaluated as character operands. This statement produces the following error message:

```
ERROR: A character operand was found in the %EVAL function or %IF
condition where a numeric operand is required. The condition was:
10.0+20.0
```

### Evaluating Floating-Point Operands

The %SYSEVALF function evaluates arithmetic expressions with operands that represent floating-point values. For example, the following expressions in the %SYSEVALF function are evaluated using floating-point arithmetic:

```
%let a=%sysevalf(10.0*3.0);
%let b=%sysevalf(10.5+20.8);
%let c=%sysevalf(5/3);
%put 10.0*3.0 = &a;
%put 10.5+20.8 = &b;
%put 5/3 = &c;
```

The %PUT statements display the following messages in the log:

```
10.0*3.0 = 30
10.5+20.8 = 31.3
5/3 = 1.6666666667
```

When the %SYSEVALF function evaluates arithmetic expressions, it temporarily converts the operands that represent numbers to floating-point values. The result of the evaluation can represent a floating-point value, but as in integer arithmetic expressions, the result is always text.

The %SYSEVALF function provides conversion type specifications: BOOLEAN, INTEGER, CEIL, and FLOOR. For example, the following %PUT statements return 1, 2, 3, and 2 respectively:

```
%let a=2.5;
%put %sysevalf(&a,boolean);
%put %sysevalf(&a,integer);
%put %sysevalf(&a,ceil);
%put %sysevalf(&a,floor);
```

These conversion types modify the value returned by %SYSEVALF so that it can be used in other macro expressions that require integer or Boolean values.

***CAUTION:***

**Specify a conversion type for the %SYSEVALF function.** If you use the %SYSEVALF function in macro expressions or assign its results to macro variables that are used in other macro expressions, then errors or unexpected results might occur if the %SYSEVALF function returns missing or floating-point values. To prevent errors, specify a conversion type that returns a value compatible with other macro expressions. For more information about using conversion types, see "%SYSEVALF Function" on page 271.

# How the Macro Processor Evaluates Logical Expressions

## Comparing Numeric Operands in Logical Expressions

A logical, or Boolean, expression returns a value that is evaluated as true or false. In the macro language, any numeric value other than 0 is true and a value of 0 is false.

When the macro processor evaluates logical expressions that contain operands that represent numbers, it converts the characters temporarily to numeric values. To illustrate how the macro processor evaluates logical expressions with numeric operands, consider the following macro definition:

```
%macro compnum(first,second);
   %if &first>&second %then %put &first is greater than &second;
   %else %if &first=&second %then %put &first equals &second;
   %else %put &first is less than &second;
%mend compnum;
```

Invoke the COMPNUM macro with these values:

```
%compnum(1,2)
%compnum(-1,0)
```

The following results are displayed in the log:

```
1 is less than 2
-1 is less than 0
```

The results show that the operands in the logical expressions were evaluated as numeric values.

## Comparing Floating-Point or Missing Values

You must use the %SYSEVALF function to evaluate logical expressions containing floating-point or missing values. To illustrate comparisons with floating-point and missing values, consider the following macro that compares parameters passed to it with the %SYSEVALF function and places the result in the log:

```
%macro compflt(first,second);
   %if %sysevalf(&first>&second) %then %put &first is greater than
&second;
   %else %if  %sysevalf(&first=&second) %then %put &first equals
```

```
&second;
   %else %put &first is less than &second;
%mend compflt;
```

Invoke the COMPFLT macro with these values:

```
%compflt (1.2,.9)
%compflt (-.1,.)
%compflt (0,.)
```

The following values are written in the log:

```
1.2 is greater than .9
-.1 is greater than .
0 is greater than .
```

The results show that the %SYSEVALF function evaluated the floating-point and missing values.

### Comparing Character Operands in Logical Expressions

To illustrate how the macro processor evaluates logical expressions, consider the COMPCHAR macro. Invoking the COMPCHAR macro compares the values passed as parameters and places the result in the log.

```
%macro compchar(first,second);
   %if &first>&second %then %put &first comes after &second;
   %else %put &first comes before &second;
%mend compchar;
```

Invoke the macro COMPCHAR with these values:

```
%compchar(a,b)
%compchar(.,1)
%compchar(Z,E)
```

The following results are printed in the log:

```
a comes before b
. comes before 1
Z comes after E
```

When the macro processor evaluates expressions with character operands, it uses the sort sequence of the host operating system for the comparison. The comparisons in these examples work with both EBCDIC and ASCII sort sequences.

A special case of a character operand is an operand that looks numeric but contains a period character. If you use an operand with a period character in an expression, both operands are compared as character values. This can lead to unexpected results. So that you can understand and better anticipate results, look at the following examples.

Invoke the COMPNUM macro with these values:

```
%compnum(10,2.0)
```

The following values are written to the log:

```
10 is less than 2.0
```

Because the %IF-THEN statement in the COMPNUM macro uses integer evaluation, it does not convert the operands with decimal points to numeric values. The operands are compared as character strings using the host sort sequence, which is the comparison of characters with smallest-to-largest values. For example, lowercase letters might have

smaller values than uppercase, and uppercase letters might have smaller values than digits.

***CAUTION:***

**The host sort sequence determines comparison results.** If you use a macro definition on more than one operating system, comparison results might differ because the sort sequence of one host operating system might differ from the other system. For more information about host sort sequences, see "SORT" in *SAS Viya Data Management and Utility Procedures Guide*.

*Chapter 7*

# Macro Quoting

**Macro Quoting** . . . . . **80**
Masking Special Characters and Mnemonics . . . . . 80
Understanding Why Macro Quoting Is Necessary . . . . . 80
Overview of Macro Quoting Functions . . . . . 81
Passing Parameters That Contain Special Characters and Mnemonics . . . . . 82

**Deciding When to Use a Macro Quoting Function and Which Function to Use** . . **83**

**%STR and %NRSTR Functions** . . . . . **85**
Using %STR and %NRSTR Functions . . . . . 85
Using Unmatched Quotation Marks and Parentheses with %STR and %NRSTR . . 86
Using % Signs with %STR . . . . . 86
Examples Using %STR . . . . . 87
Examples Using %NRSTR . . . . . 87

**%BQUOTE and %NRBQUOTE Functions** . . . . . **89**
Using %BQUOTE and %NRBQUOTE Functions . . . . . 89
Examples Using %BQUOTE . . . . . 89

**Referring to Already Quoted Variables** . . . . . **90**

**Deciding How Much Text to Mask with a Macro Quoting Function** . . . . . **90**

**%SUPERQ Function** . . . . . **91**
Using %SUPERQ . . . . . 91
Using the %SUPERQ Function to Prevent Warning Messages . . . . . 91

**Summary of Macro Quoting Functions and the Characters That They Mask** . . . . **92**

**Unquoting Text** . . . . . **93**
Restoring the Significance of Symbols . . . . . 93
Example of Unquoting . . . . . 93
What to Do When Automatic Unquoting Does Not Work . . . . . 94

**How Macro Quoting Works** . . . . . **95**

**Other Functions That Perform Macro Quoting** . . . . . **96**
Functions That Start with the Letter Q . . . . . 96
Example Using the %QSCAN Function . . . . . 96

# Macro Quoting

## Masking Special Characters and Mnemonics

The macro language is a character-based language. Even variables that appear to be numeric are generally treated as character variables (except during expression evaluation). Therefore, the macro processor enables you to generate all sorts of special characters as text. But because the macro language includes some of the same special characters, an ambiguity often arises. The macro processor must know whether to interpret a particular special character (for example, a semicolon or % sign) or a mnemonic (for example, GE or AND) as text or as a symbol in the macro language. Macro quoting functions resolve these ambiguities by masking the significance of special characters so that the macro processor does not misinterpret them.

The following special characters and mnemonics might require masking when they appear in text strings:

***Table 7.1*** *Special Characters and Mnemonics*

| | | | |
|---|---|---|---|
| blank | ) | = | LT |
| ; | ( | \| | GE |
| ¬ | + | AND | GT |
| ^ | — | OR | IN |
| ~ | * | NOT | % |
| , (comma) | / | EQ | & |
| ' | < | NE | # |
| “ | > | LE | |

## Understanding Why Macro Quoting Is Necessary

*Macro quoting functions* tell the macro processor to interpret special characters and mnemonics as text rather than as part of the macro language. If you did not use a macro quoting function to mask the special characters, the macro processor or the rest of SAS might give the character a meaning that you did not intend. Here are some examples of the types of ambiguities that can arise when text strings contain special characters and mnemonics:

- Is **`%sign`** a call to the macro SIGN or a phrase “percent sign”?
- Is OR the mnemonic Boolean operator or the abbreviation for Oregon?
- Is the quotation mark in O'Malley an unbalanced single quotation mark or just part of the name?

- Is Boys&Girls a reference to the macro variable &GIRLS or a group of children?
- Is GE the mnemonic for “greater than or equal” or is it short for General Electric?
- Which statement does a semicolon end?
- Does a comma separate parameters, or is it part of the value of one of the parameters?

Macro quoting functions enable you to clearly indicate to the macro processor how it is to interpret special characters and mnemonics.

Here is an example, using the simplest macro quoting function, %STR. Suppose you want to assign a PROC PRINT statement and a RUN statement to the macro variable PRINT. Here is the erroneous statement:

```
%let print=proc print; run;;  /* undesirable results */
```

This code is ambiguous. Are the semicolons that follow PRINT and RUN part of the value of the macro variable PRINT, or does one of them end the %LET statement? If you do not tell the macro processor what to do, it interprets the semicolon after PRINT as the end of the %LET statement. So the value of the PRINT macro variable would be the following:

```
proc print
```

The rest of the characters (RUN;;) would be simply the next part of the program.

To avoid the ambiguity and correctly assign the value of PRINT, you must mask the semicolons with the macro quoting function %STR, as follows:

```
%let print=%str(proc print; run;);
```

## *Overview of Macro Quoting Functions*

The following macro quoting functions are most commonly used:

- %STR and %NRSTR
- %BQUOTE and %NRBQUOTE
- %SUPERQ

For the paired macro quoting functions, the function beginning with NR affects the same category of special characters that are masked by the plain macro quoting function as well as ampersands and percent signs. In effect, the NR functions prevent macro and macro variable resolution. To help you remember which does which, try associating the NR in the macro quoting function names with the words “not resolved” — that is, macros and macro variables are not resolved when you use these functions.

The macro quoting functions with B in their names are useful for macro quoting unmatched quotation marks and parentheses. To help you remember the B, try associating B with “by itself”.

The %SUPERQ macro quoting function is unlike the other macro quoting functions in that it does not have a mate and works differently. For more information, see “%SUPERQ Function” on page 267.

The macro quoting functions can also be divided into two types, depending on when they take effect:

compilation functions
: cause the macro processor to interpret special characters as text in a macro program statement in open code or while compiling (constructing) a macro. The %STR and

%NRSTR functions are compilation functions. For more information, see "%STR and %NRSTR Functions" on page 262.

execution functions
: cause the macro processor to treat special characters that result from resolving a macro expression as text (such as a macro variable reference, a macro invocation, or the argument of an %EVAL function). They are called execution functions because resolution occurs during macro execution or during execution of a macro program statement in open code. The macro processor resolves the expression as far as possible, issues any warning messages for macro variable references or macro invocations that it cannot resolve, and quotes the result. The %BQUOTE and %NRBQUOTE functions are execution functions. For more information, see "%BQUOTE and %NRBQUOTE Functions" on page 250.

The %SUPERQ function takes as its argument a macro variable name (or a macro expression that yields a macro variable name). The argument must not be a reference to the macro variable whose value you are masking. That is, do not include the & before the name.

*Note:* Two other execution macro quoting functions exist: %QUOTE and %NRQUOTE. They are useful for unique macro quoting needs and for compatibility with older macro applications. For more information, see "%QUOTE and %NRQUOTE Functions" on page 256.

## Passing Parameters That Contain Special Characters and Mnemonics

Using an execution macro quoting function in the macro definition is the simplest and best way for the macro processor to accept resolved values that might contain special characters. However, if you discover that you need to pass parameter values such as **or** when a macro has not been defined with an execution macro quoting function, you can do so by masking the value in the macro invocation. The logic of the process is as follows:

1. When you mask a special character with a macro quoting function, it remains masked as long as it is within the macro facility (unless you use the "%UNQUOTE Function" on page 282).
2. The macro processor constructs the complete macro invocation before beginning to execute the macro.
3. Therefore, you can mask the value in the invocation with the %STR function. The masking is not needed when the macro processor is constructing the invocation. The value is already masked by a macro quoting function when macro execution begins and therefore does not cause problems during macro execution.

For example, suppose a macro named ORDERX does not use the %BQUOTE function. You can pass the value **or** to the ORDERX macro with the following invocation:

```
%orderx(%str(or))
```

However, placing the macro quoting function in the macro definition makes the macro much easier for you to invoke.

# Deciding When to Use a Macro Quoting Function and Which Function to Use

Use a macro quoting function anytime you want to assign to a macro variable a special character that could be interpreted as part of the macro language. The following table describes the special characters to mask when used as part of a text string and which macro quoting functions are useful in each situation.

***Table 7.2*** *Special Characters and Macro Quoting Guidelines*

| Special Character | Must Be Masked | Quoted by All Macro Quoting Functions? | Remarks |
|---|---|---|---|
| +-*/<>=^\|¬ ~ # LE LT EQ NE GE GT AND OR NOT IN | To prevent it from being treated as an operator in the argument of an %EVAL function | Yes | AND, OR, IN, and NOT need to be masked because they are interpreted as mnemonic operators by an %EVAL and by %SYSEVALF. |
| blank | To maintain, rather than ignore, a leading, trailing, or isolated blank | Yes | |
| ; | To prevent a macro program statement from ending prematurely | Yes | |
| , (comma) | To prevent it from indicating a new function argument, parameter, or parameter value | Yes | |

| Special Character | Must Be Masked | Quoted by All Macro Quoting Functions? | Remarks |
|---|---|---|---|
| ' " ( ) | If it might be unmatched | No | Arguments that might contain quotation marks and parentheses should be masked with a macro quoting function so that the macro facility interprets the single and double quotation marks and parentheses as text rather than macro language symbols or possibly unmatched quotation marks or parentheses for the SAS language. With %STR, %NRSTR, %QUOTE, and %NRQUOTE, unmatched quotation marks and parentheses must be marked with a % sign. You do not have to mark unmatched symbols in the arguments of %BQUOTE, %NRBQUOTE, and %SUPERQ. |
| *%name*<br>*&name* | (Depends on what the expression might resolve to) | No | %NRSTR, %NRBQUOTE, and %NRQUOTE mask these patterns. To use %SUPERQ with a macro variable, omit the ampersand from *name*. |

The macro facility allows you as much flexibility as possible in designing your macros. You need to mask a special character with a macro quoting function only when the macro processor would otherwise interpret the special character as part of the macro language rather than as text. For example, in this statement that you must use a macro quoting function to mask the first two semicolons to make them part of the text:

```
%let p=%str(proc print; run;);
```

However, in the macro PR, shown here, you do not need to use a macro quoting function to mask the semicolons after PRINT and RUN:

```
%macro pr(start);
   %if &start=yes %then
      %do;
         %put proc print requested;
         proc print;
         run;
      %end;
%mend pr;
```

Because the macro processor does not expect a semicolon within the %DO group, the semicolons after PRINT and RUN are not ambiguous, and they are interpreted as text.

Although it is not possible to give a series of rules that cover every situation, the following sections describe how to use each macro quoting function. Table 7.6 on page 92 provides a summary of the various characters that might need masking and of which macro quoting function is useful in each situation.

*Note:* You can also perform the inverse of a macro quoting function — that is, remove the tokenization provided by macro quoting functions. For an example of when the %UNQUOTE function is useful, see "Unquoting Text" on page 93.

# %STR and %NRSTR Functions

## *Using %STR and %NRSTR Functions*

If a special character or mnemonic affects how the macro processor constructs macro program statements, you must mask the item during macro compilation (or during the compilation of a macro program statement in open code) by using either the %STR or %NRSTR macro quoting functions.

These macro quoting functions mask the following special characters and mnemonics:

***Table 7.3*** *Special Characters Masked by the %STR and %NRSTR Functions*

| | | | | |
|---|---|---|---|---|
| blank | ) | = | NE | |
| ; | ( | \| | LE | |
| ¬ | + | # | LT | |
| ^ | — | AND | GE | |
| ~ | * | OR | GT | |
| , (comma) | / | NOT | | |
| ' | < | IN | | |
| " | > | EQ | | |

In addition to these special characters and mnemonics, %NRSTR masks & and %.

*Note:* If an unmatched single or double quotation mark or an open or close parenthesis is used with %STR or %NRSTR, these characters must be preceded by a percent sign (%).

When you use %STR or %NRSTR, the macro processor does not receive these functions and their arguments when it executes a macro. It receives only the results of these functions because these functions work when a macro compiles. By the time the macro executes, the string is already masked by a macro quoting function. Therefore, %STR and %NRSTR are useful for masking strings that are constants, such as sections of SAS code. In particular, %NRSTR is a good choice for masking strings that contain % and & signs. However, these functions are not so useful for masking strings that contain references to macro variables because it is possible that the macro variable could resolve to a value not quotable by %STR or %NRSTR. For example, the string could contain an unmarked, unmatched open parenthesis.

### Using Unmatched Quotation Marks and Parentheses with %STR and %NRSTR

If the argument to %STR or %NRSTR contains an unmatched single or double quotation mark or an unmatched open or close parenthesis, precede each of these characters with a % sign. The following table shows some examples of this technique.

***Table 7.4*** *Examples of Marking Unmatched Quotation Marks and Parentheses with %STR and %NRSTR*

| Notation | Description | Example | Quoted Value Stored |
|---|---|---|---|
| %' | unmatched single quotation mark | `%let myvar= %str(a%');` | `a'` |
| %" | unmatched double quotation mark | `%let myvar= %str(title %”first);` | `title “first` |
| %( | unmatched open parenthesis | `%let myvar= %str (log %(12);` | `log(12` |
| %) | unmatched close parenthesis | `%let myvar= %str (345%));` | `345)` |

### Using % Signs with %STR

In general, if you want to mask a % sign with a macro quoting function at compilation, use %NRSTR. There is one case where you can use %STR to mask a % sign: when the % sign does not have any text following it that could be construed by the macro processor as a macro name. The % sign must be marked by another % sign. Here are some examples.

***Table 7.5*** *Examples of Masking % Signs with %STR*

| Notation | Description | Example | Quoted Value Stored |
|---|---|---|---|
| '%' | % sign before a matched single quotation mark | `%let myvar= %str('%');` | '%' |
| %%%' | % sign before an unmatched single quotation mark | `%let myvar= %str(%%%');` | `%'` |
| ""%% | % sign after a matched double quotation mark | `%let myvar= %str(""%%);` | `""%` |

| Notation | Description | Example | Quoted Value Stored |
|---|---|---|---|
| %%%% | two % signs in a row | `%let myvar= %str(%%%%);` | `%%` |

## Examples Using %STR

The %STR function in the following %LET statement prevents the semicolon after PROC PRINT from being interpreted as the ending semicolon for the %LET statement:

```
%let printit=%str(proc print; run;);
```

As a more complex example, the macro KEEPIT1 shows how the %STR function works in a macro definition:

```
%macro keepit1(size);
   %if &size=big %then %put %str(keep city _numeric_;);
   %else %put %str(keep city;);
%mend keepit1;
```

Call the macro as follows:

```
%keepit1(big)
```

This code produces the following statement:

```
keep city _numeric_;
```

When you use the %STR function in the %IF-%THEN statement, the macro processor interprets the first semicolon after the word %THEN as text. The second semicolon ends the %THEN statement, and the %ELSE statement immediately follows the %THEN statement. Thus, the macro processor compiles the statements as you intended. However, if you omit the %STR function, the macro processor interprets the first semicolon after the word %THEN as the end of the %THEN clause. The next semicolon as constant text. Because only a %THEN clause can precede a %ELSE clause, the semicolon as constant text causes the macro processor to issue an error message and not compile the macro.

In the %ELSE statement, the %STR function causes the macro processor to treat the first semicolon in the statement as text and the second one as the end of the %ELSE clause. Therefore, the semicolon that ends the KEEP statement is part of the conditional execution. If you omit the %STR function, the first semicolon ends the %ELSE clause and the second semicolon is outside the conditional execution. It is generated as text each time the macro executes. (In this example, the placement of the semicolon does not affect the SAS code.) Again, using %STR causes the macro KEEPIT1 to compile as you intended.

Here is an example that uses %STR to mask a string that contains an unmatched single quotation mark. Note the use of the % sign before the quotation mark:

```
%let innocent=%str(I didn%'t do it!);
```

## Examples Using %NRSTR

Suppose you want the name (not the value) of a macro variable to be printed by the %PUT statement. To do so, you must use the %NRSTR function to mask the & and prevent the resolution of the macro variable, as in the following example:

```
%macro example;
```

```
   %local myvar;
   %let myvar=abc;
   %put %nrstr(The string &myvar appears in log output,);
   %put instead of the variable value.;
%mend example;

%example
```

This code writes the following text to the log:

```
The string &myvar appears in log output,
instead of the variable value.
```

If you did not use the %NRSTR function or if you used %STR, the following undesired output would appear in the log:

```
The string abc appears in log output,
instead of the variable value.
```

The %NRSTR function prevents the & from triggering macro variable resolution.

The %NRSTR function is also useful when the macro definition contains patterns that the macro processor would ordinarily recognize as macro variable references, as in the following program:

```
%macro credits(d=%nrstr(Mary&Stacy&Joan Ltd.));
   footnote "Designed by &d";
%mend credits;
```

Using %NRSTR causes the macro processor to treat &STACY and &JOAN simply as part of the text in the value of D; the macro processor does not issue warning messages for unresolvable macro variable references. Suppose you invoke the macro CREDITS with the default value of D, as follows:

```
%credits()
```

Submitting this program generates the following FOOTNOTE statement:

```
footnote "Designed by Mary&Stacy&Joan Ltd.";
```

If you omit the %NRSTR function, the macro processor attempts to resolve the references &STACY and &JOAN as part of the resolution of &D in the FOOTNOTE statement. The macro processor issues these warning messages (assuming the SERROR system option, described in "System Options for Macros" on page 331 is active) because no such macro variables exist:

```
WARNING: Apparent symbolic reference STACY not resolved.
WARNING: Apparent symbolic reference JOAN not resolved.
```

Here is a final example of using %NRSTR. Suppose you wanted a text string to include the name of a macro function: **`This is the result of %NRSTR`**. Here is the program:

```
%put This is the result of %nrstr(%nrstr);
```

You must use %NRSTR to mask the % sign at compilation, so the macro processor does not try to invoke %NRSTR a second time. If you did not use %NRSTR to mask the string **`%nrstr`**, the macro processor would complain about a missing open parenthesis for the function.

# %BQUOTE and %NRBQUOTE Functions

## Using %BQUOTE and %NRBQUOTE Functions

%BQUOTE and %NRBQUOTE mask values during execution of a macro or a macro language statement in open code. These functions instruct the macro processor to resolve a macro expression as far as possible and mask the result, issuing any warning messages for macro variable references or macro invocations that it cannot resolve. These functions mask all the characters that %STR and %NRSTR mask with the addition of unmarked percent signs; unmatched, unmarked single and double quotation marks; and unmatched, unmarked opening and closing parentheses. That means that you do not have to precede an unmatched quotation mark with a % sign, as you must when using %STR and %NRSTR.

The %BQUOTE function treats all parentheses and quotation marks produced by resolving macro variable references or macro calls as special characters to be masked at execution time. (It does not mask parentheses or quotation marks that are in the argument at compile time.) Therefore, it does not matter whether quotation marks and parentheses in the resolved value are matched; each one is masked individually.

The %NRBQUOTE function is useful when you want a value to be resolved when first encountered, if possible, but you do not want any ampersands or percent signs in the result to be interpreted as operators by an %EVAL function.

If the argument of the %NRBQUOTE function contains an unresolvable macro variable reference or macro invocation, the macro processor issues a warning message before it masks the ampersand or percent sign (assuming the SERROR or MERROR system option, described in "System Options for Macros" on page 331 is in effect). To suppress the message for unresolved macro variables, use the %SUPERQ function (discussed later in this section) instead.

The %BQUOTE and %NRBQUOTE functions operate during execution and are more flexible than %STR and %NRSTR. Therefore, %BQUOTE and %NRBQUOTE are good choices for masking strings that contain macro variable references.

## Examples Using %BQUOTE

In the following statement, the %IF-%THEN statement uses %BQUOTE to prevent an error if the macro variable STATE resolves to OR (for Oregon), which the macro processor would interpret as the logical operator OR otherwise:

```
%if %bquote(&state)=%str(OR) %then %put Oregon Dept. of
Revenue;
```

*Note:* This example works if you use %STR, but it is not robust or good programming practice. Because you cannot guarantee what &STATE is going to resolve to, you need to use %BQUOTE to mask the resolution of the macro variable at execution time, not the name of the variable itself at compile time.

In the following example, a DATA step creates a character value containing a single quotation mark and assigns that value to a macro variable. The macro READIT then uses the %BQUOTE function to enable a %IF condition to accept the unmatched single quotation mark:

```
data test;
```

```
   store="Susan's Office Supplies";
   call symput('s',store);
run;

%macro readit;
   %if %bquote(&s) ne %then %put *** valid ***;
   %else %put *** null value ***;
%mend readit;

%readit
```

When you assign the value **Susan's Office Supplies** to STORE in the DATA step, enclosing the character string in double quotation marks enables you to use an unmatched single quotation mark in the string. SAS stores the value of STORE:

```
Susan's Office Supplies
```

The CALL SYMPUT routine assigns that value (containing an unmatched single quotation mark) as the value of the macro variable S. If you do not use the %BQUOTE function when you reference S in the macro READIT, the macro processor issues an error message for an invalid operand in the %IF condition.

When you submit the code, the following is written to the log:

```
*** valid ***
```

## Referring to Already Quoted Variables

Items that have been masked by a macro quoting function, such as the value of WHOSE in the following program, remain masked as long as the item is being used by the macro processor. When you use the value of WHOSE later in a macro program statement, you do not need to mask the reference again.

```
/* Use %STR to mask the constant, and use a  % sign to mark */
/* the unmatched single quotation mark. */
%let whose=%str(John%'s);

/* You don't need to mask the macro reference, because it was */
/* masked in the %LET statement, and remains masked. */
%put *** This coat is &whose ***;
```

Here is the output from the %PUT statement that is written to the log:

```
*** This coat is John's ***
```

## Deciding How Much Text to Mask with a Macro Quoting Function

In each of the following statements, the macro processor treats the masked semicolons as text:

```
%let p=%str(proc print; run;);
%let p=proc %str(print;) %str(run;);
%let p=proc print%str(;) run%str(;);
```

The value of P is the same in each case:

```
proc print; run;
```

The results of the three %LET statements are the same because when you mask text with a macro quoting function, the macro processor quotes only the items that the function recognizes. Other text enclosed in the function remains unchanged. Therefore, the third %LET statement is the minimalist approach to macro quoting. However, masking large blocks of text with a macro quoting function is harmless and actually results in code that is much easier to read (such as the first %LET statement).

# %SUPERQ Function

## Using %SUPERQ

The %SUPERQ function locates the macro variable named in its argument and quotes the value of that macro variable without permitting any resolution to occur. It masks all items that might require macro quoting at macro execution. Because %SUPERQ does not attempt any resolution of its argument, the macro processor does not issue any warning messages that a macro variable reference or a macro invocation has not been resolved. Therefore, even when the %NRBQUOTE function enables the program to work correctly, you can use the %SUPERQ function to eliminate unwanted warning messages from the log. %SUPERQ takes as its argument either a macro variable name without an ampersand or a text expression that yields a macro variable name.

%SUPERQ retrieves the value of a macro variable from the macro symbol table and quotes it immediately, preventing the macro processor from making any attempt to resolve anything that might occur in the resolved value. For example, if the macro variable CORPNAME resolves to **`Smith&Jones`**, using %SUPERQ prevents the macro processor from attempting to further resolve **`&Jones`**. This %LET statement successfully assigns the value **`Smith&Jones`** to TESTVAR:

```
%let testvar=%superq(corpname);
```

## Using the %SUPERQ Function to Prevent Warning Messages

The sections about the %NRBQUOTE function show that it causes the macro processor to attempt to resolve the patterns *&name* and *%name* the first time it encounters them during macro execution. If the macro processor cannot resolve them, it quotes the ampersand or percent sign so that later uses of the value do not cause the macro processor to recognize them. However, if the MERROR or SERROR option is in effect, the macro processor issues a warning message that the reference or invocation was not resolved.

# Summary of Macro Quoting Functions and the Characters That They Mask

Different macro quoting functions mask different special characters and mnemonics so that the macro facility interprets them as text instead of as macro language symbols.

The following table divides the symbols into categories and shows which macro quoting functions mask which symbols.

***Table 7.6*** *Summary of Special Characters and Macro Quoting Functions by Item*

| Group | Items | Macro Quoting Functions |
|---|---|---|
| A | + — */<>=¬^\|~;, # blank AND OR NOT EQ NE LE LT GE GT IN | all |
| B | &% | %NRSTR, %NRBQUOTE, %SUPERQ, %NRQUOTE |
| C | unmatched' “() | %BQUOTE, %NRBQUOTE, %SUPERQ, %STR*, %NRSTR*, %QUOTE*, %NRQUOTE* |

***Table 7.7*** *By Function*

| Function | Affects Groups | Works At |
|---|---|---|
| %STR | A, C* | Macro compilation |
| %NRSTR | A, B, C* | Macro compilation |
| %BQUOTE | A, C | Macro execution |
| %NRBQUOTE | A, B, C | Macro execution |
| %SUPERQ | A, B, C | Macro execution (prevents resolution) |
| %QUOTE | A, C* | Macro execution. Requires unmatched quotation marks and parentheses to be marked with a percent sign (%). |
| %NRQUOTE | A, B, C* | Macro execution. Requires unmatched quotation marks and parentheses to be marked with a percent sign (%). |

*Unmatched quotation marks and parentheses must be marked with a percent sign (%) when used with %STR, %NRSTR, %QUOTE, and %NRQUOTE.

# Unquoting Text

## *Restoring the Significance of Symbols*

To *unquote* a value means to restore the significance of symbols in an item that was previously masked by a macro quoting function.

Usually, after an item has been masked by a macro quoting function, it retains its special status until one of the following occurs:

- You enclose the item with the %UNQUOTE function. (For more information, see "%UNQUOTE Function" on page 282.)
- The item leaves the word scanner and is passed to the DATA step compiler, SAS procedures, SAS macro facility, or other parts of the SAS System.
- The item is returned as an unquoted result by the %SCAN, %SUBSTR, or %UPCASE function. (To retain a value's masked status during one of these operations, use the %QSCAN, %QSUBSTR, or %QUPCASE function. For more information, see "Other Functions That Perform Macro Quoting" on page 96.)

As a rule, you do not need to unquote an item because it is automatically unquoted when the item is passed from the word scanner to the rest of SAS. Under two circumstances, however, you might need to use the %UNQUOTE function to restore the original significance to a masked item:

- when you want to use a value with its restored meaning later in the same macro in which its value was previously masked by a macro quoting function
- when masking text with a macro quoting function changes how the word scanner tokenizes it, producing SAS statements that look correct but that the SAS compiler does not recognize

## *Example of Unquoting*

The following example illustrates using a value twice: once in macro quoted form and once in unquoted form. Suppose the macro ANALYZE is part of a system that enables you to compare the output of two statistical models interactively. First, you enter an operator to specify the relationship that you want to test (one result greater than another, equal to another, and so on). The macro ANALYZE does the following:

- tests the macro quoted value of the operator to verify that you have entered it correctly
- uses the unquoted value to compare the values indicated
- writes a message

Match the numbers in the comments to the paragraphs below.

```
%macro analyze(stat);
   data _null_;
      set out1;
      call symput('v1',&stat);
   run;
```

```
   data _null_;
      set out2;
      call symput('v2',&stat);
   run;

   %put Preliminary test. Enter the operator.;
   %input;
   %let op=%bquote(&sysbuffr);
   %if &op=%str(=<) %then %let op=%str(<=);
   %else %if &op=%str(=>) %then %let op=%str(>=);
   %if &v1 %unquote(&op) &v2 %then
      %put You might proceed with the analysis.;
   %else
      %do;
         %put &stat from out1 is not &op &stat from out2.;
         %put Please check your previous models.;
      %end;
%mend analyze;
```

You mask the value of SYSBUFFR with the %BQUOTE function, which masks resolved items including unmatched, unmarked quotation marks and parentheses (but excluding the ampersand and percent sign).

The %IF condition compares the value of the macro variable OP to a string to see whether the value of OP contains the correct symbols for the operator. If the value contains symbols in the wrong order, the %THEN statement corrects the symbols. Because a value masked by a macro quoting function remains masked, you do not need to mask the reference &OP in the left side of the %IF condition.

Because you can see the characters in the right side of the %IF condition and in the %LET statement when you define the macro, you can use the %STR function to mask them. Masking them once at compilation is more efficient than masking them at each execution of ANALYZE.

To use the value of the macro variable OP as the operator in the %IF condition, you must restore the meaning of the operator with the %UNQUOTE function.

### What to Do When Automatic Unquoting Does Not Work

When the macro processor generates text from an item masked by a macro quoting function, you can usually allow SAS to unquote the macro quoted items automatically. For example, suppose you define a macro variable PRINTIT:

```
%let printit=%str(proc print; run;);
```

Then you use that macro variable in your program:

```
%put *** This code prints the data set: &printit ***;
```

When the macro processor generates the text from the macro variable, the items masked by macro quoting functions are automatically unquoted, and the previously masked semicolons work normally when they are passed to the rest of SAS.

In rare cases, masking text with a macro quoting function changes how the word scanner tokenizes the text. (The word scanner and tokenization are discussed in Chapter 2, “SAS Programs and Macro Processing,” on page 13 and Chapter 4, “Macro Processing,” on page 37.) For example, a single or double quotation mark produced by resolution within the %BQUOTE function becomes a separate token. The word scanner does not use it as the boundary of a literal token in the input stack. If generated text that was once masked

by the %BQUOTE function looks correct but SAS does not accept it, you might need to use the %UNQUOTE function to restore normal tokenization.

## How Macro Quoting Works

When the macro processor masks a text string, it masks special characters and mnemonics within the coding scheme, and prefixes and suffixes the string with a hexadecimal character, called a *delta character*. The prefix character marks the beginning of the string and also indicates what type of macro quoting is to be applied to the string. The suffix character marks the end of the string. The prefix and suffix characters preserve any leading and trailing blanks contained by the string. The hexadecimal characters used to mask special characters and mnemonics and the characters used for the prefix and suffix might vary and are not portable.

There are more hexadecimal combinations possible in each byte than are needed to represent the symbols on a keyboard. Therefore, when a macro quoting function recognizes an item to be masked, the macro processor uses a previously unused hexadecimal combination for the prefix and suffix characters.

Macro functions, such as %EVAL and %SUBSTR, ignore the prefix and suffix characters. Therefore, the prefix and suffix characters do not affect comparisons.

When the macro processor is finished with a macro quoted text string, it removes the macro quoting-coded substitute characters and replaces them with the original characters. The unmasked characters are passed on to the rest of the system. Sometimes you might see a message about unmasking, as in the following example:

```
/* Turn on SYMBOLGEN so you can see the messages about unquoting. */
options symbolgen;

/* Assign a value to EXAMPLE that contains several special */
/* characters and a mnemonic. */
%let example = %nrbquote( 1 + 1 = 3 Today's Test and More );

%put *&example*;
```

When this program is submitted, the following appears in the log:

```
SYMBOLGEN:   Macro variable EXAMPLE resolves to  1 + 1 = 3 Today's
             Test and More
SYMBOLGEN:   Some characters in the above value which were subject
             to macro quoting have been unquoted for printing.
* 1 + 1 = 3 Today's Test and More *
```

As you can see, the leading and trailing blanks and special characters were retained in the variable's value. When the macro processor was working with the string, the string actually contained coded characters that were substituted for the “real” characters. The substitute characters included coded characters to represent the start and end of the string. The leading and trailing blanks were preserved. Characters were also substituted for the special characters **+**, **=**, and **'**, and the mnemonic **AND**. When the macro finished processing and the characters were passed to the rest of SAS, the coding was removed and the real characters were replaced.

“Unquoting Text” on page 93 provides more information about what happens when a masked string is unquoted. For more information, see “SYMBOLGEN System Option” on page 360.

# Other Functions That Perform Macro Quoting

## Functions That Start with the Letter Q

Some macro functions are available in pairs, where one function starts with the letter Q:

- %SCAN and %QSCAN
- %SUBSTR and %QSUBSTR
- %UPCASE and %QUPCASE
- %SYSFUNC and %QSYSFUNC

The Q*xxx* functions are necessary because by default, macro functions return an unquoted result, even if the argument was masked by a macro quoting function. The %QSCAN, %QSUBSTR, %QUPCASE, and %QSYSFUNC functions mask the returned value at execution time. The items masked are the same as the items masked by the %NRBQUOTE function.

## Example Using the %QSCAN Function

The following macro uses the %QSCAN function to assign items in the value of SYSBUFFR (described in "Automatic Macro Variables" on page 194) as the values of separate macro variables. The numbers in the comments correspond to the explanations in the list that follows the macro code.

```
%macro splitit;
   %put What character separates the values?;  1
   %input;
   %let s=%bquote(&sysbuffr);  2
   %put Enter three values.;
   %input;
   %local i;
   %do i=1 %to 3;  3
      %global x&i;
      %let x&i=%qscan(%superq(sysbuffr),&i,&s);
4
   %end;
%mend splitit;

%splitit
What character separates the values?
#
Enter three values.
Fischer Books#Smith&Sons#Sarah's Sweet Shoppe
5
```

1. This question asks you to input a delimiter for the %QSCAN function that does not appear in the values that you enter.
2. Masking the value of SYSBUFFR with the %BQUOTE function enables you to choose a quotation mark or parenthesis as a delimiter if necessary.

3. The iterative %DO loop creates a global macro variable for each segment of SYSBUFFR and assigns it the value of that segment.
4. The %SUPERQ function masks the value of SYSBUFFR in the first argument of the %QSCAN function. It prevents any resolution of the value of SYSBUFFR.
5. The %QSCAN function returns macro quoted segments of the value of SYSBUFFR. Thus, the unmatched quotation mark in **`Sarah's Sweet Shoppe`** and the &*name* pattern in **`Smith&Sons`** do not cause problems.

*Chapter 8*

# Interfaces with the Macro Facility

**Interfaces with the Macro Facility** . . . . . **99**

**DATA Step Interfaces** . . . . . **100**
Interacting with the Macro Facility during DATA Step Execution . . . . . 100
CALL EXECUTE Routine Timing Details . . . . . 101
Example of Using CALL EXECUTE Incorrectly . . . . . 101
Example of Common Problem with CALL EXECUTE . . . . . 102

**Using SAS Language Functions in the DATA Step and Macro Facility** . . . . . **104**

**Interfaces with the SQL Procedure** . . . . . **105**
Using PROC SQL . . . . . 105
INTO Clause . . . . . 105
Controlling Job Execution . . . . . 105

**Interfaces with the SAS Component Language** . . . . . **106**
Using an SCL Program . . . . . 106
How Macro References Are Resolved by SCL . . . . . 107
Referencing Macro Variables in Submit Blocks . . . . . 107
Considerations for Sharing Macros between SCL Programs . . . . . 107
Example Using Macros in an SCL Program . . . . . 107

**SAS/CONNECT Interfaces** . . . . . **108**
Overview of SAS/CONNECT Interfaces . . . . . 108
Using %SYSRPUT with SAS/CONNECT . . . . . 109
Example Using %SYSRPUT to Check the Value of a Return Code on a Remote Host . . . . . 109
Using %SYSLPUT with SAS/CONNECT . . . . . 110
Example Using %SYSLPUT . . . . . 110

## Interfaces with the Macro Facility

An *interface* with the macro facility is not part of the macro processor but rather a SAS software feature that enables another portion of the SAS language to interact with the macro facility during execution. For example, a DATA step interface enables you to access macro variables from the DATA step. Macro facility interfaces are useful because, in general, macro processing happens before DATA step, SQL, SCL, or SAS/CONNECT execution. The connection between the macro facility and the rest of SAS is not usually dynamic. But by using an interface to the macro facility, you can dynamically connect the macro facility to the rest of SAS.

*Note:* The %SYSFUNC and %QSYSFUNC macro functions enable you to use SAS language functions with the macro processor. The %SYSCALL macro statement enables you to use SAS language CALL routines with the macro processor. These elements of the macro language are not considered true macro facility interfaces and they are discussed in this section. For more information about these macro language elements, see Chapter 12, "Macro Language Elements," on page 153.

# DATA Step Interfaces

## *Interacting with the Macro Facility during DATA Step Execution*

*DATA step interfaces* consist of eight tools that enable a program to interact with the macro facility during DATA step execution. Because the work of the macro facility takes place before DATA step execution begins, information provided by macro statements has already been processed during DATA step execution. You can use one of the DATA step interfaces to interact with the macro facility during DATA step execution. You can use DATA step interfaces to do the following:

- pass information from a DATA step to a subsequent step in a SAS program
- invoke a macro based on information available only when the DATA step executes
- resolve a macro variable while a DATA step executes
- delete a macro variable
- pass information about a macro variable from the macro facility to the DATA step

The following table lists the DATA step interfaces by category and their uses.

***Table 8.1*** *DATA Step Interfaces to the Macro Facility*

| Category | Tool | Description |
|---|---|---|
| Execution | CALL EXECUTE routine | Resolves its argument and executes the resolved value at the next step boundary (if the value is a SAS statement) or immediately (if the value is a macro language element). |
| Resolution | RESOLVE function | Resolves the value of a text expression during DATA step execution. |
| Deletion | CALL SYMDEL routine | Deletes the indicated macro variable named in the argument. |
| Information | SYMEXIST function | Returns an indication as to whether the macro variable exists. |
| Read or Write | SYMGET function | Returns the value of a macro variable during DATA step execution. |
| Information | SYMGLOBL function | Returns an indication as to whether the macro variable is global in scope. |

| Category | Tool | Description |
|---|---|---|
| Information | SYMLOCAL function | Returns an indication as to whether the macro variable is local in scope. |
| Read or Write | CALL SYMPUT routine | Assigns a value produced in a DATA step to a macro variable. |

### CALL EXECUTE Routine Timing Details

CALL EXECUTE is useful when you want to execute a macro conditionally. But you must remember that if CALL EXECUTE produces macro language elements, those elements execute immediately. If CALL EXECUTE produces SAS language statements, or if the macro language elements generate SAS language statements, those statements execute after the end of the DATA step's execution.

*Note:* Macro references execute immediately and SAS statements do not execute until after a step boundary. You cannot use CALL EXECUTE to invoke a macro that contains references for macro variables that are created by CALL SYMPUT in that macro.

### Example of Using CALL EXECUTE Incorrectly

In this example, the CALL EXECUTE routine is used incorrectly:

```
data prices;  /* ID for price category and actual price */
   input code amount;
   datalines;
56 300
99 10000
24 225
;

%macro items;
   %global special;
   %let special=football;
%mend items;

data sales;    /* incorrect usage */
   set prices;
   length saleitem $ 20;
   call execute('%items');
   saleitem="&special";
run;
```

In the DATA SALES step, the assignment statement for SALEITEM requires the value of the macro variable SPECIAL at DATA step compilation. CALL EXECUTE does not produce the value until DATA step execution. Thus, you receive a message about an unresolved macro variable, and the value assigned to SALEITEM is **`&special`**.

In this example, it would be better to eliminate the macro definition (the %LET macro statement is valid in open code) or move the DATA SALES step into the macro ITEMS. In either case, CALL EXECUTE is not necessary or useful. Here is one version of this program that works:

```
data prices;   /* ID for price category and actual price */
   input code amount;
   datalines;
56 300
99 10000
24 225
;

%let special=football;  /* correct usage */

data sales;
   set prices;
   length saleitem $ 20;
   saleitem="&special";
run;
```

The %GLOBAL statement is not necessary in this version. Because the %LET statement is executed in open code, it automatically creates a global macro variable. (For more information about macro variable scopes, see Chapter 5, "Scopes of Macro Variables," on page 47.)

### Example of Common Problem with CALL EXECUTE

This example shows a common pattern that causes an error.

```
/* This version of the example shows the problem. */

data prices;        /* ID for price category and actual price */
   input code amount;
   cards;
56 300
99 10000
24 225
;
data names;     /* name of sales department and item sold */
   input dept $ item $;
   datalines;
BB  Boat
SK  Skates
;

%macro items(codevar=);  /* create macro variable if needed */
   %global special;
   data _null_;
      set names;
      if &codevar=99 and dept='BB' then call symput('special', item);
   run;
%mend items;

data sales;  /* attempt to reference macro variable fails */
   set prices;
   length saleitem $ 20;
   if amount > 500 then
      call execute('%items(codevar=' || code || ')' );
   saleitem="&special";
run;
```

In this example, the DATA SALES step still requires the value of SPECIAL during compilation. The CALL EXECUTE routine is useful in this example because of the conditional IF statement. But as in the first example, CALL EXECUTE still invokes the macro ITEMS during DATA step execution — not during compilation. The macro ITEMS generates a DATA _NULL_ step that executes after the DATA SALES step has ceased execution. The DATA _NULL_ step creates SPECIAL, and the value of SPECIAL is available after the _NULL_ step ceases execution, which is much later than when the value was needed.

This version of the example corrects the problem:

```
/* This version solves the problem. */

data prices;     /* ID for price category and actual price */
   input code amount;
   datalines;
56 300
99 10000
24 225
;

data names;     /* name of sales department and item sold */
   input dept $ item $;
   cards;
BB  Boat
SK  Ski
;
%macro items(codevar=);   /* create macro variable if needed */
   %global special;
   data _null_;
      set names;
      if &codevar=99 and dept='BB' then
         call symput('special', item);
   run;
%mend items;

data _null_;   /* call the macro in this step */
   set prices;
   if amount > 500 then
      call execute('%items(codevar=' || code || ')' );
run;

data sales;    /* use the value created by the macro in this step */
   set prices;
   length saleitem $ 20;
   saleitem="&special";
run;
```

This version uses one DATA _NULL_ step to call the macro ITEMS. After that step ceases execution, the DATA _NULL_ step generated by ITEMS executes and creates the macro variable SPECIAL. Then the DATA SALES step references the value of SPECIAL as usual.

# Using SAS Language Functions in the DATA Step and Macro Facility

The macro functions %SYSFUNC and %QSYSFUNC can call SAS language functions and functions written with SAS/TOOLKIT software to generate text in the macro facility. %SYSFUNC and %QSYSFUNC have one difference: the %QSYSFUNC masks special characters and mnemonics and %SYSFUNC does not. For more information about these functions, see "%SYSFUNC and %QSYSFUNC Functions" on page 273.

%SYSFUNC arguments are a single SAS language function and an optional format. See the following examples:

```
%sysfunc(date(),worddate.)
%sysfunc(attrn(&dsid,NOBS))
```

You cannot nest SAS language functions within %SYSFUNC. However, you can nest %SYSFUNC functions that call SAS language functions, as in the following statement:

```
%sysfunc(compress(%sysfunc(getoption(sasautos)),%str(%)%('')))
```

This example returns the value of the SASAUTOS= system option, using the COMPRESS function to eliminate opening parentheses, closing parentheses, and single quotation marks from the result. Note the use of the %STR function and the unmatched parentheses and quotation marks that are marked with a percent sign (%).

All arguments in SAS language functions within %SYSFUNC must be separated by commas. You cannot use argument lists preceded by the word OF.

Because %SYSFUNC is a macro function, you do not need to enclose character values in quotation marks as you do in SAS language functions. For example, the arguments to the OPEN function are enclosed in quotation marks when the function is used alone but do not require quotation marks when used within %SYSFUNC.

Here are some examples of the contrast between using a function alone and within %SYSFUNC:

- **`dsid = open("sashelp.Houses","i");`**
- **`dsid = open("&mydata","&mode");`**
- **`%let dsid = %sysfunc(open(sashelp.Houses,i));`**
- **`%let dsid = %sysfunc(open(&mydata,&mode));`**

You can use %SYSFUNC and %QSYSFUNC to call all of the DATA step SAS functions except the ones that are listed in Table 17.2 on page 275. In the macro facility, SAS language functions called by %SYSFUNC can return values with a length up to 32K. However, within the DATA step, return values are limited to the length of a data set character variable.

The %SYSCALL macro statement enables you to use SAS language CALL routines with the macro processor, and it is described in "Macro Statements" on page 291.

# Interfaces with the SQL Procedure

## Using PROC SQL

Structured Query Language (SQL) is a standardized, widely used language for retrieving and updating data in databases and relational tables. SAS software's SQL processor enables you to do the following:

- create tables and views
- retrieve data stored in tables
- retrieve data stored in SQL and SAS/ACCESS views
- add or modify values in tables
- add or modify values in SQL and SAS/ACCESS views

## INTO Clause

SQL provides the INTO clause in the SELECT statement for creating SAS macro variables. You can create multiple macro variables with a single INTO clause. The INTO clause follows the same scoping rules as the %LET statement. For a summary of how macro variables are created, see Chapter 3, "Macro Variables," on page 21. For more information and examples relating to the INTO clause, see "INTO Clause" on page 287.

## Controlling Job Execution

PROC SQL also provides macro tools to do the following:

- stop execution of a job if an error occurs
- execute programs conditionally based on data values

The following table provides information about macro variables created by SQL that affect job execution.

***Table 8.2*** *Macro Variables That Affect Job Execution*

| Macro Variable | Description |
|---|---|
| SQLEXITCODE | Contains the highest return code that occurred from some types of SQL insert failures. This return code is written to the SYSERR macro variable when PROC SQL terminates. |
| SQLOBS | Contains the number of rows or observations produced by a SELECT statement. |
| SQLOOPS | Contains the number of iterations that the inner loop of PROC SQL processes. |
| SQLRC | Contains the return code from an SQL statement. For return codes, see SAS SQL documentation. |

| Macro Variable | Description |
|---|---|
| SQLXMSG | Contains descriptive information and the DBMS-specific return code for the error that is returned by the pass-through facility. |
| SQLXRC | contains the DBMS-specific return code that is returned by the pass-through facility. |

# Interfaces with the SAS Component Language

## *Using an SCL Program*

You can use the SAS macro facility to define macros and macro variables for an SCL program. Then, you can pass parameters between macros and the rest of the program. Also, through the use of the autocall and compiled stored macro facilities, macros can be used by more than one SCL program.

*Note:* Macro modules can be more complicated to maintain than a program segment because of the symbols and macro quoting that might be required. Also, implementing modules as macros does not reduce the size of the compiled SCL code. Program statements generated by a macro are added to the compiled code as if those lines existed at that location in the program.

The following table lists the SCL macro facility interfaces.

***Table 8.3*** *SCL Interfaces to the Macro Facility*

| Category | Tool | Description |
|---|---|---|
| Read or Write | SYMGET | Returns the value of a global macro variable during SCL execution. |
| | SYMGETN | Returns the value of a global macro variable as a numeric value. |
| | CALL SYMPUT | Assigns a value produced in SCL to a global macro variable. |
| | CALL SYMPUTN | Assigns a numeric value to a global macro variable. |

*Note:* It is inefficient to use SYMGETN to retrieve values that are not assigned with SYMPUTN. It is also inefficient to use **&** to reference a macro variable that was created with CALL SYMPUTN. Instead, use SYMGETN. In addition, it is inefficient to use SYMGETN and CALL SYMPUTN with values that are not numeric.

For more information about these elements, see "DATA Step Call Routines for Macros" on page 227 and "DATA Step Functions for Macros" on page 239.

### *How Macro References Are Resolved by SCL*

An important point to remember when using the macro facility with SCL is that macros and macro variable references in SCL programs are resolved when the SCL program compiles, not when you execute the application. To further control the assignment and resolution of macros and macro variables, use the following techniques:

- If you want macro variables to be assigned and retrieved when the SCL program executes, use CALL SYMPUT and CALL SYMPUTN in the SCL program.
- If you want a macro call or macro variable reference to resolve when an SCL program executes, use SYMGET and SYMGETN in the SCL program.

### *Referencing Macro Variables in Submit Blocks*

In SCL, macro variable references are resolved at compile time unless they are in a Submit block. When SCL encounters a name prefixed with an ampersand (&) in a Submit block, it checks whether the name following the ampersand is the name of an SCL variable. If so, SCL substitutes the value of the corresponding variable for the variable reference in the submit block. If the name following the ampersand does not match any SCL variable, the name passes intact (including the ampersand) with the submitted statements. When SAS processes the statements, it attempts to resolve the name as a macro variable reference

To guarantee that a name is passed as a macro variable reference in submitted statements, precede the name with two ampersands (for example, &&DSNAME). If you have both a macro variable and an SCL variable with the same name, a reference with a single ampersand substitutes the SCL variable. To force the macro variable to be substituted, reference it with two ampersands (&&).

### *Considerations for Sharing Macros between SCL Programs*

Sharing macros between SCL programs can be useful, but it can also raise some configuration management problems. If a macro is used by more than one program, you must keep track of all the programs that use it so that you can recompile all of them each time the macro is updated. Because SCL is compiled, each SCL program that calls a macro must be recompiled whenever that macro is updated.

***CAUTION:***

**Recompile the SCL program.** If you fail to recompile the SCL program when you update the macro, you run the risk of the compiled SCL being out of sync with the source.

### *Example Using Macros in an SCL Program*

This SCL program is for an example application with the fields BORROWED, INTEREST, and PAYMENT. The program uses the macros CKAMOUNT and CKRATE to validate values entered into fields by users. The program calculates the payment, using values entered for the interest rate (INTEREST) and the sum of money (BORROWED).

```
/* Display an error message if AMOUNT */
   /* is less than zero or larger than 1000. */
%macro ckamount(amount);
```

```
   if (&amount < 0) or (&amount > 1000) then
      do;
         erroron borrowed;
         _msg_='Amount must be between $0 and $1,000.';
         stop;
      end;
   else erroroff borrowed;
%mend ckamount;

   /* Display an error message if RATE */
   /* is less than 0 or greater than 1.5 */
%macro ckrate(rate);
   if (&rate < 0) or (&rate > 1) then
      do;
         erroron interest;
         _msg_='Rate must be between 0 and 1.5';
         stop;
      end;
   else erroroff interest;
%mend ckrate;

   /*  Open the window with BORROWED at 0 and INTEREST at .5.  */
INIT:
   control error;
   borrowed=0;
   interest=.5;
return;

MAIN:
      /*  Run the macro CKAMOUNT to validate  */
      /*  the value of BORROWED.              */
   %ckamount(borrowed)
      /*  Run the macro CKRATE to validate  */
      /* the value of INTEREST.             */
   %ckrate(interest)
      /*  Calculate payment.  */
   payment=borrowed*interest;
return;

TERM:
return;
```

# SAS/CONNECT Interfaces

## *Overview of SAS/CONNECT Interfaces*

Many times when working with macros and SAS/CONNECT, the results that you see are not what you expected. When using RSUBMIT within the macro facility, it is important to have an understanding of what happens at compile time versus what happens at execution time. Knowing the behavior of this interaction helps you when using macros and SAS/CONNECT together.

### Using %SYSRPUT with SAS/CONNECT

The %SYSRPUT macro statement is submitted with SAS/CONNECT to a remote host to retrieve the value of a macro variable stored on the remote host. %SYSRPUT assigns that value to a macro variable on the local host. %SYSRPUT is similar to the %LET macro statement because it assigns a value to a macro variable. However, %SYSRPUT assigns a value to a variable on the local host, not on the remote host where the statement is processed. The %SYSRPUT statement places the macro variable in the current scope of the local host.

*Note:* The names of the macro variables on the remote and local hosts must not contain a leading ampersand.

The %SYSRPUT statement is useful for capturing the value of the automatic macro variable SYSINFO and passing that value to the local host. SYSINFO contains return-code information provided by some SAS procedures. Both the UPLOAD and the DOWNLOAD procedures of SAS/CONNECT can update the macro variable SYSINFO and set it to a nonzero value when the procedure terminates due to errors. You can use %SYSRPUT on the remote host to send the value of the SYSINFO macro variable back to the local SAS session. Thus, you can submit a job to the remote host and test whether a PROC UPLOAD or DOWNLOAD step has successfully completed before beginning another step on either the remote host or the local host.

To use %SYSRPUT, you must have invoked a remote SAS windowing environment session by submitting the DMR option with the SAS command.

To create a new macro variable or to modify the value of an existing macro variable on a remote host or a server, use the %SYSLPUT macro statement.

### Example Using %SYSRPUT to Check the Value of a Return Code on a Remote Host

This example illustrates how to download a file and return information about the success of the step. When remote processing is completed, the job checks the value of the return code stored in RETCODE. Processing continues on the local host if the remote processing is successful. In this example, the %SYSRPUT statement follows a PROC DOWNLOAD step, so the value returned by SYSINFO indicates the success of the PROC DOWNLOAD step:

```
/* This code executes on the remote host. */
rsubmit;
   proc download data=remote.mydata out=local.mydata;
   run;
         /* RETCODE is on the local host. */
         /* SYSINFO is on the remote host. */
   %sysrput retcode=&sysinfo;
endrsubmit;

   /* This code executes on the local host. */
%macro checkit;
   %if &retcode = 0 %then
      %do;
         further processing on local host
      %end;
%mend checkit;
```

```
%checkit
```

To determine the success or failure of a step executed on a remote host, use the %SYSRPUT macro statement to check the value of the automatic macro variable SYSERR.

For more information and syntax of the %SYSRPUT statement, see "%SYSRPUT Statement" on page 328.

### Using %SYSLPUT with SAS/CONNECT

The %SYSLPUT statement is a macro statement that is submitted in the client session to assign a value that is available in the client session to a macro variable that can be accessed from the server session. If you are signed on to multiple server sessions, %SYSLPUT submits the macro assignment statement to the most recently used server session. If you are signed on to only one server session, %SYSLPUT submits the macro assignment statement to that server session. If you are not signed on to any session, an error condition results. Like the %LET statement, the %SYSLPUT statement assigns a value to a macro variable. Unlike %LET, the %SYSRPUT statement assigns a value to a variable in the server session rather than in the client session where the statement is executed. The %SYSRPUT statement stores the macro variable in the Global Symbol Table in the server session.

### Example Using %SYSLPUT

%SYSLPUT enables you to dynamically assign values to variables that are used by macros that are executed in a server session. The macro statement %SYSLPUT is used to create the macro variable REMID in the server session and to use the value of the client macro variable RUNID. The REMID variable is used by the %DOLIB macro, which is executed in a server session. This process finds out which operating system-specific library assignment should be used in the server session.

```
%macro assignlib (runid);

   signon rem &runid
   %syslput remid=&runid
   rsubmit rem &runid
      %macro dolib;
         %if (&runid eq 1) %then %do;
            libname mylib 'h:';
            %end;
         %else %if (&runid eq 2) %then %do;
            libname mylib '/afs/some/linux/path';
            %end;
      %mend;
      %dolib;
   endrsubmit;

%mend;
```

*Chapter 9*

# Storing and Reusing Macros

**Storing and Reusing Macros** . . . . . **111**

**Saving Macros in an Autocall Library** . . . . . **112**
Overview of an Autocall Library . . . . . 112
Using Directories as Autocall Libraries . . . . . 113
Using SAS Catalogs as Autocall Libraries . . . . . 113
Calling an Autocall Macro . . . . . 114

**Saving Macros Using the Stored Compiled Macro Facility** . . . . . **115**
Overview of the Stored Compiled Macro Facility . . . . . 115
Compiling and Storing a Macro Definition . . . . . 115
Storing Autocall Macros Supplied by SAS . . . . . 116
Calling a Stored Compiled Macro . . . . . 116

## Storing and Reusing Macros

When you submit a macro definition, by default, the macro processor compiles and stores the macro in a SAS catalog in the Work library. These macros, referred to as *session compiled macros*, exist only during the current SAS session. To save frequently used macros between sessions, you can use either the autocall macro facility or the stored compiled macro facility.

The autocall macro facility stores the source for SAS macros in a collection of external files called an *autocall library*. The autocall facility is useful when you want to create a pool of easily maintained macros in a location that can be accessed by different applications and users. Autocall libraries can be concatenated together. The primary disadvantage of the autocall facility is that the first time an autocall macro is called in a session, the macro processor compiles it. This compilation is overhead that you can avoid by using the stored compiled macro facility.

The stored compiled macro facility stores compiled macros in a SAS catalog in a SAS library that you specify. By using stored compiled macros, you might save macro compilation time in your production-level jobs. However, because these stored macros are compiled, you must save and maintain the source for the macro definitions in a different location.

The autocall facility and the stored compiled macro facility each offer advantages. Here are some of the factors that determine how you choose to save a macro definition:

- how often you use a macro

- how often you change it
- how many users need to execute it
- how many compiled macro statements it has

If you are developing new programs, consider creating macros and compiling them during your current session. If you are running production-level jobs using name-style macros, consider using stored compiled macros. If you are letting a group of users share macros, consider using the autocall facility.

*Note:* For greater efficiency, store only name-style macros if you use the stored compiled macro facility. Storing statement-style and command-style macros is less efficient.

It is good practice, when you are programming stored compiled macros or autocall macros, to use the %LOCAL statement. This statement defines macro variables that will be used only inside that macro. Otherwise, values of macro variables defined outside of the current macro might be altered. See the discussion of macro variable scopes in Chapter 5, "Scopes of Macro Variables," on page 47.

In general, macro and variable names in the SAS macro facility are case insensitive and are internally changed to uppercase. The values are case sensitive in the SAS macro facility and are not changed.

When calling an autocall macro or a stored compiled macro, the macro name is changed to uppercase and passed to the catalog routines to open a member of that name. The catalog routines are host dependent and use the default casing for the particular host when searching for a member. Macro catalog entries should be made using the default casing for the host in question. Here are the host defaults:

- Linux default is lowercase

*Note:* In Linux, the member name that contains the autocall macro must be all lowercase letters.

# Saving Macros in an Autocall Library

## *Overview of an Autocall Library*

Generally, an autocall library is a directory containing individual files, each of which contains one macro definition. In SAS 6.11 and later, an autocall library can also be a SAS catalog. (See the following section for more information about using SAS catalogs as autocall libraries.)

*Operating Environment Information*

*Autocall Libraries on Different Hosts* The term *directory* refers to an aggregate storage location that contains files (or members) managed by the host operating system. Different host operating systems identify an aggregate storage location with different names, such as a directory, a subdirectory, a maclib, a text library, or a partitioned data set. For more information, see the SAS Companion for your operating system.

### *Using Directories as Autocall Libraries*

To use a directory as a SAS autocall library, do the following:

1. To create library members, store the source code for each macro in a separate file in a directory. The name of the file must be the same as the macro name. For example, the statements defining a macro that you would call by submitting %SPLIT must be in a file named Split.

   *Operating Environment Information*
   *Autocall Library Member Names* On operating systems that allow filenames with extensions, you must name autocall macro library members with a special extension, usually **.SAS**. Look at the autocall macros on your system provided by SAS to determine whether names of files containing macros must have a special extension at your site.

2. Set the SASAUTOS system option to specify the directory as an autocall library. On most hosts, the reserved fileref SASAUTOS is assigned at invocation time to the autocall library supplied by SAS or another one designated by your site. If you are specifying one or more autocall libraries, remember to concatenate the autocall library supplied by SAS with your autocall libraries so that these macros will also be available. For more information, see your host documentation and "SASAUTOS= System Option" on page 357.

When storing files in an autocall library, remember the following:

- SAS does not restrict the type of material that you place in an autocall library. You should store only autocall library files in it to avoid confusion and for ease of maintenance.
- SAS lets you include more than one macro definition, as well as open code, in an autocall library member. You should generally keep only one macro in any autocall library member. If you need to keep several macros in the same autocall library member, keep related macros together.

### *Using SAS Catalogs as Autocall Libraries*

In SAS 6.11 and later, you can use the CATALOG access method to store autocall macros as SOURCE entries in SAS catalogs. To create an autocall library using a SAS catalog, follow these steps:

1. Use a LIBNAME statement to assign a libref to the SAS library.
2. Use a FILENAME statement with the CATALOG argument to assign a fileref to the catalog that contains the autocall macros. For example, the following code creates a fileref, MyMacros, that points to a catalog named MyMacs.MyAutos:

   ```
   libname mymacs 'SAS-library';
   filename mymacros catalog 'mymacs.myautos';
   ```

3. Store the source code for each macro in a SOURCE entry in a SAS catalog. (SOURCE is the entry type.) The name of the SOURCE entry must be the same as the macro name.
4. Set the SASAUTOS system option to specify the fileref as an autocall library. For more information, see "SASAUTOS= System Option" on page 357.

### Calling an Autocall Macro

To call an autocall macro, the system options MAUTOSOURCE must be set and SASAUTOS must be assigned. MAUTOSOURCE enables the autocall facility, and SASAUTOS specifies the autocall libraries. For more information, see "MAUTOSOURCE System Option" on page 336 and "SASAUTOS= System Option" on page 357.

Once you have set the required options, calling an autocall macro is like calling a macro that you have created in your current session. However, it is important that you understand how the macro processor locates the called macro. When you call a macro, the macro processor does the following tasks:

- searches for a session compiled macro definition
- searches for a stored compiled macro definition in the library specified by the SASMSTORE option, if the MSTORED option is set
- searches for a member in the autocall libraries specified by the SASAUTOS option in the order in which they are specified, if the MAUTOSOURCE option is set
- searches the SASHelp library for SAS production stored compiled macro definitions

When SAS finds a library member in an autocall library with that macro name, the macro processor does the following:

- compiles all of the source statements in that member, including any and all macro definitions, and stores the result in the session catalog
- executes any open code (macro statements or SAS source statements not within any macro definition) in that member
- executes the macro with the name that you invoked

*Note:* If an autocall library member contains more than one macro, the macro processor compiles all of the macros but executes only the macro with the name that you invoked.

Any open code statements in the same autocall library member as a macro execute only the first time you invoke the macro. When you invoke the macro later in the same session, the compiled macro is executed, which contains only the compiled macro definition and not the other code the autocall macro source file might have contained.

It is not advisable to change SASAUTOS during a SAS session. If you change the SASAUTOS= specification in an ongoing SAS session, SAS will store the new specification only until you invoke an uncompiled autocall macro. SAS then will close all opened libraries and open all the newly specified libraries that it can open.

For information about debugging autocall macros, see Chapter 10, "Macro Facility Error Messages and Debugging," on page 117.

# Saving Macros Using the Stored Compiled Macro Facility

## *Overview of the Stored Compiled Macro Facility*

The stored compiled macro facility compiles and saves compiled macros in a permanent catalog in a library that you specify. This compilation occurs only once. If the stored compiled macro is called in the current or later sessions, the macro processor executes the compiled code.

In SAS 9.1.3 or higher, the stored compiled macro catalog is initially opened for Read-Only access. When a stored compiled macro is being compiled or updated, the catalog is immediately closed and reopened for Update access. After the macro is compiled and the catalog has been updated or changed, the catalog is again immediately closed and reopened for Read-Only access.

## *Compiling and Storing a Macro Definition*

To compile a macro definition in a permanent catalog, you must first create the source for each stored compiled macro. To store the compiled macro, use the following steps:

1. Use the STORE option in the %MACRO statement. You can use the SOURCE option to store the source code with the compiled code. In addition, you can assign a descriptive title for the macro entry in the SAS catalog, by specifying the DES= option. For example, the %MACRO statement in the following definition shows the STORE, SOURCE, and DES= options:

   ```
   %macro myfiles / store source
        des='Define filenames';
     filename file1 'external-file-1';
     filename file2 'external-file-2';
   %mend;
   ```

   ***CAUTION:***

   **Save your macro source code.** You cannot re-create the source statements from a compiled macro. Therefore, you must save the original macro source statements if you want to change the macro. For all stored compiled macros, you should document your macro source code well. You can save the source code with the compiled code using the SOURCE option in the %MACRO statement or you can save the source in a separate file. If you save the source in a separate file, it is recommended that you save the source code in the same catalog as the compiled macro. In this example, save it to the following library: **`mylib.sasmacro.myfiles.source`**

   *Note:* To retrieve the source of a compiled stored macro, see "%COPY Statement" on page 296.

2. Set the MSTORED system option to enable the stored compiled macro facility. For more information, see "MSTORED System Option" on page 355.

3. Assign the SASMSTORE option to specify the SAS library that contains or will contain the catalog of stored compiled SAS macros. For example, to store or call

compiled macros in a SAS catalog named MyLib.SASMACR, submit these statements:

```
libname mylib 'SAS-library';
options mstored sasmstore=mylib;
```

For more information, see "SASMSTORE= System Option" on page 358.

4. Submit the source for each macro that you want to compile and permanently store.

You cannot move a stored compiled macro to another operating system or to a different release of SAS. However, you can move the macro source code to another operating system or to a different SAS release where you can then compile and store it. For more information, see your host companion.

### Storing Autocall Macros Supplied by SAS

If you use the macros in the autocall library supplied by SAS, you can save macro compile time by compiling and storing those macros in addition to ones that you create yourself. Many of the macros related to Base SAS software that are in the autocall library supplied by SAS can be compiled and stored in a SAS catalog named SASMACR. This action can be done by using the autocall macro COMPSTOR that is supplied by SAS. For more information, see "%COMPSTOR Autocall Macro" on page 177.

### Calling a Stored Compiled Macro

Once you have set the required system options, calling a stored compiled macro is just like calling session compiled macros. However, it is important that you understand how the macro processor locates a macro. When you call a macro, the macro processor searches for the macro name using this sequence:

1. the macros compiled during the current session
2. the stored compiled macros in the SASMACR catalog in the specified library (if options MSTORED and SASMSTORE= are in effect)
3. each autocall library specified in the SASAUTOS option (if options SASAUTOS= and MAUTOSOURCE are in effect)
4. the stored compiled macros in the SASMACR catalog in the SASHelp library

You can display the entries in a catalog containing compiled macros. For more information, see Chapter 10, "Macro Facility Error Messages and Debugging," on page 117.

*Chapter 10*

# Macro Facility Error Messages and Debugging

**General Macro Debugging Information** . . . . . **118**
Developing Macros in a Layered Approach . . . . . 118
Encountering Errors . . . . . 118
Developing Bug-free Macros . . . . . 119

**Troubleshooting Your Macros** . . . . . **119**
Solving Common Macro Problems . . . . . 119
Solving Macro Variable Resolution Problems . . . . . 121
Solving Problems with Macro Variable Scope . . . . . 122
Solving Open Code Statement Recursion Problems . . . . . 123
Solving Problems with Macro Functions . . . . . 124
Solving Unresolved Macro Problems . . . . . 124
Solving the “Black Hole” Macro Problem . . . . . 124
Resolving Timing Issues . . . . . 126
Example of a Macro Statement Executing Immediately . . . . . 126
Resolving Macro Resolution Problems Occurring during DATA Step Compilation . . . . . 127
Solving Problems with the Autocall Facility . . . . . 128
Fixing Autocall Library Specifications . . . . . 129
Fixing Autocall Macro Definition Errors . . . . . 129
File and Macro Names for Autocall . . . . . 130
Displaying Information about Stored Compiled Macros . . . . . 130
Solving Problems with Expression Evaluation . . . . . 131

**Debugging Techniques** . . . . . **132**
Using System Options to Track Problems . . . . . 132
Tracing the Flow of Execution with MLOGIC . . . . . 132
Nesting Information Generated by MLOGICNEST . . . . . 133
Examining the Generated SAS Statements with MPRINT . . . . . 133
Nesting Information Generated by MPRINTNEST . . . . . 134
Storing MPRINT Output in an External File . . . . . 134
Examining Macro Variable Resolution with SYMBOLGEN . . . . . 135
Using the %PUT Statement to Track Problems . . . . . 136

# General Macro Debugging Information

## Developing Macros in a Layered Approach

Because the macro facility is such a powerful tool, it is also complex, and debugging large macro applications can be extremely time-consuming and frustrating. Therefore, it makes sense to develop your macro application in a way that minimizes the errors. This makes the errors that do occur as easy as possible to find and fix. The first step is to understand what type of errors can occur and when they manifest themselves. Then, develop your macros using a modular, layered approach. Finally, use some built-in tools such as system options, automatic macro variables, and the %PUT statement to diagnose errors.

*Note:* To receive certain important warning messages about unresolved macro names and macro variables, be sure the "SERROR System Option" on page 359 and "MERROR System Option" on page 342 are in effect. For more information, see "System Options for Macros" on page 331.

## Encountering Errors

When the word scanner processes a program and finds a token in the form of `&` or `%`, it triggers the macro processor to examine the name token that follows the `&` or `%`. Depending on the token, the macro processor initiates one of the following activities:

- macro variable resolution
- macro open code processing
- macro compilation
- macro execution

An error can occur during any one of these stages. For example, if you misspell a macro function name or omit a necessary semicolon, that is a *syntax error* during compilation. Syntax errors occur when program statements do not conform to the rules of the macro language. Or, you might refer to a variable out of scope, causing a *macro variable resolution error*. *Execution errors* (also called *semantic errors*) are usually errors in program logic. They can occur, for example, when the text generated by the macro has faulty logic (statements not executed in the right order or in the way you expect).

Of course, even if your macro code is perfect, that does not guarantee that you will not encounter errors caused by plain SAS code. For example, you might encounter the following:

- a libref that is not defined
- a syntax error in open code (that is, outside of a macro definition)
- a typographical error in the code that your macro generates

Typically, error messages with numbers are plain SAS code error messages. Error messages generated by the macro processor do not have numbers.

### *Developing Bug-free Macros*

When programming in any language, it is good technique to develop your code in modules. That is, instead of writing one massive program, develop it piece by piece, test each piece separately, and put the pieces together. This technique is especially useful when developing macro applications because of the two-part nature of SAS macros: macro code and the SAS code generated by the macro code.

Another good idea is to proofread your macro code for common mistakes before you submit it.

The following list outlines some key items to check for:

- The names in the %MACRO and %MEND statements match, and there is a %MEND for each %MACRO.
- The number of %DO statements matches the number of %END statements.
- %TO values for iterative %DO statements exist and are appropriate.
- All statements end with semicolons.
- Comments begin and end correctly and do not contain unmatched single quotation marks.
- Macro variable references begin with `&`and macro statements begin with `%`.
- Macro variables created by CALL SYMPUT are not referenced in the same DATA step in which they are created.
- Statements that execute immediately (such as %LET) are not part of conditional DATA step logic.
- Single quotation marks are not used around macro variable references (such as in TITLE or FILENAME statements). When used in quoted strings, macro variable references resolve only in strings marked with double quotation marks.
- Macro variable values do not contain any keywords or characters that could be interpreted as mathematical operators. (If they do contain such characters, use the appropriate macro quoting function.)
- Macro variables, %GOTO labels, and macro names do not conflict with reserved SAS and host environment keywords.

## Troubleshooting Your Macros

### *Solving Common Macro Problems*

The following table lists some problems that you might encounter when working with the macro facility. Because many of these problems do not cause error messages to be written to the log, solving them can be difficult. For each problem, the table gives some possible causes and solutions.

***Table 10.1*** *Commonly Encountered Macro Problems*

| Problem | Cause | Explanation |
|---|---|---|
| SAS Studio session stops responding after you submit a macro definition. You enter and submit code but nothing happens. | • Syntax error in %MEND statement<br>• Missing semicolon, parenthesis, or quotation mark<br>• Missing %MEND statement<br>• Unclosed comment | The %MEND statement is not recognized and all text is becoming part of the macro definition. |
| SAS Studio session stops responding after you call a macro. | An error in invocation, such as forgetting to provide one or more parameters, or forgetting to use parentheses when invoking a macro that is defined with parameters. | The macro facility is waiting for you to finish the invocation. |
| The macro does not compile when you submit it. | A syntax error exists somewhere in the macro definition. | Only syntactically correct macros are compiled. |
| The macro does not execute when you call it or partially executes and stops. | • A bad value was passed to the macro (for example, as a parameter).<br>• A syntax error exists somewhere in the macro definition. | A macro successfully executes only when it receives the correct number of parameters that are of the correct type. |
| The macro executes but the SAS code gives bad results or no results. | Incorrect logic in the macro or SAS code. | |
| Code runs fine if submitted as open code, but when generated by a macro, the code does not work and issues strange error messages. | • Tokenization is not as you intended.<br>• A syntax error exists somewhere in the macro definition. | Rarely, macro quoting functions alter the tokenization of text enclosed in them. Use the "%UNQUOTE Function" on page 282. |
| A %MACRO statement generates "invalid statement" error. | • The MACRO system option is turned off.<br>• A syntax error exists somewhere in the macro definition. | For the macro facility to work, the MACRO system option must be on. Edit your SAS configuration file accordingly. |

The following table lists some common macro error and warning messages. For each message, some probable causes are listed, and pointers to more information are provided.

***Table 10.2*** *Common Macro Error Messages and Causes*

| Error Message | Possible Causes | For More Information |
|---|---|---|
| **`Apparent invocation of macro xxx not resolved.`** | • You have misspelled the macro name.<br>• MAUTOSOURCE system option is turned off.<br>• MAUTOSOURCE is on, but you have specified an incorrect pathname in the SASAUTOS= system option.<br>• You are using the autocall facility but have given the macro and file different names.<br>• You are using the autocall facility but did not give the file the **`.sas`** extension.<br>• There is a syntax error within the macro definition. | • Check the spelling of the macro name.<br>• "Solving Problems with the Autocall Facility" on page 128.<br>• "Developing Bug-free Macros" on page 119. |
| **`Apparent symbolic reference xxx not resolved.`** | • You are trying to resolve a macro variable in the same DATA step as the CALL SYMPUT that created it.<br>• You have misspelled the macro variable name.<br>• You are referencing a macro variable that is not in scope.<br>• You have omitted the period delimiter when adding text to the end of the macro variable. | • "Resolving Timing Issues" on page 126.<br>• Check the spelling of the macro variable.<br>• "Solving Problems with Macro Variable Scope" on page 122.<br>• "Solving Macro Variable Resolution Problems" on page 121.<br>• "Generating a Suffix for a Macro Variable Reference" on page 11 |

For a list of macro facility error messages and warnings, see "SAS Macro Error Messages" on page 367 and "SAS Macro Warning Messages" on page 399.

## *Solving Macro Variable Resolution Problems*

When the macro processor examines a name token that follows an **`&`**, it searches the macro symbol tables for a matching macro variable entry. If it finds a matching entry, it pulls the associated text from the symbol table and replaces ***`&name`*** on the input stack. A macro variable name is passed to the macro processor, but the processor does not find a matching entry in the symbol tables. So, it leaves the token on the input stack and generates this message:

```
WARNING: Apparent symbolic reference
NAME not resolved.
```

The unresolved token is transferred to the input stack for use by other parts of SAS.

*Note:* You receive the WARNING only if the SERROR system option is on.

To solve these problems, check that you have spelled the macro variable name right and that you are referencing it in an appropriate scope.

When a macro variable resolves but does not resolve to the correct value, you can check several things. First, if the variable is a result of a calculation, ensure that the correct values were passed into the calculation. And, ensure that you have not inadvertently changed the value of a global variable. (For more information about variable scope problems, see "Solving Problems with Macro Variable Scope" on page 122.)

Another common problem is adding text to the end of a macro variable but forgetting to add a delimiter that shows where the macro variable name ends and the added text begins. For example, suppose you want to write a TITLE statement with a reference to WEEK1, WEEK2, and so on. You set a macro variable equal to the first part of the string and supply the week's number in the TITLE statement:

```
%let wk=week;

title "This is data for &wk1";   /* INCORRECT */
```

When these statements compile, the macro processor looks for a macro variable named WK1, not WK. To fix the problem, add a period (the macro delimiter) between the end of the macro variable name and the added text, as in the following statements:

```
%let wk=week;

title "This is data for &wk.1";
```

***CAUTION:***

**Do not use AF, DMS, or SYS as prefixes with macro variable names.** The letters AF, DMS, and SYS are frequently used by SAS as prefixes for macro variables created by SAS. SAS does not prevent you from using AF, DMS, or SYS as a prefix for macro variable names. However, using these strings as prefixes might create a conflict between the names that you specify and the name of a SAS created macro variable (including automatic macro variables in later SAS releases). If a name conflict occurs, SAS might not issue a warning or error message, depending on the details of the conflict. Therefore, the best practice is to avoid using the strings AF, DMS, or SYS as the beginning characters of macro names and macro variable names.

## Solving Problems with Macro Variable Scope

A common mistake that occurs with macro variables concerns referencing local macro variables outside of their scopes. As described in Chapter 5, "Scopes of Macro Variables," on page 47 macro variables are either global or local. Referencing a variable outside of its scope prevents the macro processor from resolving the variable reference. For example, consider the following program:

```
%macro totinv(var);
   data inv;
      retain total 0;
      set .Houses end=final;
      total=total+&var;
      if final then call symput("macvar",put(total,dollar14.2));
   run;
```

```
   %put **** TOTAL=&macvar ****;
%mend totinv;

%totinv(price)
%put **** TOTAL=&macvar ****;   /* ERROR */
```

When you submit these statements, the %PUT statement in the macro TOTINV writes the value of TOTAL to the log. The %PUT statement that follows the macro call generates a warning message and writes the text **`TOTAL=&macvar`** to the log, as follows:

```
TOTAL= $1,240,800.00
WARNING: Apparent symbolic reference MACVAR not resolved.
**** TOTAL=&macvar ****
```

The second %PUT statement fails because the macro variable MACVAR is local to the TOTINV macro. To correct the error, you must use a %GLOBAL statement to declare the macro variable MACVAR.

Another common mistake that occurs with macro variables concerns overlapping macro variable names. If, within a macro definition, you refer to a macro variable with the same name as a global macro variable, you affect the global variable, which might not be what you intended. Either give your macro variables distinct names or use a %LOCAL statement to specifically define the variables in a local scope. For an example of this technique, see "Forcing a Macro Variable to Be Local" on page 59.

## *Solving Open Code Statement Recursion Problems*

*Recursion* is something calling itself. *Open code recursion* is when your open code erroneously causes a macro statement to call another macro statement. This call is referred to as a recursive reference. The most common error that causes open code recursion is a missing semicolon. In the following example, the %LET statement is not terminated by a semicolon:

```
%let a=b   /* ERROR */
%put **** &a ****;
```

When the macro processor encounters the %PUT statement within the %LET statement, it generates this error message:

```
ERROR: Open code statement recursion detected.
```

Open code recursion errors usually occur because the macro processor is not reading your macro statements as you intended. Careful proofreading can usually solve open code recursion errors, because this type of error is mostly the result of typographical errors in your code, not errors in execution logic.

To recover from an open code recursion error, first try submitting a single semicolon. If that does not work, try submitting the following string:

```
*'; *"; *); */; %mend; run;
```

Continue submitting this string until the following message appears in the log:

```
ERROR: No matching %MACRO statement for this %MEND statement.
```

If the above method does not work, close your SAS session and restart SAS. Of course, closing and restarting SAS causes you to lose any unsaved data. Be sure to save often while you are developing your macros, and proofread them carefully before you submit them.

### Solving Problems with Macro Functions

Some common causes of problems with macro functions include the following:

- misspelling the function name
- omitting the opening or closing parenthesis
- omitting an argument or specifying an extra argument

If you encounter an error related to a macro function, you might also see other error messages. The messages are generated by the invalid tokens left on the input stack by the macro processor.

Consider the following example. The user wants to use the %SUBSTR function to assign a portion of the value of the macro variable LINCOLN to the macro variable SECONDWD. But a typographical error exists in the second %LET statement, where %SUBSTR is misspelled as %SUBSRT:

```
%macro test;
%let lincoln=Four score and seven;
%let secondwd=%subsrt(&lincoln,6,5);   /* ERROR */
%put *** &secondwd ***;
%mend test;

%test
```

When the erroneous program is submitted, the following appears in the log:

```
WARNING: Apparent invocation of macro SUBSRT not resolved.
```

The error messages clearly point to the function name, which is misspelled.

### Solving Unresolved Macro Problems

When a macro name is passed to the macro processor but the processor does not find a matching macro definition, it generates the following message:

```
WARNING: Apparent invocation of macro
NAME not resolved.
```

This error could be caused by the following:

- the misspelling of the name of a macro or a macro function
- an error in a macro definition that caused the macro to be compiled as a dummy macro

A *dummy macro* is a macro that the macro processor partially compiles but does not store.

*Note:* You receive this warning only if the MERROR system option is on.

### Solving the “Black Hole” Macro Problem

When the macro processor begins compiling a macro definition, it reads and compiles tokens until it finds a matching %MEND statement. If you omit a %MEND statement or cause it to be unrecognized by omitting a semicolon in the preceding statement, the

macro processor does not stop compiling tokens. Every line of code that you submit becomes part of the macro.

Resubmitting the macro definition and adding the %MEND statement does not correct the error. When you submit the corrected definition, the macro processor treats it as a nested definition in the original macro definition. The macro processor must find a matching %MEND statement to stop compilation.

*Note:* It is a good practice to use the %MEND statement with the macro name, so you can easily match %MACRO and %MEND statements.

If you recognize that SAS is not processing submitted statements and you are not sure how to recover, submit %MEND statements one at a time until the following message appears in the log:

```
ERROR: No matching %MACRO statement for this %MEND statement.
```

Then recall the original erroneous macro definition, correct the error in the %MEND statement, and submit the definition for compilation.

There are other syntax errors that can create similar problems, such as unmatched quotation marks and unclosed parentheses. Often, one of these syntax errors leads to others. Consider the following example:

```
%macro rooms;
   /* other macro statements& */
   %put **** %str(John's office) ****;   /* ERROR */
%mend rooms;

%rooms
```

When you submit these statements, the macro processor begins to compile the macro definition ROOMS. However, the single quotation mark in the %PUT statement is not marked by a percent sign. Therefore, during compilation the macro processor interprets the single quotation mark as the beginning of a literal token. It does not recognize the closing parenthesis, the semicolon at the end of the statement, or the %MEND statement at the end of the macro definition.

To recover from this error, you must submit the following:

```
');
%mend;
```

If the above methods do not work, try submitting the following string:

```
*'; *"; *); */; %mend; run;
```

Continue submitting this string until the following message appears in the log:

```
ERROR: No matching %MACRO statement for this %MEND statement.
```

Obviously, it is easier to catch these errors before they occur. You can avoid subtle syntax errors by carefully checking your macros before submitting them for compilation. For a syntax checklist, see "Developing Bug-free Macros" on page 119.

*Note:* Another cause of unexplained and unexpected macro behavior is using a reserved word as the name of a macro variable or macro. For example, because SAS reserves names starting with SYS, you should not create macros and macro variables with names beginning with SYS. Most host environments have reserved words too. For example, on PC-based platforms, the word CON is reserved for console input. For

reserved SAS keywords, see Appendix 1, " Reserved Words in the Macro Facility," on page 365. Check your SAS companion for host environment reserved words.

## Resolving Timing Issues

Many macro errors occur because a macro variable resolves at a different time than when the user intended or a macro statement executes at an unexpected time. A prime example of the importance of timing is when you use CALL SYMPUT to write a DATA step variable to a macro variable. You cannot use this macro variable in the same DATA step where it is defined; only in subsequent steps (after the DATA step's RUN statement).

The key to preventing timing errors is to understand how the macro processor works. In simplest terms, the two major steps are compilation and execution. The compilation step resolves all macro code to compiled code. Then the code is executed. Most timing errors occur because of the following:

- the user expects something to happen during compilation that does not actually occur until execution
- expects something to happen later but is actually executed right away

Here are two examples to help you understand why the timing of compilation and execution can be important.

## Example of a Macro Statement Executing Immediately

In the following program, the user intends to use the %LET statement and the SR_CIT variable to indicate whether a data set contains any data for senior citizens:

```
data senior;
   set census;
   if age > 65 then
   do;
      %let sr_cit = yes;  /* ERROR */
      output;
   end;
run;
```

However, the results differ from the user's expectations. The %LET statement is executed immediately and the DATA step is being compiled--before the data set is read. Therefore, the %LET statement executes regardless of the results of the IF condition. Even if the data set contains no observations where AGE is greater than 65, SR_CIT is always **yes**.

The solution is to set the macro variable's value by a means that is controlled by the IF logic and does not execute unless the IF statement is true. In this case, the user should use CALL SYMPUT, as in the following correct program:

```
%let sr_cit = no;
data senior;
   set census;
   if age > 65 then
   do;
      call symput ("sr_cit","yes");
    output;
   end;
run;
```

When this program is submitted, the value of SR_CIT is set to **yes**only if an observation is found with AGE greater than 65. Note that the variable was initialized to **no**. It is generally a good idea to initialize your macro variables.

### *Resolving Macro Resolution Problems Occurring during DATA Step Compilation*

In the previous example, you learned you had to use CALL SYMPUT to conditionally assign a macro variable a value in a DATA step. So, you submit the following program:

```
%let sr_age = 0;
data senior;
   set census;
   if age > 65 then
   do;
      call symput("sr_age",age);
      put "This data set contains data about a person";
      put "who is &sr_age years old."; /* ERROR */
   end;
run;
```

If AGE was 67, you would expect to see a log message like the following:

```
This data set contains data about a person
who is 67 years old.
```

However, no matter what AGE is, the following message is sent to the log:

```
This data set contains data about a person
who is 0 years old.
```

When the DATA step is being compiled, &SR_AGE is sent to the macro facility for resolution, and the result is passed back before the DATA step executes. To achieve the desired result, submit this corrected program instead:

```
%let sr_age = 0;
data senior;
   set census;
   if age > 65 then
   do;
      call symput("sr_age",age);
      stop;
   end;
run;

data _null_;
   put "This data set contains data about a person";
   put "who is &sr_age years old.";
run;
```

*Note:* Use double quotation marks in statements like PUT, because macro variables do not resolve when enclosed in single quotation marks.

Here is another example of erroneously referring to a macro variable in the same step that creates it:

```
data _null_;
   retain total 0;
   set mydata end=final;
   total=total+price;
```

```
   call symput("macvar",put(total,dollar14.2));
   if final then put "*** total=&macvar ***"; /* ERROR */
run;
```

When these statements are submitted, the following lines are written to the log:

```
WARNING: Apparent symbolic reference MACVAR not resolved.

*** total=&macvar ***
```

As this DATA step is tokenized and compiled, the **&**causes the word scanner to trigger the macro processor, which looks for a MACVAR entry in a symbol table. Because such an entry does not exist, the macro processor generates the warning message. Because the tokens remain on the input stack, they are transferred to the DATA step compiler. During DATA step execution, the CALL SYMPUT statement creates the macro variable MACVAR and assigns a value to it. However, the text **&macvar**in the PUT statement occurs because the text has already been processed while the macro was being compiled. If you were to resubmit these statements, the macro would appear to work correctly, but the value of MACVAR would reflect the value set during the previous execution of the DATA step. This value can be misleading.

Remember that in general, the **%** and **&**trigger immediate execution or resolution during the compilation stage of the rest of your SAS code.

For more examples and explanation of how CALL SYMPUT creates macro variables, see "Special Cases of Scope with the CALL SYMPUT Routine" on page 63.

## Solving Problems with the Autocall Facility

The autocall facility is an efficient way of storing and using production (debugged) macros. When a call to an autocall macro produces an error, the cause is one of two things:

- an erroneous autocall library specification
- an invalid autocall macro definition

If the error is the autocall library specification and the MERROR option is set, SAS can generate any or all of the following warnings:

```
WARNING: No logical assign for filename
FILENAME.
WARNING: Source level autocall is not found or cannot be opened.
         Autocall has been suspended and OPTION NOMAUTOSOURCE has
         been set. To use the autocall facility again, set OPTION
         MAUTOSOURCE.
WARNING: Apparent invocation of macro
MACRO-NAME not resolved.
```

If the error is in the autocall macro definition, SAS generates a message like the following:

```
NOTE: Line generated by the invoked macro
"MACRO-NAME".
```

### *Fixing Autocall Library Specifications*

When an autocall library specification causes an error, it is because the macro processor cannot find the member containing the autocall macro definition in the library or libraries specified in the SASAUTOS system option.

To correct this error, follow these steps.

1. If the unresolved macro call created an invalid SAS statement, submit a single semicolon to terminate the invalid statement. SAS is then able to correctly recognize subsequent statements.
2. Look at the value of the SASAUTOS system option by printing the output of the OPTIONS procedure. (Or, edit your SAS configuration file or SAS autoexec file.) Verify each fileref or directory name. If you find an error, submit a new OPTIONS statement..
3. Check the MAUTOSOURCE system option. If SAS could not open at least one library, it sets the NOMAUTOSOURCE option. If NOMAUTOSOURCE is present, reset MAUTOSOURCE with a new OPTIONS statement.
4. If the library specifications are correct, check the contents of each directory to verify that the autocall library member exists and that it contains a macro definition of the same name. If the member is missing, add it.
5. Set the MRECALL option with a new OPTIONS statement. By default, the macro processor searches only once for an undefined macro. Setting this option causes the macro processor to search the autocall libraries for the specification again.
6. Call the autocall macro, which includes and submits the autocall macro source.
7. Reset the NOMRECALL option.

*Note:* Some host environments have environment variables or system-level logical names assigned to the SASAUTOS library. Check your SAS companion documentation for more information about how the SASAUTOS library specification is handled in your host environment.

### *Fixing Autocall Macro Definition Errors*

When the autocall facility locates an autocall library member, the macro processor compiles any macros in that library member. It stores the compiled macros in the catalog containing stored compiled macros. For the rest of your SAS session, invoking one of those macros retrieves the compiled macro from the Work library. Under no circumstances does the autocall facility use an autocall library member when a compiled macro with the same name already exists. Thus, if you invoke an autocall macro and discover you made an error when you defined it, you must correct the autocall library member for future use. Compile the corrected version directly in your program or session.

To correct an autocall macro definition, do the following:

1. Use the INCLUDE command to bring the autocall library member into the code editor. If the macro is stored in a catalog SOURCE entry, use the COPY command to bring the program into the code editor.
2. Correct the error.

3. Store a copy of the corrected macro in the autocall library with the FILE command for a macro in an external file or with a SAVE command for a macro in a catalog entry.
4. Submit the macro definition from the code editor.

The macro processor then compiles the corrected version, replacing the incorrect compiled macro. The corrected, compiled macro is now ready to execute at the next invocation.

To correct an autocall macro definition in an interactive line mode session, do the following:

1. Edit the autocall macro source with a text editor.
2. Correct the error.
3. Use a %INCLUDE statement to bring the corrected library member into your SAS session.

The macro processor then compiles the corrected version, replacing the incorrect compiled macro. The corrected, compiled macro is now ready to execute at the next invocation.

### File and Macro Names for Autocall

When you want to use a macro as an autocall macro, you must store the macro in a file with the same name as the macro. Also, the file extension must be **.sas** (if your operating system uses file extensions). If you experience problems with the autocall facility, be sure the macro and filenames match and the file has the right extension when necessary.

### Displaying Information about Stored Compiled Macros

To display the list of entries in a catalog containing compiled macros, you can use the CATALOG procedure. The following PROC step displays the contents of a macro catalog in a SAS library identified with the libref MYSASLIB:

```
libname mysaslib
'SAS-library';
   proc catalog catalog=mysaslib.sasmacr;
      contents;
   run;
   quit;
```

You can also use PROC CATALOG to display information about autocall library macros stored in SOURCE entries in a catalog. You cannot use PROC CATALOG or the Navigation pane to copy, delete, or rename stored compiled macros.

You can use the MCOMPILENOTE system option to issue a note to the log upon the completion of the compilation of any macro. For more information, see "MCOMPILENOTE System Option" on page 337.

In SAS 6.11 and later, you can use PROC SQL to retrieve information about all compiled macros. For example, submitting these statements produces output similar to the following output:

```
proc sql;
   select * from dictionary.catalogs
```

```
where memname in ('SASMACR');
```

***Output 10.1*** *Output from PROC SQL Program for Viewing Compiled Macros*

```
Library   Member    Member    Object    Object                          Date      Object
Name      Name      Type      Name      Type      Object Description    Modified  Alias
-------------------------------------------------------------------------------------------
WORK      SASMACR   CATALOG   FINDAUTO  MACRO                           05/28/96

SASDATA   SASMACR   CATALOG   CLAUSE    MACRO     Count words in clause 05/24/96

SASDATA   SASMACR   CATALOG   CMPRES    MACRO     CMPRES autocall macro 05/24/96

SASDATA   SASMACR   CATALOG   DATATYP   MACRO     DATATYP autocall macro 05/24/96

SASDATA   SASMACR   CATALOG   LEFT      MACRO     LEFT autocall macro   05/24/96
```

To display information about compiled macros when you invoke them, use the SAS system options MLOGIC, MPRINT, and SYMBOLGEN. When you specify the SAS system option MLOGIC, the libref and date of compilation of a stored compiled macro are written to the log along with the usual information displayed during macro execution.

## Solving Problems with Expression Evaluation

The following macro statements use the %EVAL function:

***Table 10.3*** *Macro Statements That Use the %EVAL Function*

| | | |
|---|---|---|
| %DO | %IF-%THEN | %SCAN |
| %DO %UNTIL | %QSCAN | %SYSEVALF |
| %DO %WHILE | %QSUBSTR | %SUBSTR |

In addition, you can use the %EVAL function to specify an expression evaluation.

The most common errors that occur while evaluating expressions are the presence of character operands where numeric operands are required or ambiguity about whether a token is a numeric operator or a character value. Chapter 6, “Macro Expressions,” on page 71 discusses these and other macro expression errors.

Quite often, an error occurs when a special character or a keyword appears in a character string. Consider the following program:

```
%macro conjunct(word= );
   %if &word = and or &word = but or &word = or %then   /* ERROR */
      %do %put *** &word is a conjunction. ***;

   %else
      %do %put *** &word is not a conjunction. ***;
%mend conjunct;
```

In the %IF statement, the values of WORD being tested are ambiguous — they could also be interpreted as the numeric operators AND and OR. Therefore, SAS generates the following error messages in the log:

```
ERROR: A character operand was found in the %EVAL function or %IF
       condition where a numeric operand is required. The condition
       was:word = and or      &word = but or       &word = or
ERROR: The macro will stop executing.
```

To fix this problem, use the quoting functions %BQUOTE and %STR, as in the following corrected program:

```
%macro conjunct(word= );
   %if %bquote(&word) = %str(and) or %bquote(&word) = but or
          %bquote(&word) = %str(or) %then
      %do %put *** &word is a conjunction. ***;

   %else
      %do %put *** &word is not a conjunction. ***;
%mend conjunct;
```

In the corrected program, the %BQUOTE function quotes the result of the macro variable resolution (in case the user passes in a word containing an unmatched quotation mark or some other odd value). The %STR function quotes the comparison values AND and OR at compile time, so they are not ambiguous. You do not need to use %STR on the value BUT, because it is not ambiguous (not part of the SAS or macro languages). For more information, see Chapter 7, “Macro Quoting,” on page 79.

# Debugging Techniques

## Using System Options to Track Problems

The SAS system options MLOGIC, MLOGICNEST, MPRINT, MPRINTNEST, and SYMBOLGEN can help you track the macro code and SAS code generated by your macro. Messages generated by these options appear in the log, prefixed by the name of the option responsible for the message.

*Note:* Whenever you use the macro facility, use the following macro options: MACRO, MERROR, and SERROR. SOURCE is a system option that is helpful when using the macro facility. It is also helpful to use the SOURCE2 system option when using the %INCLUDE.

Although the following sections discuss each system option separately, you can, of course, combine them. However, each option can produce a significant amount of output, and too much information can be as confusing as too little. So, use only those options that you think you might need and turn them off when you complete the debugging.

## Tracing the Flow of Execution with MLOGIC

The MLOGIC system option traces the flow of execution of your macro, including the resolution of parameters, the scope of variables (global or local), the conditions of macro expressions being evaluated, the number of loop iterations, and the beginning and end of each macro execution. Use the MLOGIC option when you think a bug lies in the program logic (as opposed to simple syntax errors).

*Note:* MLOGIC can produce a lot of output, so use it only when necessary, and turn it off when debugging is finished.

In the following example, the macro FIRST calls the macro SECOND to evaluate an expression:

```
%macro second(param);
   %let a = %eval(&param); &a
%mend second;

%macro first(exp);
   %if (%second(&exp) ge 0) %then
      %put **** result >= 0 ****;
   %else
      %put **** result < 0 ****;
%mend first;

options mlogic;
%first(1+2)
```

Submitting this example with option MLOGIC shows when each macro starts execution, the values of passed parameters, and the result of the expression evaluation.

```
MLOGIC(FIRST):  Beginning execution.
MLOGIC(FIRST):  Parameter EXP has value 1+2
MLOGIC(SECOND):  Beginning execution.
MLOGIC(SECOND):  Parameter PARAM has value 1+2
MLOGIC(SECOND):  %LET (variable name is A)
MLOGIC(SECOND):  Ending execution.
MLOGIC(FIRST):  %IF condition (%second(&exp) ge 0) is TRUE
MLOGIC(FIRST):  %PUT **** result >= 0 ****
MLOGIC(FIRST):  Ending execution.
```

### Nesting Information Generated by MLOGICNEST

MLOGICNEST allows the macro nesting information to be written to the log in the MLOGIC output. The setting of MLOGICNEST does not imply the setting of MLOGIC. You must set both MLOGIC and MLOGICNEST in order for output (with nesting information) to be written to the log.

For more information and an example, see "MLOGICNEST System Option" on page 349.

### Examining the Generated SAS Statements with MPRINT

The MPRINT system option writes to the log each SAS statement generated by a macro. Use the MPRINT option when you suspect your bug lies in code that is generated in a manner that you did not expect.

For example, the following program generates a simple DATA step:

```
%macro second(param);
   %let a = %eval(&param); &a
%mend second;

%macro first(exp);
   data _null_;
      var=%second(&exp);
```

```
      put var=;
   run;
%mend first;

options mprint;
%first(1+2)
```

When you submit these statements with option MPRINT, these lines are written to the log:

```
MPRINT(FIRST):   DATA _NULL_;
MPRINT(FIRST):   VAR=
MPRINT(SECOND):  3
MPRINT(FIRST):  ;
MPRINT(FIRST):   PUT VAR=;
MPRINT(FIRST):   RUN;

VAR=3
```

The MPRINT option shows you the generated text and identifies the macro that generated it.

### Nesting Information Generated by MPRINTNEST

MPRINTNEST allows the macro nesting information to be written to the log in the MPRINT output. This value has no effect on the MPRINT output that is sent to an external file. For more information, see "MFILE System Option" on page 345.

The setting of MPRINTNEST does not imply the setting of MPRINT. You must set both MPRINT and MPRINTNEST in order for output (with the nesting information) to be written to the log.

For more information and an example, see "MPRINTNEST System Option" on page 352.

### Storing MPRINT Output in an External File

You can store text that is generated by the macro facility during macro execution in an external file. Printing the statements generated during macro execution to a file is useful for debugging macros when you want to test generated text in a later SAS session.

To use this feature, set both the MFILE and MPRINT system options on. Also assign MPRINT as the fileref for the file to contain the output generated by the macro facility:

```
options mprint mfile;
filename mprint 'external-file';
```

The external file created by the MPRINT system option remains open until the SAS session terminates. The MPRINT text generated by the macro facility is written to the log during the SAS session and to the external file when the session ends. The text consists of program statements generated during macro execution with macro variable references and macro expressions resolved. Only statements generated by the macro are stored in the external file. Any program statements outside the macro are not written to the external file. Each statement begins on a new line with one space separating words. The text is stored in the external file without the **MPRINT(*macroname*)**: prefix, which is displayed in the log.

If MPRINT is not assigned as a fileref or if the file cannot be accessed, warnings are written to the log and MFILE is turned off. To use the feature again, you must specify MFILE again.

By default, the MPRINT and MFILE options are off.

The following example uses the MPRINT and MFILE options to store generated text in the external file named TempOut:

```
options mprint mfile;
filename mprint 'TEMPOUT';

%macro temp;
   data one;
      %do i=1 %to 3;
         x&i=&i;
      %end;
   run;
%mend temp;

%temp
```

The macro facility writes the following lines to the log and creates the external file named TempOut:

```
MPRINT(TEMP):   DATA ONE;
NOTE: The macro generated output from MPRINT will also be written
      to external file '/u/local/abcdef/TEMPOUT' while OPTIONS
      MPRINT and MFILE are set.
MPRINT(TEMP):   X1=1;
MPRINT(TEMP):   X2=2;
MPRINT(TEMP):   X3=3;
MPRINT(TEMP):   RUN;
```

When the SAS session ends, the file TempOut contains:

```
DATA ONE;
X1=1;
X2=2;
X3=3;
RUN;
```

*Note:* Using MPRINT to write code to an external file is a debugging tool only. It should not be used to create SAS code files for purposes other than debugging.

## *Examining Macro Variable Resolution with SYMBOLGEN*

The SYMBOLGEN system option tells you what each macro variable resolves to by writing messages to the log. This option is especially useful in spotting quoting problems, where the macro variable resolves to something other than what you intended because of a special character.

For example, suppose you submit the following statements:

```
options symbolgen;

%let a1=dog;
%let b2=cat;
%let b=1;
%let c=2;
```

```
%let d=a;
%let e=b;
%put **** &&&d&b ****;
%put **** &&&e&c ****;
```

The SYMBOLGEN option writes these lines to the log:

```
SYMBOLGEN:  && resolves to &.
SYMBOLGEN:  Macro variable D resolves to a
SYMBOLGEN:  Macro variable B resolves to 1
SYMBOLGEN:  Macro variable A1 resolves to dog
**** dog ****

SYMBOLGEN:  && resolves to &.
SYMBOLGEN:  Macro variable E resolves to b
SYMBOLGEN:  Macro variable C resolves to 2
SYMBOLGEN:  Macro variable B2 resolves to cat
**** cat ****
```

Reading the log provided by the SYMBOLGEN option is easier than examining the program statements to trace the indirect resolution. Notice that the SYMBOLGEN option traces each step of the macro variable resolution by the macro processor. When the resolution is complete, the %PUT statement writes the value to the log.

When you use SYMBOLGEN to trace the values of macro variables that have been masked with a macro quoting function, you might see an additional message about the quoting being “stripped for printing.” For example, suppose you submit the following statements, with SYMBOLGEN:

```
%let nickname = %str(My name%'s O%'Malley, but I%'m called Bruce);
%put *** &nickname ***;
```

The log contains the following after these statements have executed:

```
SYMBOLGEN:  Macro variable NICKNAME resolves to
                           My name's O'Malley, but I'm called Bruce
SYMBOLGEN:  Some characters in the above value which were
                          subject to macro quoting have been
                          unquoted for printing.
*** My name's O'Malley, but I'm called Bruce ***
```

You can ignore the unquoting message.

## Using the %PUT Statement to Track Problems

Along with using the SYMBOLGEN system option to write the values of macro variables to the log, you might find it useful to use the %PUT statement while developing and debugging your macros. When the macro is finished, you can delete or comment out the %PUT statements. The following table provides some occasions where you might find the %PUT statement helpful in debugging, and an example of each:

***Table 10.4*** *Example %PUT Statements That Are Useful When Debugging Macros*

| Situation | Example |
|---|---|
| Show a macro variable's value | **%PUT ****&=*variable-name*****;** |

| Situation | Example |
|---|---|
| Check leading or trailing blanks in a variable's value | **%PUT ***&*variable-name****;** |
| Check double-ampersand resolution, as during a loop | **%PUT ***variable-name&i = &&*variable-name****;** |
| Check evaluation of a condition | **%PUT ***This condition was met.***;** |

As you recall, macro variables are stored in symbol tables. There is a global symbol table, which contains global macro variables, and a local symbol table, which contains local macro variables. During the debugging process, you might find it helpful to print these tables occasionally to examine the scope and values of a group of macro variables. To do so, use the %PUT statement with one of the following options:

_ALL_
: describes all currently defined macro variables, regardless of scope. User-generated global and local variables as well as automatic macro variables are included.

_AUTOMATIC_
: describes all automatic macro variables. The scope is listed as AUTOMATIC. All automatic macro variables are global except SYSPBUFF.

_GLOBAL_
: describes all global macro variables that were not created by the macro processor. The scope is listed as GLOBAL. Automatic macro variables are not listed.

_LOCAL_
: describes user-generated local macro variables defined within the currently executing macro. The scope is listed as the name of the macro in which the macro variable is defined.

_READONLY_
: lists all user-defined read-only macro variables, regardless of scope. The scope is either GLOBAL, for global macro variables, or the name of the macro in which the macro variable is defined.

_USER_
: describes all user-generated macro variables, regardless of scope. For global macro variables, the scope is GLOBAL; for local macro variables, the scope is the name of the macro.

_WRITABLE_
: lists all user-defined read and write macro variables, regardless of scope. The scope is either GLOBAL, for global macro variables, or the name of the macro in which the macro variable is defined.

The following example uses the %PUT statement with the argument _USER_ to examine the global and local variables available to the macro TOTINV. Notice the use of the user-generated macro variable TRACE to control when the %PUT statement writes values to the log.

```
%macro totinv(var);
   %global macvar;
   data inv;
      retain total 0;
```

```
      set .Houses end=final;
      total=total+&var;
      if final then call symput("macvar",put(total,dollar14.2));
   run;

   %if &trace = ON  %then
      %do;
         %put *** Tracing macro scopes. ***;
         %put _USER_;
      %end;
%mend totinv;

%let trace=ON;
%totinv(price)
%put *** TOTAL=&macvar ***;
```

The first %PUT statement in the macro TOTINV writes the message about tracing being on and then writes the scope and value of all user-generated macro variables to the log.

```
*** Tracing macro scopes. ***
TOTINV VAR price
GLOBAL TRACE ON
GLOBAL MACVAR  $1,240,800.00
*** TOTAL= $1,240,800.00 ***
```

For a more detailed discussion of macro variable scopes, see Chapter 5, “Scopes of Macro Variables,” on page 47.

*Chapter 11*

# Writing Efficient and Portable Macros

**Writing Efficient and Portable Macros** . . . . . **139**

**Keeping Efficiency in Perspective** . . . . . **140**

**Writing Efficient Macros** . . . . . **140**
Use Macros Wisely . . . . . 140
Use Name Style Macros . . . . . 141
Avoid Nested Macro Definitions . . . . . 141
Assign Function Results to Macro Variables . . . . . 142
Turn Off System Options When Appropriate . . . . . 143
Use the Stored Compiled Macro Facility . . . . . 143
Centrally Store Autocall Macros . . . . . 144
Other Useful Efficiency Tips . . . . . 144
Storing Only One Copy of a Long Macro Variable Value . . . . . 145

**Writing Portable Macros** . . . . . **146**
Using Portable SAS Language Functions with %SYSFUNC . . . . . 146
Example Using %SYSFUNC . . . . . 147
Using Automatic Variables with Host-Specific Values . . . . . 147
Example Using SYSPARM . . . . . 149
SYSPARM Details . . . . . 150
Macro Language Elements with System Dependencies . . . . . 150
Host-Specific Macro Variables . . . . . 151
Naming Macros and External Files for Use with the Autocall Facility . . . . . 151

## Writing Efficient and Portable Macros

The macro facility is a powerful tool for making your SAS code development more efficient. But macros are only as efficient as you make them. There are several techniques and considerations for writing efficient macros. You can extend the power of the macro facility by creating macros that can be used on more than one host environment. In order to do this, there are additional considerations for writing portable macros.

# Keeping Efficiency in Perspective

Efficiency is an elusive thing, hard to quantify and harder still to define. What works with one application might not work with another, and what is efficient on one host environment might be inefficient on a different system. However, there are some generalities that you should keep in mind.

Usually, efficiency issues are discussed in terms of CPU cycles, elapsed time, I/O hits, memory usage, disk storage, and so on. This section does not give benchmarks in these terms because of all the variables involved. A program that runs only once needs different tuning than a program that runs hundreds of times. An application running on a mainframe has different hardware parameters than an application developed on a desktop PC. You must keep efficiency in perspective with your environment.

There are different approaches to efficiency, depending on what resources you want to conserve. Are CPU cycles more critical than I/O hits? Do you have lots of memory but no disk space? Taking stock of your situation before deciding how to tune your programs is a good idea.

The area of efficiency most affected by the SAS macro facility is human efficiency — how much time is required to both develop and maintain a program. Autocall macros are particularly important in this area because the autocall facility provides code reusability. Once you develop a macro that performs a task, you can save it and use it for the following:

- in the application that you developed it for
- in future applications without any further work

A library of reusable, immediately callable macros is a boon to any application development team.

The stored compiled macro facility (described in Chapter 9, “Storing and Reusing Macros,” on page 111) might reduce execution time by enabling previously compiled macros to be accessed during different SAS jobs and sessions. But it is a tool that is efficient only for production applications, not during application development. So the efficiency techniques that you choose depend not only on your hardware and personnel situation, but also on the stage that you have reached in your application development process.

Also, remember that incorporating macro code into a SAS application does not automatically make the application more efficient. When designing a SAS application, concentrate on making the basic SAS code that macros generate more efficient. There are many sources for information about efficient SAS code, including *SAS Programming Tips: A Guide to Efficient SAS Processing*.

# Writing Efficient Macros

## *Use Macros Wisely*

An application that uses a macro to generate only constant text can be inefficient. In general, for these situations consider using a %INCLUDE statement. The %INCLUDE statement does not have to compile the code first (it is executed immediately). Therefore,

it might be more efficient than using a macro (especially if the code is executed only once). For more information, see "%INCLUDE Statement" in *SAS Viya Statements: Reference*.

If you use the same code repeatedly, it might be more efficient to use a macro. A macro is compiled only once during a SAS job, no matter how many times it is called.

### Use Name Style Macros

Macros come in three invocation types: name style, command style, and statement style. Of the three, name style is the most efficient because name style macros always begin with a `%`, which immediately tells the word scanner to pass the token to the macro processor. With the other two types, the word scanner does not know immediately whether the token should be sent to the macro processor. Therefore, time is wasted while the word scanner determines whether the token should be sent.

### Avoid Nested Macro Definitions

Nesting macro definitions inside other macros is usually unnecessary and inefficient. When you call a macro that contains a nested macro definition, the macro processor generates the nested macro definition as text and places it on the input stack. The word scanner then scans the definition and the macro processor compiles it. Do not nest the definition of a macro that does not change. You will cause the macro processor to compile the same macro each time that section of the outer macro is executed.

As a rule, you should define macros separately. If you want to nest a macro's scope, simply nest the macro call, not the macro definition.

For example, the macro STATS1 contains a nested macro definition for the macro TITLE:

```
/* Nesting a Macro Definition--INEFFICIENT */
%macro stats1(product,year);
   %macro title;
      title "Statistics for &product in &year";
      %if &year>1929 and &year<1935 %then
         %do;
            title2 "Some Data Might Be Missing";
         %end;
   %mend title;

   proc means data=products;
      where product="&product" and year=&year;
      %title
   run;
%mend stats1;

%stats1(steel,2002)
%stats1(beef,2000)
%stats1(fiberglass,2001)
```

Each time the macro STATS1 is called, the macro processor generates the definition of the macro TITLE as text, recognizes a macro definition, and compiles the macro TITLE. In this case, STATS1 was called three times, which means the TITLE macro was compiled three times. With only a few statements, this task takes only micro-seconds; but in large macros with hundreds of statements, the wasted time could be significant.

The values of PRODUCT and YEAR are available to TITLE because its call is within the definition of STATS1. Therefore, it is unnecessary to nest the definition of TITLE to make values available to TITLE's scope. Nesting definitions are also unnecessary because no values in the definition of the TITLE statement are dependent on values that change during the execution of STATS1. (Even if the definition of the TITLE statement depended on such values, you could use a global macro variable to effect the changes, rather than nest the definition.)

The following program shows the macros defined separately:

```
/* Separating Macro Definitions--EFFICIENT */
%macro stats2(product,year);
   proc means data=products;
      where product="&product" and year=&year;
      %title
   run;
%mend stats2;

%macro title;
   title "Statistics for &product in &year";
   %if &year>1929 and &year<1935 %then
      %do;
         title2 "Some Data Might Be Missing";
      %end;
%mend title;

%stats2(cotton,1999)
%stats2(brick,2002)
%stats2(lamb,2001)
```

Here, because the definition of the macro TITLE is outside the definition of the macro STATS2, TITLE is compiled only once, even though STATS2 is called three times. Again, the values of PRODUCT and YEAR are available to TITLE because its call is within the definition of STATS2.

*Note:* Another reason to define macros separately is because it makes them easier to maintain, each in a separate file.

## Assign Function Results to Macro Variables

It is more efficient to resolve a variable reference than it is to evaluate a function. Therefore, assign the results of frequently used functions to macro variables.

For example, the following macro is inefficient because the length of the macro variable THETEXT must be evaluated at every iteration of the %DO %WHILE statement:

```
/* INEFFICIENT MACRO */
%macro test(thetext);
   %let x=1;
      %do %while (&x > %length(&thetext));
         .
         .
         .
      %end;
%mend test;

%test(Four Score and Seven Years Ago)
```

A more efficient method would be to evaluate the length of THETEXT once and assign that value to another macro variable. Then, use that variable in the %DO %WHILE statement, as in the following program:

```
/* MORE EFFICIENT MACRO */
%macro test2(thetext);
   %let x=1;
   %let length=%length(&thetext);
   %do %while (&x > &length);
      .
      .
      .
   %end;
%mend test2;

%test(Four Score and Seven Years Ago)
```

As another example, suppose you want to use the %SUBSTR function to pull the year out of the value of SYSDATE. Instead of using %SUBSTR repeatedly in your code, assign the value of the %SUBSTR(&SYSDATE, 6) to a macro variable, and use that variable whenever you need the year.

### *Turn Off System Options When Appropriate*

While the debugging system options, such as MPRINT and MLOGIC, are very helpful at times, it is inefficient to run production (debugged) macros with this type of system option set to on. For production macros, run your job with the following settings: NOMLOGIC, NOMPRINT, NOMRECALL, and NOSYMBOLGEN.

Even if your job has no errors, if you run it with these options turned on you incur the overhead that the options require. By turning them off, your program runs more efficiently.

*Note:* Another approach to deciding when to use MPRINT versus NOMPRINT is to match this option's setting with the setting of the SOURCE option. That is, if your program uses the SOURCE option, it should also use MPRINT. If your program uses NOSOURCE, then run it with NOMPRINT as well.

*Note:* If you do not use autocall macros, use the NOMAUTOSOURCE system option. If you do not use stored compiled macros, use the NOMSTORED system option.

### *Use the Stored Compiled Macro Facility*

The stored compiled macro facility reduces execution time by enabling macros compiled in a previous SAS job or session to be accessed during subsequent SAS jobs and sessions. Therefore, these macros do not need to be recompiled. Use the stored compiled macro facility only for production (debugged) macros. It is not efficient to use this facility when developing a macro application.

***CAUTION:***

**Save the source code.** You cannot re-create the source code for a macro from the compiled code. You should keep a copy of the source code in a safe place, in case the compiled code becomes corrupted for some reason. Having a copy of the source is also necessary if you intend to modify the macro at a later time.

For more information about the stored compiled macro facility, see Chapter 9, “Storing and Reusing Macros,” on page 111.

*Note:* The compiled code generated by the stored compiled macro facility is not portable. If you need to transfer macros to another host environment, you must move the source code and recompile and store it on the new host.

### Centrally Store Autocall Macros

When using the autocall facility, it is most efficient in terms of I/O to store all your autocall macros in one library and append that library name to the beginning of the SASAUTOS system option specification. Of course, you could store the autocall macros in as many libraries as you want. But each time you call a macro, each library is searched sequentially until the macro is found. Opening and searching only one library reduces the time SAS spends looking for macros.

However, it might make more sense, if you have hundreds of autocall macros, to have them separated into logical divisions according to the following:

- purpose
- levels of production
- who supports them
- and so on

As usual, you must balance reduced I/O against ease-of-use and ease-of-maintenance.

All autocall libraries in the concatenated list are opened and left open during a SAS job or session. The first time you call an autocall macro, any library that did not open the first time is tested again each time an autocall macro is used. Therefore, it is extremely inefficient to have invalid pathnames in your SASAUTOS system option specification. You see no warnings about this wasted effort on the part of SAS, unless no libraries at all open.

There are two efficiency tips involving the autocall facility:

- Do not store nonmacro code in autocall library files.
- Do not store more than one macro in each autocall library file.

Although these two practices are used by SAS and do work, they contribute significantly to code-maintenance effort and therefore are less efficient.

### Other Useful Efficiency Tips

Here are some other efficiency techniques that you can try:

- Reset macro variables to null if the variables are no longer going to be referenced.
- Use triple ampersands to force an additional scan of macro variables with long values, when appropriate. For more information, see "Storing Only One Copy of a Long Macro Variable Value" on page 145.
- Adjust the values of "MSYMTABMAX= System Option" on page 355 and "MVARSIZE= System Option" on page 356 to fit your situation. In general, increase the values if disk space is in short supply; decrease the values if memory is in short supply. MSYMTABMAX affects the space available for storing macro variable symbol tables; MVARSIZE affects the space available for storing values of individual macro variables.

### *Storing Only One Copy of a Long Macro Variable Value*

Because macro variables can have very long values, the way you store macro variables can affect the efficiency of a program. Indirect references using three ampersands enable you to store fewer copies of a long value.

For example, suppose your program contains long macro variable values that represent sections of SAS programs:

```
%let pgm=%str(data flights;
   set schedule;
   totmiles=sum(of miles1-miles20);
   proc print;
   var flightid totmiles;);
```

You want the SAS program to end with a RUN statement:

```
%macro check(val);
         /* first version */    &val
    %if %index(&val,%str(run;))=0 %then %str(run;);
%mend check;
```

First, the macro CHECK generates the program statements contained in the parameter VAL (a macro variable that is defined in the %MACRO statement and passed in from the macro call). Then, the %INDEX function searches the value of VAL for the characters **`run;`**. (The %STR function causes the semicolon to be treated as text.) If the characters are not present, the %INDEX function returns 0. The %IF condition becomes true, and the macro processor generates a RUN statement.

To use the macro CHECK with the variable PGM, assign the parameter VAL the value of PGM in the macro call:

```
%check(&pgm)
```

As a result, SAS sees the following statements:

```
data flights;
   set schedule;
   totmiles=sum(of miles1-miles20);

proc print;
   var flightid totmiles;
run;
```

The macro CHECK works properly. However, the macro processor assigns the value of PGM as the value of VAL during the execution of CHECK. Thus, the macro processor must store two long values (the value of PGM and the value of VAL) while CHECK is executing.

To make the program more efficient, write the macro so that it uses the value of PGM rather than copying the value into VAL:

```
%macro check2(val);  /* more efficient macro */   &&&val
   %if %index(&&&val,%str(run;))=0 %then %str(run;);
%mend check2;

%check2(pgm)
```

The macro CHECK2 produces the same result as the macro CHECK:

```
data flights;
```

```
   set schedule;
   totmiles=sum(of miles1-miles20);

proc print;
   var flightid totmiles;
run;
```

However, in the macro CHECK2, the value assigned to VAL is simply the name **PGM**, not the value of PGM. The macro processor resolves &&&VAL into &PGM and then into the SAS statements contained in the macro variable PGM. Thus, the long value is stored only once.

# Writing Portable Macros

## *Using Portable SAS Language Functions with %SYSFUNC*

If your code runs in two different environments, you have essentially doubled the worth of your development effort. But portable applications require some planning ahead. For more details about any host-specific feature of SAS, see the SAS documentation for your host environment.

You can use the %SYSFUNC macro function to access SAS language functions to perform most host-specific operations, such as opening or deleting a file. For more information, see "%SYSFUNC and %QSYSFUNC Functions" on page 273.

Using %SYSFUNC to access portable SAS language functions can save you a lot of macro coding (and is therefore not only portable but also more efficient). The following table lists some common host-specific tasks and the functions that perform those tasks.

***Table 11.1*** *Portable SAS Language Functions and Their Uses*

| Task | SAS Language Function or Functions |
|---|---|
| Assign and verify existence of fileref and physical file | FILENAME, FILEREF, PATHNAME |
| Open a file | FOPEN, MOPEN |
| Verify existence of a file | FEXIST, FILEEXIST |
| Get information about a file | FINFO, FOPTNAME, FOPTNUM |
| Write data to a file | FAPPEND, FWRITE |
| Read from a file | FPOINT, FREAD, FREWIND, FRLEN |
| Close a file | FCLOSE |

| Task | SAS Language Function or Functions |
|---|---|
| Delete a file | FDELETE |
| Open a directory | DOPEN |
| Return information about a directory | DINFO, DNUM, DOPTNAME, DOPTNUM, DREAD |
| Close a directory | DCLOSE |
| Read a host-specific option | GETOPTION |
| Interact with the File Data Buffer (FDB) | FCOL, FGET, FNOTE, FPOS, FPUT, FSEP |
| Assign and verify librefs | LIBNAME, LIBREF, PATHNAME |
| Get information about executed host environment commands | SYSRC |

*Note:* Of course, you can also use other functions, such as ABS, MAX, and TRANWRD, with %SYSFUNC. A few SAS language functions are not available with %SYSFUNC. For more information, see "%SYSFUNC and %QSYSFUNC Functions" on page 273.

### Example Using %SYSFUNC

The following program deletes the file identified by the fileref MyFile:

```
%macro testfile(filrf);
   %let
rc=%sysfunc(filename(filrf,physical-filename));
   %if &rc = 0 and %sysfunc(fexist(&filrf)) %then
      %let rc=%sysfunc(fdelete(&filrf));
   %let rc=%sysfunc(filename(filrf));
%mend testfile;

%testfile(myfile)
```

### Using Automatic Variables with Host-Specific Values

#### Macro Variables by Task

The automatic macro variables are available under all host environments, but the values are determined by each host. The following table lists the macro variables by task. The "Type" column tells you if the variable can be changed (Read and Write) or can be inspected (Read Only).

***Table 11.2*** *Automatic Macro Variables with Host-Specific Results*

| Task | Automatic Macro Variable | Type |
|---|---|---|
| Obsolete | SYSDEVIC | Read and write |
| List of the mode of execution (values are FORE or BACK). Some host environments allow only one mode, FORE. | SYSENV | Read-only |
| List the name of the currently executing batch job, user ID, or process. For example, on Linux, SYSJOBID is the PID. | SYSJOBID | Read-only |
| Obsolete | SYSRC | Read and write |
| List the abbreviation of the host environment that you are using. | SYSSCP | Read-only |
| List a more detailed abbreviation of the host environment that you are using. | SYSSCPL | Read-only |
| Retrieve a character string that was passed to SAS by the SYSPARM= system option. | SYSPARM | Read and write |
| Time zone name based on TIMEZONE option. | SYSTIMEZONE | Read-only |
| Time zone ID based on TIMEZONE option. | SYSTIMEZONEIDENT | Read-only |
| Current time zone offset based on TIMEZONE option. | SYSTIMEZONEOFFSET | Read-only |

### *Examples Using SYSSCP and SYSSCPL*

The macro DELFILE uses the value of SYSSCP to determine the platform that is running SAS and deletes a TMP file. FILEREF is a macro parameter that contains a filename. Because the filename is host-specific, making it a macro parameter enables the macro to use whatever filename syntax is necessary for the host environment.

```
%macro delfile(fileref);
    /* Unix */
   %if &sysscp=HP 800 or &sysscp=HP 300 %then %do;
         X "rm &fileref..TMP";
   %end;

      /* DOS-LIKE platforms */
   %else %if &sysscp=OS2 or &sysscp=WIN %then %do;
            X "DEL &fileref..TMP";
   %end;
    /* CMS */
   %else %if &sysscp=CMS %then %do;
           X "ERASE &fileref  TMP A";
   %end;
```

```
%mend delfile;
```

Here is a call to the macro DELFILE in a PC environment that deletes a file named C:\SAS\sashelp\Doc1.Tmp:

```
%delfile(c:\sas\sashelp\Doc1)
```

Now, suppose you know your macro application is going to run on Linux. The SYSSCPL automatic macro variable provides information about the name of the host environment, similar to the SYSSCP automatic macro variable. However, SYSSCPL provides more information and enables you to further modify your macro code.

### *Example Using SYSPARM*

Suppose the SYSPARM= system option is set to the name of a city. That means the SYSPARM automatic variable is set to the name of that city. You can use that value to subset a data set and generate code specific to that value. Simply by making a small change to the command that invokes SAS (or to the configuration SAS file), your SAS job will perform different tasks.

```
/* Create a data set, based on the value of the */
/* SYSPARM automatic variable. */
/* An example data set name could be MYLIB.BOSTON. */
data mylib.&sysparm;
   set mylib.alltowns;
      /* Use the SYSPARM SAS language function to */
      /* compare the value (city name) */
      /* of SYSPARM to a data set variable. */
   if town=sysparm();
run;
```

When this program executes, you end up with a data set that contains data for only the town that you are interested in. You can change what data set is generated before you start your SAS job.

Now suppose you want to further use the value of SYSPARM to control what procedures your job uses. The following macro does just that:

```
%macro select;
   %if %upcase(&sysparm) eq BOSTON %then
      %do;
         proc report ... more SAS code;
            title "Report on &sysparm";
         run;
      %end;

   %if %upcase(&sysparm) eq CHICAGO %then
      %do;
         proc chart ... more SAS code;
            title "Growth Values for &sysparm";
         run;
      %end;
   .
   .  /* more macro code */
   .
%mend select;
```

### SYSPARM Details

The value of the SYSPARM automatic macro variable is the same as the value of the SYSPARM= system option, which is equivalent to the return value of the SAS language function SYSPARM. The default value is null. Because you can use the SYSPARM= system option at SAS invocation, you can set the value of the SYSPARM automatic macro variable before your SAS session begins.

### Macro Language Elements with System Dependencies

Several macro language elements are host-specific, including the following:

any language element that relies on the sort sequence
Examples of such expressions include %DO, %DO %UNTIL, %DO %WHILE, %IF-%THEN, and %EVAL.

For example, consider the following program:

```
%macro testsort(var);
    %if &var < a %then %put *** &var is less than a ***;
    %else %put *** &var is greater than a ***;
%mend testsort;
%testsort(1)
      /* Invoke the macro with the number 1 as the parameter. */
```

On EBCDIC systems, such as VSE, this program causes the following to be written to the log:

```
*** 1 is greater than a ***
```

But on an ASCII system (such as Linux), the following is written to the log:

```
*** 1 is less than a ***
```

MSYMTABMAX=
The MSYMTABMAX system option specifies the maximum amount of memory available to the macro variable symbol tables. If this value is exceeded, the symbol tables are stored in a Work file on disk.

MVARSIZE=
The MVARSIZE system option specifies the maximum number of bytes for any macro variable stored in memory. If this value is exceeded, the macro variable is stored in a Work file on disk.

%SCAN and %QSCAN
The default delimiters that the %SCAN and %QSCAN functions use to search for words in a string are different on ASCII and EBCDIC systems. The default delimiters are

ASCII systems
blank . < ( + & ! $ * ) ; ^ – / , % |

EBCDIC systems
blank . < ( + | & ! $ * ) ; ¬ – / , % ¦ ¢

%TSO and %CMS
The%TSO and %CMS macro statements enable you to issue a host environment command.

%SYSGET
: On some host environments, the %SYSGET function returns the value of host environment variables and symbols.

SYSPARM=
: The SYSPARM= system option can supply a value for the SYSPARM automatic macro variable at SAS invocation. It is useful in customizing a production job. For example, to create a title based on a city as part of noninteractive execution, the production program might contain the SYSPARM= system option. It can be in the SAS configuration file or the command that invokes SAS. For an example using the SYSPARM= system option in conjunction with the SYSPARM automatic macro variable, see "SYSPARM Details" on page 150.

SASMSTORE=
: The SASMSTORE= system option specifies the location of stored compiled macros.

SASAUTOS=
: The SASAUTOS= system option specifies the location of autocall macros.

## *Host-Specific Macro Variables*

Some host environments create unique macro variables. These macro variables are not automatic macro variables. The following tables list some commonly used host-specific macro variables. Additional host-specific macro variables might be available in future releases. See your SAS companion for more information.

## *Naming Macros and External Files for Use with the Autocall Facility*

When naming macros that will be stored in an autocall library, there are restrictions depending on your host environment. Here is a list of some of the restrictions:

- Every host environment has file naming conventions. If the host environment uses file extensions, use **`.sas`** as the extension of your macro files.
- Although SAS names can contain underscores, some host environments do not use them in the names of external files. Some host environments that do not use underscores do use the number sign (#) and might automatically replace the # with _ when the macro is used.
- Some host environments have reserved words, such as CON and NULL. Do not use reserved words when naming autocall macros or external files.
- Some hosts have host-specific autocall macros. Do not define a macro with the same name as these autocall macros.
- Macro catalogs are not portable. Remember to always save your macro source code in a safe place.
- On Linux systems the filename that contains the autocall macro must be all lowercase letters.

*Chapter 12*

# Macro Language Elements

**Macro Language Elements** . . . . . **153**

**Macro Statements** . . . . . **154**
Using Macro Statements . . . . . 154
Macro Statements That Perform Automatic Evaluation . . . . . 155

**Macro Functions** . . . . . **156**
Using Macro Functions . . . . . 156
Macro Character Functions . . . . . 157
Macro Evaluation Functions . . . . . 158
Macro Quoting Functions . . . . . 159
Compilation Quoting Functions . . . . . 159
Execution of Macro Quoting Functions . . . . . 159
Quotation Marks and Parentheses without a Match . . . . . 160
Macro Functions for Double-Byte Character Set (DBCS) . . . . . 161
Other Macro Functions . . . . . 161

**Automatic Macro Variables** . . . . . **162**

**Interfaces with the Macro Facility** . . . . . **165**

**Selected Autocall Macros Provided with SAS Software** . . . . . **167**
Overview of Provided Autocall Macros . . . . . 167
Required System Options for Autocall Macros . . . . . 168
Using Autocall Macros . . . . . 168
Autocall Macros for Double-Byte Character Set (DBCS) . . . . . 168

**Selected System Options Used in the Macro Facility** . . . . . **169**

## Macro Language Elements

The SAS macro language consists of statements, functions, and automatic macro variables. This section defines and lists these elements.

- “Macro Statements” on page 154
- “Macro Functions” on page 156
- “Automatic Macro Variables” on page 162

Also covered are the interfaces to the macro facility provided by SAS software, the SQL procedure, and SAS Component Language as well as selected autocall macros and macro system options.

# Macro Statements

## Using Macro Statements

A macro language statement instructs the macro processor to perform an operation. It consists of a string of keywords, SAS names, and special characters and operators, and it ends in a semicolon. Some macro language statements are used only in macro definitions. You can use others anywhere in a SAS session or job, either inside or outside macro definitions (referred to as open code). The following table lists macro language statements that you can use in both macro definitions and open code.

***Table 12.1*** *Macro Language Statements Used in Macro Definitions and Open Code*

| Statement | Description |
|---|---|
| %* comment | Designates comment text. |
| %COPY | Copies specified items from a SAS library. |
| %GLOBAL | Creates macro variables that are available during the execution of an entire SAS session. |
| %IF %THEN %ELSE | Conditionally processes a portion of a macro. |
| %INPUT | Supplies values to macro variables during macro execution. |
| %LET | Creates a macro variable and assigns it a value. |
| %MACRO | Begins a macro definition. |
| %PUT | Writes text or the values of macro variables to the log. |
| %SYMDEL | Deletes the indicated macro variable named in the argument. |
| %SYSCALL | Invokes a SAS call routine. |
| %SYSEXEC | Obsolete |
| %SYSLPUT | Defines a new macro variable or modifies the value of an existing macro variable on a remote host or server. |
| %SYSMACDELETE | Deletes a macro definition from the Work.SASMACR catalog. |
| %SYSMSTORECLEAR | Closes stored compiled macros and clears the SASMSTORE= library. |
| %SYSRPUT | Assigns the value of a macro variable on a remote host to a macro variable on the local host. |

The following table lists macro language statements that you can use only in macro definitions.

***Table 12.2*** *Macro Language Statements Used in Macro Definitions Only*

| Statement | Description |
|---|---|
| %ABORT | Stops the macro that is executing along with the current DATA step, SAS job, or SAS session. |
| %DO | Begins a %DO group. |
| %DO, Iterative | Executes statements repetitively, based on the value of an index variable. |
| %DO %UNTIL | Executes statements repetitively until a condition is true. |
| %DO %WHILE | Executes statements repetitively while a condition is true. |
| %END | Ends a %DO group. |
| %GOTO | Branches macro processing to the specified label. |
| %label: | Identifies the destination of a %GOTO statement. |
| %LOCAL | Creates macro variables that are available only during the execution of the macro where they are defined. |
| %MEND | Ends a macro definition. |
| %RETURN | Causes normal termination of the currently executing macro. |

## *Macro Statements That Perform Automatic Evaluation*

Some macro statements perform an operation based on an evaluation of an arithmetic or logical expression. They perform the evaluation by automatically calling the %EVAL function. If you get an error message about a problem with %EVAL when a macro does not use %EVAL only, check for one of these statements. The following macro statements perform automatic evaluation:

- %DO *macro-variable=expression* %TO *expression* <%BY *expression*>;
- %DO %UNTIL(*expression*);
- %DO %WHILE(*expression*);
- %IF *expression* %THEN *action*;

For more information about operands and operators in expressions, see Chapter 6, “Macro Expressions,” on page 71.

# Macro Functions

## Using Macro Functions

A macro language function processes one or more arguments and produces a result. You can use all macro functions in both macro definitions and open code. Macro functions include character functions, evaluation functions, and quoting functions. The macro language functions are listed in the following table.

***Table 12.3*** *Macro Functions*

| Function | Description |
|---|---|
| %BQUOTE, %NRBQUOTE | Mask special characters and mnemonic operators in a resolved value at macro execution. |
| %EVAL | Evaluates arithmetic and logical expressions using integer arithmetic. |
| %INDEX | Returns the position of the first character of a string. |
| %LENGTH | Returns the length of a string. |
| %QUOTE, %NRQUOTE | Mask special characters and mnemonic operators in a resolved value at macro execution. Unmatched quotation marks (“ ”) and parentheses ( () ) must be marked with a preceding %. |
| %SCAN, %QSCAN | Search for a word specified by its number. %QSCAN masks special characters and mnemonic operators in its result. |
| %STR, %NRSTR | Mask special characters and mnemonic operators in constant text at macro compilation. Unmatched quotation marks (“ ”) and parentheses ( () ) must be marked with a preceding %. |
| %SUBSTR, %QSUBSTR | Produce a substring of a character string. %QSUBSTR masks special characters and mnemonic operators in its result. |
| %SUPERQ | Masks all special characters and mnemonic operators at macro execution but prevents resolution of the value. |
| %SYMEXIST | Returns an indication as to whether the named macro variable exists. |
| %SYMGLOBL | Returns an indication as to whether the named macro variable is global in scope. |
| %SYMLOCAL | Returns an indication as to whether the named macro variable is local in scope. |

| Function | Description |
|---|---|
| %SYSEVALF | Evaluates arithmetic and logical expressions using floating-point arithmetic. |
| %SYSFUNC, %QSYSFUNC | Execute SAS functions or user-written functions. %QSYSFUNC masks special characters and mnemonic operators in its result. |
| %SYSGET | Returns the value of a specified host environment variable. |
| %SYSMACEXEC | Indicates whether a macro is currently executing. |
| %SYSMACEXIST | Indicates whether there is a macro definition in the Work.SASMACR catalog. |
| %SYSMEXECDEPTH | Returns the depth of nesting from the point of call. |
| %SYSMEXECNAME | Returns the name of the macro executing at a nesting level. |
| %SYSPROD | Reports whether a SAS software product is licensed at the site. |
| %UNQUOTE | Unmasks all special characters and mnemonic operators for a value. |
| %UPCASE, %QUPCASE | Convert characters to uppercase. %QUPCASE masks special characters and mnemonic operators in its result. |

### *Macro Character Functions*

Character functions change character strings or provide information about them. The following table lists the macro character functions.

***Table 12.4*** *Macro Character Functions*

| Function | Description |
|---|---|
| %INDEX | Returns the position of the first character of a string. |
| %LENGTH | Returns the length of a string. |
| %SCAN, %QSCAN | Search for a word that is specified by a number. %QSCAN masks special characters and mnemonic operators in its result. |
| %SUBSTR, %QSUBSTR | Produce a substring of a character string. %QSUBSTR masks special characters and mnemonic operators in its result. |
| %UPCASE, %QUPCASE | Convert characters to uppercase. %QUPCASE masks special characters and mnemonic operators in its result. |

For macro character functions that have a Q form (for example, %SCAN and %QSCAN), the two functions work alike except that the function beginning with Q

masks special characters and mnemonic operators in its result. Use the function beginning with Q when an argument has been previously masked with a macro quoting function or when you want the result to be masked (for example, when the result might contain an unmatched quotation mark or parenthesis). For more information, see "Macro Quoting" on page 80.

Many macro character functions have names corresponding to SAS character functions and perform similar tasks (such as %SUBSTR and SUBSTR). But, macro functions operate before the DATA step executes. Consider the following DATA step:

```
data out.%substr(&sysday,1,3);     /* macro function */
   set in.weekly (keep=name code sales);
   length location $4;
   location=substr(code,1,4);         /* SAS function */
run;
```

Running the program on Monday creates the data set name Out.Mon:

```
data out.MON;                      /* macro function */
   set in.weekly (keep=name code sales);
   length location $4;
   location=substr(code,1,4);         /* SAS function */
run;
```

Suppose that the IN.WEEKLY variable CODE contains the values cary18593 and apex19624. The SAS function SUBSTR operates during DATA step execution and assigns these values to the variable LOCATION: **cary** and **apex**.

## Macro Evaluation Functions

Evaluation functions evaluate arithmetic and logical expressions. They temporarily convert the operands in the argument to numeric values. Then, they perform the operation specified by the operand and convert the result to a character value. The macro processor uses evaluation functions to do the following:

- make character comparisons
- evaluate logical (Boolean) expressions
- assign numeric properties to a token, such as an integer in the argument of a function

For more information, see Chapter 6, "Macro Expressions," on page 71. The following table lists the macro evaluation functions.

***Table 12.5*** *Macro Evaluation Functions*

| Function | Description |
|---|---|
| %EVAL | Evaluates arithmetic and logical expressions using integer arithmetic. |
| %SYSEVALF | Evaluates arithmetic and logical expressions using floating-point arithmetic. |

%EVAL is called automatically by the macro processor to evaluate expressions in the arguments to the statements that perform evaluation in the following functions:

- %QSCAN(*argument*, *n*<, *delimiters*>)
- %QSUBSTR(*argument*, *position*<, *length*>)

- %SCAN(*argument*, *n*<, *delimiters*>)
- %SUBSTR(*argument*, *position*<, *length*>)

## Macro Quoting Functions

Macro quoting functions mask special characters and mnemonic operators so that the macro processor interprets them as text instead of elements of the macro language.

The following table lists the macro quoting functions, and also describes the special characters that they mask and when they operate. (Although %QSCAN, %QSUBSTR, and %QUPCASE mask special characters and mnemonic operations in their results, they are not considered quoting functions. Their purpose is to process a character value and not simply to quote a value.) For more information, see "Macro Quoting" on page 80.

***Table 12.6*** *Macro Quoting Functions*

| Function | Description |
|---|---|
| %BQUOTE, %NRBQUOTE | Mask special characters and mnemonic operators in a resolved value at macro execution. %BQUOTE and %NRBQUOTE are the most powerful functions for masking values at execution time because they do not require that unmatched quotation marks (“ ”) and parentheses ( () ) be marked. |
| %QUOTE, %NRQUOTE | Mask special characters and mnemonic operators in a resolved value at macro execution. Unmatched quotation marks (“ ”) and parentheses ( () ) must be marked with a preceding %. |
| %STR, %NRSTR | Mask special characters and mnemonic operators in constant text at macro compilation. Unmatched quotation marks (“ ”) and parentheses ( () ) must be marked with a preceding %. |
| %SUPERQ | Masks all special characters and mnemonic operators at macro execution but prevents resolution of the value. |
| %UNQUOTE | Unmasks all special characters and mnemonic operators for a value. |

## Compilation Quoting Functions

%STR and %NRSTR mask special characters and mnemonic operators in values during compilation of a macro definition or a macro language statement in open code. For example, the %STR function prevents the following %LET statement from ending prematurely. It keeps the semicolon in the PROC PRINT statement from being interpreted as the semicolon for the %LET statement.

```
%let printit=%str(proc print; run;);
```

## Execution of Macro Quoting Functions

%BQUOTE, %NRBQUOTE, %QUOTE, %NRQUOTE, and %SUPERQ mask special characters and mnemonic operators in values during execution of a macro or a macro language statement in open code. Except for %SUPERQ, these functions instruct the

macro processor to resolve a macro expression as far as possible and mask the result. The other quoting functions issue warning messages for any macro variable references or macro invocations that they cannot resolve. %SUPERQ protects the value of a macro variable from any attempt at further resolution.

Of the quoting functions that resolve values during execution, %BQUOTE and %NRBQUOTE are the most flexible. For example, the %BQUOTE function prevents the following %IF statement from producing an error if the macro variable STATE resolves to OR (for Oregon). Without %BQUOTE, the macro processor would interpret the abbreviation for Oregon as the logical operator OR.

```
%if %bquote(&state)=nc %then %put North Carolina Dept. of
Revenue;
```

%SUPERQ fetches the value of a macro variable from the macro symbol table and masks it immediately, preventing the macro processor from attempting to resolve any part of the resolved value. For example, %SUPERQ prevents the following %LET statement from producing an error when it resolves to a value with an ampersand, like **`Smith&Jones`**. Without %SUPERQ, the macro processor would attempt to resolve **`&Jones`**.

```
%let testvar=%superq(corpname);
     /* No ampersand in argument to %superq. */
```

(%SUPERQ takes as its argument either a macro variable name without an ampersand or a text expression that yields a macro variable name.)

### Quotation Marks and Parentheses without a Match

Syntax errors result if the arguments of %STR, %NRSTR, %QUOTE, and %NRQUOTE contain a quotation mark or parenthesis that does not have a match. To prevent these errors, mark these quotation marks and parentheses by preceding them with a percent sign. For example, write the following to store the value **`345)`** in macro variable B:

```
%let b=%str(345%));
```

If an argument of %STR, %NRSTR, %QUOTE, or %NRQUOTE contains a percent sign that precedes a quotation mark or parenthesis, use two percent signs (%%) to specify that the argument's percent sign does not mark the quotation mark or parenthesis. For example, write the following to store the value **`TITLE "20%";`** in macro variable P:

```
%let p=%str(TITLE "20%%";);
```

If the argument for one of these functions contains a character string with the comment symbols **`/*`** and **`-->`**, use a %STR function with each character. For example, consider these statements:

```
%let instruct=Comments can start with %str(/)%str(*).;
%put &instruct;
```

They write the following line to the log:

```
Comments can start with /*
```

*Note:* Unexpected results can occur if the comment symbols are not quoted with a quoting function.

For more information about macro quoting, see "Macro Quoting" on page 80.

## Macro Functions for Double-Byte Character Set (DBCS)

Because East Asian languages have thousands of characters, double (two) bytes of information are needed to represent each character. Each East Asian language usually has more than one DBCS encoding system. SAS processes the DBCS encoding information that is unique for the major East Asian languages. The following table defines the macro functions that support DBCS.

***Table 12.7*** *Macro Functions for DBCS*

| Functions | Description |
|---|---|
| %KCMPRES | Compresses multiple blanks and removes leading and trailing blanks. |
| %KINDEX | Returns the position of the first character of a string. |
| %KLEFT and %QKLEFT | Left-aligns an argument by removing leading blanks. |
| %KLENGTH | Returns the length of a string. |
| %KSCAN and %QKSCAN | Searches for a word that is specified by its position in a string. |
| %KSUBSTR and %QKSUBSTR | %KSUBSTR and %QKSUBSTR produces a substring of a character string. |
| %KUPCASE and %QKUPCASE | Converts values to uppercase. |

For more information, see "Dictionary of Macro Functions for NLS" in *SAS Viya National Language Support: Reference Guide*.

## Other Macro Functions

Seven other macro functions do not fit into the earlier categories, but they provide important information. The following table lists these functions.

***Table 12.8*** *Other Macro Functions*

| Function | Description |
|---|---|
| %SYMEXIST | Returns an indication as to whether the named macro variable exists. |
| %SYMGLOBL | Returns an indication as to whether the named macro variable is global in scope. |
| %SYMLOCAL | Returns an indication as to whether the named macro variable is local in scope. |

| Function | Description |
|---|---|
| %SYSFUNC, %QSYSFUNC | Execute SAS language functions or user-written functions within the macro facility. |
| %SYSGET | Returns the value of the specified host environment variable. For more information, see the SAS Companion for your operating environment. |
| %SYSPROD | Reports whether a SAS software product is licensed at the site. |

The %SYSFUNC and %QSYSFUNC functions enable the following:

- most of the functions from SAS software
- a function written with the SAS/TOOLKIT software
- a function created using the FCMP procedure available to the macro facility

Consider the following examples:

```
/* in a DATA step or SCL program */
   dsid=open(".Houses","i");
/* in the macro facility */
   %let dsid = %sysfunc(open(.Houses,i));
```

For more information, see "%SYSFUNC and %QSYSFUNC Functions" on page 273.

# Automatic Macro Variables

Automatic macro variables are created by the macro processor and they supply a variety of information. They are useful in programs to check the status of a condition before executing code. You reference automatic macro variables such as &SYSLAST or &SYSJOBID the same way you do macro variables that you create.

***CAUTION:***

**Do not create macro variable names that begin with SYS.** The three-letter prefix SYS is reserved for use by SAS for automatic macro variables. For a complete list of reserved words in the macro language, see Appendix 1, " Reserved Words in the Macro Facility," on page 365.

For example, suppose you want to include the day and date that your current SAS session was invoked. Write the FOOTNOTE statement to reference the automatic macro variables SYSDAY and SYSDATE9:

```
footnote "Report for &sysday, &sysdate9";
```

If the current SAS session was invoked on June 13, 2007, macro variable resolution causes SAS to see this statement:

```
FOOTNOTE "Report for Friday, 13JUN2007";
```

All automatic variables except for SYSPBUFF are global and are created when you invoke SAS. The following table lists the automatic macro variables and describes their Read and Write status.

***Table 12.9*** *Automatic Macro Variables*

| Variable | Read and Write Status |
|---|---|
| SYSADDRBITS | Read-only |
| SYSBUFFR | Read and write |
| SYSCC | Read and write |
| SYSCHARWIDTH | Read-only |
| SYSCMD | Read and write |
| SYSDATASTEPPHASE | Read-only |
| SYSDATE | Read-only |
| SYSDATE9 | Read-only |
| SYSDAY | Read-only |
| SYSDEVIC | Obsolete |
| SYSDMG | Read and write |
| SYSDSN | Read and write |
| SYSENCODING | Read-only |
| SYSENDIAN | Read-only |
| SYSENV | Read-only |
| SYSERR | Read-only |
| SYSERRORTEXT | Read-only |
| SYSFILRC | Read and write |
| SYSHOSTINFOLONG | Read-only |
| SYSHOSTNAME | Read-only |
| SYSINCLUDEFILEDEVICE | Read-only |
| SYSINCLUDEFILEDIR | Read-only |
| SYSINCLUDEFILEFILEREF | Read-only |
| SYSINCLUDEFILENAME | Read-only |

| Variable | Read and Write Status |
|---|---|
| SYSINDEX | Read-only |
| SYSINFO | Read-only |
| SYSJOBID | Read-only |
| SYSLAST | Read and write |
| SYSLCKRC | Read and write |
| SYSLIBRC | Read and write |
| SYSLOGAPPLNAME | Read-only |
| SYSMACRONAME | Read-only |
| SYSMAXLONG | Read-only |
| SYSMENV | Read-only |
| SYSMSG | Obsolete |
| SYSNCPU | Read-only |
| SYSNOBS | Read-only |
| SYSODSESCAPECHAR | Read-only |
| SYSODSPATH | Read-only |
| SYSPARM | Read and write |
| SYSPBUFF | Read and write |
| SYSPRINTTOLIST | Read-only |
| SYSPRINTTOLOG | Read-only |
| SYSPROCESSID | Read-only |
| SYSPROCESSMODE | Read-only |
| SYSPROCESSNAME | Read-only |
| SYSPROCNAME | Read-only |
| SYSRC | Obsolete |
| SYSSCP | Read-only |

| Variable | Read and Write Status |
|---|---|
| SYSSCPL | Read-only |
| SYSSITE | Read-only |
| SYSSIZEOFLONG | Read-only |
| SYSSIZEOFPTR | Read-only |
| SYSSIZEOFUNICODE | Read-only |
| SYSSTARTNAME | Read-only |
| SYSTCPIPHOSTNAME | Read-only |
| SYSTIME | Read-only |
| SYSTIMEZONE | Read-only |
| SYSTIMEZONEIDENT | Read-only |
| SYSTIMEZONEOFFSET | Read-only |
| SYSUSERID | Read-only |
| SYSVER | Read-only |
| SYSVLONG | Read-only |
| SYSVLONG4 | Read-only |
| SYSWARNINGTEXT | Read-only |

# Interfaces with the Macro Facility

The DATA step, the SAS Component Language, and the SQL procedure provide interfaces with the macro facility. The following tables list the elements that interact with the SAS macro facility.

The DATA step provides elements that enable a program to interact with the macro facility during DATA step execution.

***Table 12.10*** *Interfaces to the DATA Steps*

| Element | Description |
|---|---|
| EXECUTE routine | Resolves an argument and executes the resolved value at the next step boundary. |

| Element | Description |
|---|---|
| RESOLVE function | Resolves the value of a text expression during DATA step execution. |
| SYMDEL routine | Deletes the indicated macro variable named in the argument. |
| SYMEXIST function | Returns an indication as to whether the named macro variable exists. |
| SYMGET function | Returns the value of a macro variable to the DATA step during DATA step execution. |
| SYMGLOBL function | Returns an indication as to whether the named macro variable is global in scope. |
| SYMLOCAL function | Returns an indication as to whether the named macro variable is local in scope. |
| SYMPUT and SYMPUTX routines | Assigns a value produced in a DATA step to a macro variable. |

The SAS Component Language (SCL) provides two elements for using the SAS macro facility to define macros and macro variables for SCL programs.

***Table 12.11*** *Interfaces to the SAS Component Language*

| Element | Description |
|---|---|
| SYMGETN | Returns the value of a global macro variable as a numeric value. |
| SYMPUTN | Assigns a numeric value to a global macro variable. |

The SQL procedure provides a feature for creating and updating macro variables with values produced by the SQL procedure.

***Table 12.12*** *Interfaces to the SQL Procedure*

| Element | Description |
|---|---|
| INTO | Assigns the result of a calculation or the value of a data column. |

For more information, see “Interfaces with the Macro Facility” on page 99.

# Selected Autocall Macros Provided with SAS Software

## Overview of Provided Autocall Macros

SAS supplies libraries of autocall macros to each SAS site. The libraries that you receive depend on the SAS products licensed at your site. You can use autocall macros without having to define or include them in your programs.

When SAS is installed, the autocall libraries are included in the value of the SASAUTOS system option in the system configuration file. The autocall macros are stored as individual members, each containing a macro definition. Each member has the same name as the macro definition that it contains.

Although the macros available in the autocall libraries supplied by SAS are working utility programs, you can also use them as models for your own routines. In addition, you can call them in macros that you write yourself.

To explore these macro definitions, browse the commented section at the beginning of each member. See the setting of SAS system option SASAUTOS, to find the location of the autocall libraries. To view the SASAUTOS value, use one of the following:

- the OPTIONS procedure
- the VERBOSE system option
- the OPLIST system option

For more information about these options, see “SAS System Options,” in *SAS Viya System Options: Reference*.

The following table lists selected autocall macros.

***Table 12.13*** *Selected Autocall Macros*

| Macro | Description |
|---|---|
| CMPRES and QCMPRES | Compresses multiple blanks and removes leading and trailing blanks. QCMPRES masks the result so that special characters and mnemonic operators are treated as text instead of being interpreted by the macro facility. |
| COMPSTOR | Compiles macros and stores them in a catalog in a permanent SAS library. |
| DATATYP | Returns the data type of a value. |
| LEFT and QLEFT | Left-aligns an argument by removing leading blanks. QLEFT masks the result so that special characters and mnemonic operators are treated as text instead of being interpreted by the macro facility. |
| SYSRC | Returns a value corresponding to an error condition. |

| Macro | Description |
|---|---|
| TRIM and QTRIM | Trims trailing blanks. QTRIM masks the result so that special characters and mnemonic operators are treated as text instead of being interpreted by the macro facility. |
| VERIFY | Returns the position of the first character unique to an expression. |

## Required System Options for Autocall Macros

To use autocall macros, you must set two SAS system options:

MAUTOSOURCE
activates the autocall facility. NOMAUTOSOURCE disables the autocall facility.

SASAUTOS=*library-specification* | (*library-specification-1*..., *library-specification-n*)
specifies the autocall library or libraries. For more information, see the SAS companion for your operating system.

If your site has installed the autocall libraries supplied by SAS and uses the standard configuration of SAS software supplied by SAS, you need only to ensure that the SAS system option MAUTOSOURCE is in effect to begin using the autocall macros.

Although the MAUTOLOCDISPLAY system option is not required, it displays the source location of the autocall macros in the log when the autocall macro is invoked. For more information, see "MAUTOLOCDISPLAY System Option" on page 334.

## Using Autocall Macros

To use an autocall macro, call it in your program with the statement %*macro-name*. The macro processor searches first in the Work library for a compiled macro definition with that name. If the macro processor does not find a compiled macro and if the MAUTOSOURCE is in effect, the macro processor searches the libraries specified by the SASAUTOS option for a member with that name. When the macro processor finds the member, it does the following:

1. compiles all of the source statements in that member, including all macro definitions
2. executes any open code (macro statements or SAS source statements not within any macro definition) in that member
3. executes the macro with the name that you invoked

After the macro is compiled, it is stored in the Work.SASMACR catalog and is available for use in the SAS session without having to be recompiled.

You can also create your own autocall macros and store them in libraries for easy execution. For more information, see Chapter 9, "Storing and Reusing Macros," on page 111.

## Autocall Macros for Double-Byte Character Set (DBCS)

Because East Asian languages have thousands of characters, double (two) bytes of information are needed to represent each character. Each East Asian language usually has more than one DBCS encoding system. SAS processes the DBCS encoding

information that is unique for the major East Asian languages. The following table contains definitions for the autocall macros that support DBCS.

***Table 12.14*** *Autocall Macros for DBCS*

| Autocall Macros | Description |
|---|---|
| %KLOWCASE and %QKLOWCAS | Changes the uppercase characters to lowercase. |
| %KTRIM and %QKTRIM | Trims the trailing blanks. |
| %KVERIFY | Returns the position of the first character unique to an expression. |

For more information, see "Dictionary of Autocall Macros for NLS" in *SAS Viya National Language Support: Reference Guide*.

## Selected System Options Used in the Macro Facility

The following table lists the SAS system options that apply to the macro facility.

***Table 12.15*** *System Options Used in the Macro Facility*

| Option | Description |
|---|---|
| CMDMAC | Obsolete |
| IMPLMAC | Controls statement-style macro invocation. |
| MACRO | Controls whether the SAS macro language is available. |
| MAUTOCOMPLOC | Displays in the log the source location of the autocall macros when the autocall macro is compiled. |
| MAUTOLOCDISPLAY | Displays the source location of the autocall macros in the log when the autocall macro is invoked. |
| MAUTOLOCINDES | Specifies whether the macro processor prepends the full pathname of the autocall source file to the description field of the catalog entry of compiled auto call macro definition in the Work.SASMACR catalog. |
| MAUTOSOURCE | Controls whether the macro autocall feature is available. |
| MCOMPILE | Allows new definitions of macros. |
| MCOMPILENOTE | Issues a NOTE to the log upon the completion of the compilation of a macro. |
| MCOVERAGE | Enables the generation of coverage analysis data. |

| Option | Description |
|---|---|
| MCOVERAGELOC | Specifies the location of the coverage analysis data file. |
| MERROR | Controls whether the macro processor issues a warning message when a macro-like name (*%name*) does not match a compiled macro. |
| MEXECNOTE | Displays macro execution information in the log at macro invocation. |
| MEXECSIZE | Specifies the maximum macro size that can be executed in memory. |
| MFILE | Determines whether MPRINT output is routed to an external file. |
| MINDELIMITER | Specifies the character to be used as the delimiter for the macro IN operator. |
| MINOPERATOR | Controls whether the macro processor recognizes the IN (#) logical operator. |
| MLOGIC | Controls whether macro execution is traced for debugging. |
| MLOGICNEST | Allows the macro nesting information to be displayed in the MLOGIC output in the log. |
| MPRINT | Controls whether SAS statements generated by macro execution are traced for debugging. |
| MPRINTNEST | Allows the macro nesting information to be displayed in the MPRINT output in the log. |
| MRECALL | Controls whether the macro processor searches the autocall libraries for a member that was not found during an earlier search. |
| MREPLACE | Enables existing macros to be redefined. |
| MSTORED | Controls whether stored compiled macros are available. |
| MSYMTABMAX | Specifies the maximum amount of memory available to the macro variable symbol table or tables. |
| MVARSIZE | Specifies the maximum size for in-memory macro variable values. |
| SASAUTOS | Specifies one or more autocall libraries. |
| SASMSTORE | Specifies the libref of a SAS library containing a catalog of stored compiled SAS macros. |

| Option | Description |
|---|---|
| SERROR | Controls whether the macro processor issues a warning message when a macro variable reference does not match a macro variable. |
| SYMBOLGEN | Controls whether the results of resolving macro variable references are displayed for debugging. |
| SYSPARM | Specifies a character string that can be passed to SAS programs. |

# Part 2

# Macro Language Dictionary

*Chapter 13*
***AutoCall Macros*** . . . . . *175*

*Chapter 14*
***Automatic Macro Variables*** . . . . . *193*

*Chapter 15*
***DATA Step Call Routines for Macros*** . . . . . *227*

*Chapter 16*
***DATA Step Functions for Macros*** . . . . . *239*

*Chapter 17*
***Macro Functions*** . . . . . *249*

*Chapter 18*
***SQL Clauses for Macros*** . . . . . *287*

*Chapter 19*
***Macro Statements*** . . . . . *291*

*Chapter 20*
***System Options for Macros*** . . . . . *331*

*Chapter 13*

# AutoCall Macros

**AutoCall Macros** . . . . . **175**

**Dictionary** . . . . . **175**
%CMPRES and %QCMPRES Autocall Macros . . . . . 175
%COMPSTOR Autocall Macro . . . . . 177
%DATATYP Autocall Macro . . . . . 177
%KVERIFY Autocall Macro . . . . . 178
%LEFT Autocall Macro . . . . . 179
%LOWCASE and %QLOWCASE Autocall Macros . . . . . 180
%QCMPRES Autocall Macro . . . . . 181
%QLEFT Autocall Macro . . . . . 181
%QLOWCASE Autocall Macro . . . . . 182
%QTRIM Autocall Macro . . . . . 183
%SYSRC Autocall Macro . . . . . 183
%TRIM and %QTRIM Autocall Macro . . . . . 188
%VERIFY Autocall Macro . . . . . 190

## AutoCall Macros

SAS supplies libraries of autocall macros to each SAS site. The libraries that you receive depend on the SAS products licensed at your site. You can use autocall macros without having to define or include them in your programs.

## Dictionary

### %CMPRES and %QCMPRES Autocall Macros

Compress multiple blanks and remove leading and trailing blanks.

**Type:** Autocall macros

**Requirement:** MAUTOSOURCE system option

## Syntax

**%CMPRES** (*text* | *text-expression*)

**%QCMPRES** (*text* | *text-expression*)

## Details

*Note:* Autocall macros are included in a library supplied by SAS Institute. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see "Storing and Reusing Macros" on page 111.

The CMPRES and QCMPRES macros compress multiple blanks and remove leading and trailing blanks. If the argument might contain a special character or mnemonic operator, listed below, use %QCMPRES.

CMPRES returns an unquoted result, even if the argument is quoted. QCMPRES produces a result with the following special characters and mnemonic operators masked, so the macro processor interprets them as text instead of as elements of the macro language:

```
& % ' " ( ) + - * / < > = ¬ ^ ~ ; , # blank
AND OR NOT EQ NE LE LT GE GT IN
```

## Examples

### Example 1: Removing Unnecessary Blanks with %CMPRES

```
%macro createft;
   %let footnote="The result of &x &op &y is %eval(&x &op &y).";
   footnote1 &footnote;
   footnote2 %cmpres(&footnote);
%mend createft;
data _null_;
   x=5;
   y=10;
   call symput('x',x);    /* Uses BEST12. format */
   call symput('y',y);    /* Uses BEST12. format */
   call symput('op','+'); /* Uses $1. format     */
run;
%createft
```

The CREATEFT macro generates two footnote statements.

```
FOOTNOTE1 "The result of 5 + _________10 is _________15.";
FOOTNOTE2 "The result of 5 + 10 is 15.";
```

### Example 2: Contrasting %QCMPRES and %CMPRES

```
%let x=5;
%let y=10;
%let a=%nrstr(%eval(&x   +   &y));
%put QCMPRES: %qcmpres(&a);
%put CMPRES: %cmpres(&a);
```

The %PUT statements write the following lines to the log:

```
QCMPRES: %eval(&x + &y)
```

```
CMPRES: 15
```

## %COMPSTOR Autocall Macro

Compiles macros and stores them in a catalog in a permanent SAS library.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

### Syntax

**%COMPSTOR**(PATHNAME=*SAS-data-library*)

#### *Required Argument*

***SAS-data-library***
is the physical name of a SASdata library on your host system. The COMPSTOR macro uses this value to automatically assign a libref. Do not enclose *SAS-data-library* in quotation marks.

### Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see "Storing and Reusing Macros" on page 111.

The COMPSTOR macro compiles the following autocall macros in a SAS catalog named SASMACR in a permanent SAS library. The overhead of compiling is saved when these macros are called for the first time in a SAS session. You can use the COMPSTOR macro as an example of how to create compiled stored macros. For more information about the autocall macros that are supplied by SAS or about using stored compiled macros, see "Storing and Reusing Macros" on page 111.

| | |
|---|---|
| %CMPRES | %QLEFT |
| %DATATYP | %QTRIM |
| %LEFT | %TRIM |
| %QCMPRES | %VERIFY |

## %DATATYP Autocall Macro

Returns the data type of a value.

**Type:** Autocall macro

**Restriction:** Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel.

**Requirement:** MAUTOSOURCE system option

## Syntax

**%DATATYP** (*text* | *text-expression*)

## Details

The DATATYP macro returns a value of **NUMERIC** when an argument consists of digits and a leading plus or minus sign, a decimal, or a scientific or floating-point exponent (E or D in uppercase or lowercase letters). Otherwise, it returns the value **CHAR.**

*Note:* %DATATYP does not identify hexadecimal numbers.

## Example: Determining the Data Type of a Value

```
%macro add(a,b);
%if (%datatyp(&a)=NUMERIC and %datatyp(&b)=NUMERIC) %then %do;
    %put The result is %sysevalf(&a+&b).;
%end;
%else %do;
   %put Error:  Addition requires numbers.;
%end;
%mend add;
```

You can invoke the ADD macro:

```
%add(5.1E2,225)
```

The macro then writes this message to the log:

```
The result is 735.
```

Similarly, you can invoke the ADD macro:

```
%add(0c1x, 12)
```

The macro then writes this message to the log:

```
Error:  Addition requires numbers.
```

# %KVERIFY Autocall Macro

Returns the position of the first character unique to an expression.

**Category:** DBCS

**Type:** Autocall macro for NLS

**Requirement:** MAUTOSOURCE system option

## Syntax

**%KVERIFY**(*source*, *excerpt*)

### *Required Arguments*

**source**
text or a text expression. This is the text that you want to examine for characters that do not exist in the excerpt.

**excerpt**
text or a text expression. This is the text that defines the set of characters that %KVERIFY uses to examine the source.

## Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel.

%KVERIFY returns the position of the first character in the source that is not also present in excerpt. If all the characters in source are present in the excerpt, %KVERIFY returns a value of 0.

# %LEFT Autocall Macro

Left-align an argument by removing leading blanks.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

## Syntax

**%LEFT**(*text* | *text-expression*)

## Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see "Storing and Reusing Macros" on page 111.

The LEFT macro and the QLEFT macro both left-align arguments by removing leading blanks. If the argument might contain a special character or mnemonic operator, listed below, use %QLEFT.

%LEFT returns an unquoted result, even if the argument is quoted. %QLEFT produces a result with the following special characters and mnemonic operators masked so that the macro processor interprets them as text instead of as elements of the macro language:

```
& % ' " ( ) + - * / < > = ¬ ^ ~ ; , # blank
AND OR NOT EQ NE LE LT GE GT IN
```

## Example: Contrasting %LEFT and %QLEFT

In this example, both the LEFT and QLEFT macros remove leading blanks. However, the QLEFT macro protects the leading **&** in the macro variable SYSDAY so that it does not resolve.

```
%let d=%nrstr(   &sysday   );
%put *&d* *%qleft(&d)* *%left(&d)*;
```

The %PUT statement writes the following line to the log:

```
*   &sysday    * *&sysday   * *Tuesday   *
```

## %LOWCASE and %QLOWCASE Autocall Macros

Change uppercase characters to lowercase.

**Type:** Autocall macros

**Requirement:** MAUTOSOURCE system option

### Syntax

**%LOWCASE** *text* | *text-expression*()

**%QLOWCASE** (*text* | *text-expression*)

### Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see "Storing and Reusing Macros" on page 111.

The %LOWCASE and %QLOWCASE macros change uppercase alphabetic characters to their lowercase equivalents. If the argument might contain a special character or mnemonic operator, listed below, use %QLOWCASE.

%LOWCASE returns a result without quotation marks, even if the argument has quotation marks. %QLOWCASE produces a result with the following special characters and mnemonic operators masked so that the macro processor interprets them as text instead of as elements of the macro language:

```
& % ' " ( ) + - * / < > = ¬ ^ ~ ; , # blank
AND OR NOT EQ NE LE LT GE GT IN
```

### Example: Creating a Title with Initial Letters Capitalized

```
%macro initcaps(title);
   %global newtitle;
   %let newtitle=;
   %let lastchar=;
   %do i=1 %to %length(&title);
      %let char=%qsubstr(&title,&i,1);
      %if (&lastchar=%str( ) or &i=1) %then %let char=%qupcase(&char);
      %else %let char=%qlowcase(&char);
      %let newtitle=&newtitle&char;
      %let lastchar=&char;
   %end;
   TITLE "&newtitle";
```

```
%mend;
%initcaps(%str(sales: COMMAND REFERENCE, VERSION 2, SECOND EDITION))
```

Submitting this example generates the following statement:

```
TITLE "Sales: Command Reference, Version 2, Second Edition";
```

## %QCMPRES Autocall Macro

Compresses multiple blanks, removes leading and trailing blanks, and returns a result that masks special characters and mnemonic operators.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

### Syntax

**%QCMPRES** (*text* | *text-expression*)

#### *Without Arguments*

See "%CMPRES and %QCMPRES Autocall Macros" on page 175.

### Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see "Storing and Reusing Macros" on page 111.

## %QLEFT Autocall Macro

Left-aligns an argument by removing leading blanks and returns a result that masks special characters and mnemonic operators.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

### Syntax

**%QLEFT** *text* | *text-expression*()

#### *Without Arguments*

See "%LEFT Autocall Macro" on page 179.

### Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS

support personnel. For more information, see “Storing and Reusing Macros” on page 111.

The LEFT macro and the QLEFT macro both left-align arguments by removing leading blanks. If the argument might contain a special character or mnemonic operator, listed below, use %QLEFT.

%LEFT returns an unquoted result, even if the argument is quoted. %QLEFT produces a result with the following special characters and mnemonic operators masked so that the macro processor interprets them as text instead of as elements of the macro language:

```
& % ' " ( ) + – * / < > = ¬ ^ ~ ; , # blank
AND OR NOT EQ NE LE LT GE GT IN
```

### Example: Contrasting %LEFT and %QLEFT

In this example, both the LEFT and QLEFT macros remove leading blanks. However, the QLEFT macro protects the leading **&** in the macro variable SYSDAY so that it does not resolve.

```
%let d=%nrstr(   &sysday   );
%put *&d* *%qleft(&d)* *%left(&d)*;
```

The %PUT statement writes the following line to the log:

```
*   &sysday    * *&sysday   * *Tuesday   *
```

## %QLOWCASE Autocall Macro

Changes uppercase characters to lowercase and returns a result that masks special characters and mnemonic operators.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

### Syntax

**%QLOWCASE**(*text* | *text-expression*)

#### *Without Arguments*

See “%LOWCASE and %QLOWCASE Autocall Macros” on page 180.

### Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see “Storing and Reusing Macros” on page 111.

## %QTRIM Autocall Macro

Trims trailing blanks and returns a result that masks special characters and mnemonic operators.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

### Syntax

**%QTRIM** (*text* | *text-expression*)

#### *Without Arguments*

See "%TRIM and %QTRIM Autocall Macro" on page 188.

### Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see "Storing and Reusing Macros" on page 111.

## %SYSRC Autocall Macro

Returns a value corresponding to an error condition.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

### Syntax

**%SYSRC**(*character-string*)

#### *Required Argument*

***character-string***
is one of the mnemonic values listed in Table 13.1 on page 184 or a text expression that produces the mnemonic value.

### Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see "Storing and Reusing Macros" on page 111.

The SYSRC macro enables you to test for return codes produced by SCL functions, the MODIFY statement, and the SET statement with the KEY= option. The SYSRC autocall

macro tests for the error conditions by using mnemonic strings rather than the numeric values associated with the error conditions.

When you invoke the SYSRC macro with a mnemonic string, the macro generates a SAS return code. The mnemonics are easier to read than the numeric values, which are not intuitive and subject to change.

You can test for specific errors in SCL functions by comparing the value returned by the function with the value returned by the SYSRC macro with the corresponding mnemonic. To test for errors in the most recent MODIFY or SET statement with the KEY= option, compare the value of the _IORC_ automatic variable with the value returned by the SYSRC macro when you invoke it with the value of the appropriate mnemonic.

The following table lists the mnemonic values to specify with the SYSRC function and a description of the corresponding error.

***Table 13.1*** *Mnemonics for Warning and Error Conditions*

| Mnemonic | Description |
|---|---|
| Library Assign or Deassign Messages | |
| _SEDUPLB | The libref refers to the same physical library as another libref. |
| _SEIBASN | The specified libref is not assigned. |
| _SEINUSE | The library or member is not available for use. |
| _SEINVLB | The library is not in a valid format for the access method. |
| _SEINVLN | The libref is not valid. |
| _SELBACC | The action requested cannot be performed because you do not have the required access level on the library. |
| _SELBUSE | The library is still in use. |
| _SELGASN | The specified libref is not assigned. |
| _SENOASN | The libref is not assigned. |
| _SENOLNM | The libref is not available for use. |
| _SESEQLB | The library is in sequential (tape) format. |
| _SWDUPLB | The libref refers to the same physical file as another libref. |
| _SWNOLIB | The library does not exist. |
| Fileref Messages | |
| _SELOGNM | The fileref is assigned to an invalid file. |

| Mnemonic | Description |
|---|---|
| _SWLNASN | The fileref is not assigned. |
| SAS Data Set Messages | |
| _DSENMR | The TRANSACTION data set observation does not exist in the MASTER data set. |
| _DSEMTR | Multiple TRANSACTION data set observations do not exist in MASTER data set. |
| _DSENOM | No matching observation was found in MASTER data set. |
| _SEBAUTH | The data set has passwords. |
| _SEBDIND | The index name is not a valid SAS name. |
| _SEDSMOD | The data set is not open in the correct mode for the specified operation. |
| _SEDTLEN | The data length is invalid. |
| _SEINDCF | The new name conflicts with an index name. |
| _SEINVMD | The open mode is invalid. |
| _SEINVPN | The physical name is invalid. |
| _SEMBACC | You do not have the level of access required to open the data set in the requested mode. |
| _SENOLCK | A record-level lock is not available. |
| _SENOMAC | Member-level access to the data set is denied. |
| _SENOSAS | The file is not a SAS data set. |
| _SEVARCF | The new name conflicts with an existing variable name. |
| _SWBOF | You tried to read the previous observation when you were on the first observation. |
| _SWNOWHR | The record no longer satisfies the WHERE clause. |
| _SWSEQ | The task requires reading observations in a random order, but the engine that you are using allows only sequential access. |
| _SWWAUG | The WHERE clause has been augmented. |
| _SWWCLR | The WHERE clause has been cleared. |
| _SWWREP | The WHERE clause has been replaced. |

| Mnemonic | Description |
|---|---|
| SAS File Open and Update Messages | |
| _SEBDSNM | The filename is not a valid SAS name. |
| _SEDLREC | The record has been deleted from the file. |
| _SEFOPEN | The file is currently open. |
| _SEINVON | The option name is invalid. |
| _SEINVOV | The option value is invalid. |
| _SEINVPS | The value of the File Data Buffer pointer is invalid. |
| _SELOCK | The file is locked by another user. |
| _SENOACC | You do not have the level of access required to open the file in the requested mode. |
| _SENOALL | _ALL_ is not allowed as part of a filename in this release. |
| _SENOCHN | The record was not changed because it would cause a duplicate value for an index that does not allow duplicates. |
| _SENODEL | Records cannot be deleted from this file. |
| _SENODLT | The file could not be deleted. |
| _SENOERT | The file is not open for writing. |
| _SENOOAC | You are not authorized for the requested open mode. |
| _SENOOPN | The file or directory is not open. |
| _SENOPF | The physical file does not exist. |
| _SENORD | The file is not opened for reading. |
| _SENORDX | The file is not radix addressable. |
| _SENOTRD | No record has been read from the file yet. |
| _SENOUPD | The file cannot be opened for update because the engine is read only. |
| _SENOWRT | You do not have Write access to the member. |
| _SEOBJLK | The file or directory is in exclusive use by another user. |
| _SERECRD | No records have been read from the input file. |

| Mnemonic | Description |
|---|---|
| _SWACMEM | Access to the directory will be provided one member at a time. |
| _SWDLREC | The record has been deleted from file. |
| _SWEOF | End of file. |
| _SWNOFLE | The file does not exist. |
| _SWNOPF | The file or directory does not exist. |
| _SWNOREP | The file was not replaced because of the NOREPLACE option. |
| _SWNOTFL | The item pointed to exists but is not a file. |
| _SWNOUPD | This record cannot be updated at this time. |
| Library/Member/Entry Messages | |
| _SEBDMT | The member type specification is invalid. |
| _SEDLT | The member was not deleted. |
| _SELKUSR | The library or library member is locked by another user. |
| _SEMLEN | The member name is too long for this system. |
| _SENOLKH | The library or library member is not currently locked. |
| _SENOMEM | The member does not exist. |
| _SWKNXL | You have locked a library, member, or entry, that does not exist yet. |
| _SWLKUSR | The library or library member is locked by another user. |
| _SWLKYOU | You have already locked the library or library member. |
| _SWNOLKH | The library or library member is not currently locked. |
| Miscellaneous Operations | |
| _SEDEVOF | The device is offline or unavailable. |
| _SEDSKFL | The disk or tape is full. |
| _SEINVDV | The device type is invalid. |
| _SENORNG | There is no write ring in the tape opened for Write access. |

| Mnemonic | Description |
|---|---|
| _SOK | The function was successful. |
| _SWINVCC | The carriage-control character is invalid. |
| _SWNODSK | The device is not a disk. |
| _SWPAUAC | Pause in I/O, process accumulated data up to this point. |
| _SWPAUSL | Pause in I/O, slide data window forward and process accumulated data up to this point. |
| _SWPAUU1 | Pause in I/O, extra user control point 1. |
| _SWPAUU2 | Pause in I/O, extra user control point 2. |

### Comparisons

The SYSRC autocall macro and the SYSRC automatic macro variable are not the same. For more information, see "SYSRC Automatic Macro Variable" on page 217.

### Example: Examining the Value of _IORC_

The following DATA step illustrates using the autocall macro SYSRC and the automatic variable _IORC_ to control writing a message to the log:

```
data big;
   modify big trans;
   by id;
   if _iorc_=%sysrc(_dsenmr) then put 'WARNING: Check ID=' id;
run;
```

## %TRIM and %QTRIM Autocall Macro

Trim trailing blanks.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

### Syntax

**%TRIM**(*text* | *text-expression*)

**%QTRIM**(*text* | *text-expression*)

### Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS

support personnel. For more information, see "Storing and Reusing Macros" on page 111.

The TRIM macro and the QTRIM macro both trim trailing blanks. If the argument contains a special character or mnemonic operator, listed below, use %QTRIM.

QTRIM produces a result with the following special characters and mnemonic operators masked so that the macro processor interprets them as text instead of as elements of the macro language:

```
& % ' " ( ) + - * / < > = ¬ ° ~ ; , #  blank
AND OR NOT EQ NE LE LT GE GT IN
```

## Examples

### *Example 1: Removing Trailing Blanks*

In this example, the TRIM autocall macro removes the trailing blanks from a message that is written to the log.

```
%macro numobs(dsn);
%local num;
data _null_;
   set &dsn nobs=count;
   call symput('num', left(put(count,8.)));
   stop;
   run;
    %if &num eq 0 %then
       %put There were NO observations in %upcase(&dsn).;
    %else
       %put There were %trim(&num) observations in %upcase(&dsn).;
%mend numobs;
%numobs(sample)
```

Invoking the NUMOBS macro generates the following statements:

```
DATA _NULL_;
SET SAMPLE NOBS=COUNT;
CALL SYMPUT('num', LEFT(PUT(COUNT,8.)));
STOP;
RUN;
```

If the data set Sample contains six observations, then the %PUT statement writes this line to the log:

```
There were 6 observations in SAMPLE.
```

### *Example 2: Contrasting %TRIM and %QTRIM*

These statements are executed January 28, 1999:

```
%let date=%nrstr(   &sysdate   );
%put *&date* *%qtrim(&date)* *%trim(&date)*;
```

The %PUT statement writes this line to the log:

```
*   &sysdate   * *   &sysdate* *   28JAN99*
```

# %VERIFY Autocall Macro

Returns the position of the first character unique to an expression.

**Type:** Autocall macro

**Requirement:** MAUTOSOURCE system option

## Syntax

**%VERIFY**(*source*, *excerpt*)

### *Required Arguments*

***source***
is text or a text expression that you want to examine for characters that do not exist in *excerpt*.

***excerpt***
is text or a text expression. This is the text that defines the set of characters that %VERIFY uses to examine *source*.

## Details

*Note:* Autocall macros are included in a library supplied by SAS. This library might not be installed at your site or might be a site-specific version. If you cannot access this macro or if you want to find out if it is a site-specific version, see your on-site SAS support personnel. For more information, see "Storing and Reusing Macros" on page 111.

%VERIFY returns the position of the first character in *source* that is not also present in *excerpt*. If all characters in *source* are present in *excerpt*, %VERIFY returns 0.

## Example: Testing for a Valid Fileref

The ISNAME macro checks a string to verify that it is a valid fileref and prints a message in the log that explains why a string is or is not valid.

```
%macro isname(name);
    %let name=%upcase(&name);
    %if %length(&name)>8 %then
       %put &name: The fileref must be 8 characters or less.;
    %else %do;
       %let first=ABCDEFGHIJKLMNOPQRSTUVWXYZ_;
       %let all=&first.1234567890;
       %let chk_1st=%verify(%substr(&name,1,1),&first);
       %let chk_rest=%verify(&name,&all);
       %if &chk_rest>0 %then
          %put &name: The fileref cannot contain
              "%substr(&name,&chk_rest,1)".;
       %if &chk_1st>0 %then
          %put &name: The first character cannot be
              "%substr(&name,1,1)".;
       %if (&chk_1st or &chk_rest)=0  %then
          %put &name is a valid fileref.;
```

```
    %end;
 %mend isname;
%isname(file1)
%isname(1file)
%isname(filename1)
%isname(file$)
```

When this program executes, the following is written to the log:

```
FILE1 is a valid fileref.
1FILE: The first character cannot be "1".
FILENAME1: The fileref must be 8 characters or less.
FILE$: The fileref cannot contain "$".
```

*Chapter 14*

# Automatic Macro Variables

**Automatic Macro Variables** . . . . . **194**

**Dictionary** . . . . . **194**
SYSADDRBITS Automatic Macro Variable . . . . . 194
SYSBUFFR Automatic Macro Variable . . . . . 195
SYSCC Automatic Macro Variable . . . . . 195
SYSCHARWIDTH Automatic Macro Variable . . . . . 196
SYSCMD Automatic Macro Variable . . . . . 196
SYSDATASTEPPHASE Automatic Macro Variable . . . . . 196
SYSDATE Automatic Macro Variable . . . . . 197
SYSDATE9 Automatic Macro Variable . . . . . 198
SYSDATE9 Automatic Macro Variable . . . . . 199
SYSDAY Automatic Macro Variable . . . . . 199
SYSDEVIC Automatic Macro Variable . . . . . 200
SYSDMG Automatic Macro Variable . . . . . 200
SYSDSN Automatic Macro Variable . . . . . 201
SYSENCODING Automatic Macro Variable . . . . . 202
SYSENDIAN Automatic Macro Variable . . . . . 202
SYSENV Automatic Macro Variable . . . . . 202
SYSERR Automatic Macro Variable . . . . . 203
SYSERRORTEXT Automatic Macro Variable . . . . . 205
SYSFILRC Automatic Macro Variable . . . . . 206
SYSHOSTINFOLONG Automatic Macro Variable . . . . . 206
SYSHOSTNAME Automatic Macro Variable . . . . . 207
SYSINCLUDEFILEDEVICE Automatic Macro Variable . . . . . 207
SYSINCLUDEFILEDIR Automatic Macro Variable . . . . . 207
SYSINCLUDEFILEFILEREF Automatic Macro Variable . . . . . 208
SYSINCLUDEFILENAME Automatic Macro Variable . . . . . 208
SYSINDEX Automatic Macro Variable . . . . . 208
SYSINFO Automatic Macro Variable . . . . . 208
SYSJOBID Automatic Macro Variable . . . . . 209
SYSLAST Automatic Macro Variable . . . . . 209
SYSLCKRC Automatic Macro Variable . . . . . 210
SYSLIBRC Automatic Macro Variable . . . . . 210
SYSLOGAPPLNAME Automatic Macro Variable . . . . . 211
SYSMACRONAME Automatic Macro Variable . . . . . 211
SYSMAXLONG Automatic Macro Variable . . . . . 211
SYSMENV Automatic Macro Variable . . . . . 211
SYSMSG Automatic Macro Variable . . . . . 212
SYSNCPU Automatic Macro Variable . . . . . 212
SYSNOBS Automatic Macro Variable . . . . . 212
SYSODSESCAPECHAR Automatic Macro Variable . . . . . 213

SYSODSPATH Automatic Macro Variable . . . . . 213
SYSPARM Automatic Macro Variable . . . . . 213
SYSPBUFF Automatic Macro Variable . . . . . 214
SYSPRINTTOLIST Automatic Macro Variable . . . . . 215
SYSPRINTTOLOG Automatic Macro Variable . . . . . 215
SYSPROCESSID Automatic Macro Variable . . . . . 215
SYSPROCESSMODE Automatic Macro Variable . . . . . 216
SYSPROCESSNAME Automatic Macro Variable . . . . . 217
SYSPROCNAME Automatic Macro Variable . . . . . 217
SYSRC Automatic Macro Variable . . . . . 217
SYSSCP and SYSSCPL Automatic Macro Variables . . . . . 217
SYSSCPL Automatic Macro Variable . . . . . 218
SYSSITE Automatic Macro Variable . . . . . 218
SYSSIZEOFLONG Automatic Macro Variable . . . . . 218
SYSSIZEOFPTR Automatic Macro Variable . . . . . 218
SYSSIZEOFUNICODE Automatic Macro Variable . . . . . 219
SYSTCPIPHOSTNAME Automatic Macro Variable . . . . . 219
SYSTIME Automatic Macro Variable . . . . . 219
SYSTIMEZONE Automatic Macro Variable . . . . . 220
SYSTIMEZONEIDENT Automatic Macro Variable . . . . . 220
SYSTIMEZONEOFFSET Automatic Macro Variable . . . . . 221
SYSUSERID Automatic Macro Variable . . . . . 222
SYSVER Automatic Macro Variable . . . . . 222
SYSVLONG Automatic Macro Variable . . . . . 223
SYSVLONG4 Automatic Macro Variable . . . . . 223
SYSWARNINGTEXT Automatic Macro Variable . . . . . 224

# Automatic Macro Variables

Automatic macro variables are created by the macro processor and they supply a variety of information. They are useful in programs to check the status of a condition before executing code.

# Dictionary

## SYSADDRBITS Automatic Macro Variable

Contains the number of bits of an address.

**Type:** Automatic macro variable (read only)

### Details

The SYSADDRBITS automatic macro variable contains the number of bits needed for an address.

## SYSBUFFR Automatic Macro Variable

Contains text that is entered in response to a %INPUT statement when there is no corresponding macro variable.

**Type:** Automatic macro variable (read and write)

### Details

Until the first execution of a %INPUT statement, SYSBUFFR has a null value. However, SYSBUFFR receives a new value during each execution of a %INPUT statement, either the text entered in response to the %INPUT statement where there is no corresponding macro variable or a null value. If a %INPUT statement contains no macro variable names, all characters entered are assigned to SYSBUFFR.

### Example: Assigning Text to SYSBUFFR

This %INPUT statement accepts the values of the two macro variables WATRFALL and RIVER:

```
%input watrfall river;
```

If you enter the following text, there is not a one-to-one match between the two variable names and the text:

```
Angel Tributary of Caroni
```

For example, you can submit these statements:

```
%put WATRFALL contains: *&watrfall*;
%put RIVER contains: *&river*;
%put SYSBUFFR contains: *&sysbuffr*;
```

After execution, they produce this output in the log:

```
WATRFALL contains: *Angel*
RIVER contains: *Tributary*
SYSBUFFR contains: * of Caroni*
```

As the log demonstrates, the text stored in SYSBUFFR includes leading and embedded blanks.

## SYSCC Automatic Macro Variable

Contains the current condition code that SAS returns to your operating environment (the operating environment condition code).

**Type:** Automatic macro variable (read and write)

**See:** “Automatic Macro Variables in Linux Environments” on page 415

### Details

SYSCC is a read and write automatic macro variable that enables you to reset the job condition code and to recover from conditions that prevent subsequent steps from running.

A normal exit internally to SAS is 0. The host code translates the internal value to a meaningful condition code by each host for each operating environment. &SYSCC of 0 at SAS termination is the value of success for that operating environment's return code.

The method to check the operating environment return code is host dependent.

The warning condition code in SAS sets &SYSCC to 4.

## SYSCHARWIDTH Automatic Macro Variable

Contains the character width value.

**Type:** Automatic macro variable (read only)

### Details

The character width value is either 1 (narrow) or 2 (wide).

## SYSCMD Automatic Macro Variable

Obsolete

## SYSDATASTEPPHASE Automatic Macro Variable

Indicates the current running phase of the DATA step.

**Type:** Automatic macro variable (read only)

### Details

Macros are designed to only execute during the compilation of a DATA step or during the execution of a DATA step. The new automatic macro variable SYSDATASTEPPHASE ensures that the macro is being executed as part of the proper phase of a DATA step.

The value of SYSDATASTEPPHASE automatic macro variable indicates the current active phase of the DATA step. When the DATA step is not active, the value of SYSDATASTEPPHASE is null. The following are possible values of SYSDATASTEPPHASE automatic macro variable :

- INITIALIZATION
- COMPILATION
- RESOLUTION
- EXECUTION
- AUTO-LOADING STORED PROGRAM

- COMPILATION — STORED PROGRAM LOADING
- LOADING STORED PROGRAM
- AUTO-SAVING STORED PROGRAM
- SAVING STORED PROGRAM

Any non-null value, other than EXECUTION, should be considered as part of the DATA step compilation process.

## Examples

### *Example 1: EXECUTION Phase*

```
24   data null;
25      x=1;
26      /* Placing the argument in single quote marks delays the   */
27      /* evaluation until after the DATA step has been compiled. */
28      call execute('%put &sysdatastepphase;');
29      put x=;
30   run;
EXECUTION
NOTE: DATA statement used (Total process time):
      real time           0.04 seconds
      cpu time            0.01 seconds

x=1
```

### *Example 2: COMPILATION Phase*

```
1          data null;
2             call symput("phase", "&sysdatastepphase");
3          run;

NOTE: The data set WORK.NULL has 1 observations and 0 variables.
NOTE: DATA statement used (Total process time):
      real time           0.01 seconds
      cpu time            0.00 seconds


4
5          %put &=phase;
PHASE=COMPILATION
```

# SYSDATE Automatic Macro Variable

Contains the date on which a SAS job or session began executing.

**Type:** Automatic macro variable (read only)

**See:** “SYSDATE9 Automatic Macro Variable” on page 198

## Details

SYSDATE contains a SAS date value in the DATE7. format, which displays a two-digit date, the first three letters of the month name, and a two-digit year. The date does not change during the individual job or session. For example, you could use SYSDATE in programs to check the date before you execute code that you want to run on certain dates of the month.

## Example: Formatting a SYSDATE Value

Macro FDATE assigns a format that you specify to the value of SYSDATE:

```
%macro fdate(fmt);
   %global fdate;
   data _null_;
      call symput("fdate",left(put("&sysdate"d,&fmt)));
   run;
%mend fdate;
%fdate(worddate.)
title "Tests for &fdate";
```

If you execute this macro on July 28, 1998, SAS sees the statements:

```
DATA _NULL_;
   CALL SYMPUT("FDATE",LEFT(PUT("28JUL98"D,WORDDATE.)));
RUN;
TITLE "Tests for July 28, 1998";
```

For another method of formatting the current date, see the %SYSFUNC and %QSYSFUNC functions.

# SYSDATE9 Automatic Macro Variable

Contains the date on which a SAS job or session began executing.

**Type:** Automatic macro variable (read only)

**See:** “SYSDATE Automatic Macro Variable” on page 197

## Details

SYSDATE9 contains a SAS date value in the DATE9. format, which displays a two-digit date, the first three letters of the month name, and a four-digit year. The date does not change during the individual job or session. For example, you could use SYSDATE9 in programs to check the date before you execute code that you want to run on certain dates of the month.

## Example: Formatting a SYSDATE9 Value

Macro FDATE assigns a format that you specify to the value of SYSDATE9:

```
%macro fdate(fmt);
b    %global fdate;
   data _null_;
      call symput("fdate",left(put("&sysdate9"d,&fmt)));
   run;
```

```
%mend fdate;
%fdate(worddate.)
title "Tests for &fdate";
```

If you execute this macro on July 28, 2008, SAS sees the statements:

```
DATA _NULL_;
   CALL SYMPUT("FDATE",LEFT(PUT("28JUL2008"D,WORDDATE.)));
RUN;
TITLE "Tests for July 28, 2008";
```

For another method of formatting the current date, see the %SYSFUNC and %QSYSFUNC functions.

## SYSDATE9 Automatic Macro Variable

Contains the date on which a SAS job or session began executing.

**Type:** Automatic macro variable (read only)

**See:** "SYSDATE Automatic Macro Variable" on page 197

### Details

SYSDATE9 contains a SAS date value in the DATE9. format, which displays a two-digit date, the first three letters of the month name, and a four-digit year. The date does not change during the individual job or session. For example, you could use SYSDATE9 in programs to check the date before you execute code that you want to run on certain dates of the month.

### Example: Formatting a SYSDATE9 Value

Macro FDATE assigns a format that you specify to the value of SYSDATE9:

```
%macro fdate(fmt);
b    %global fdate;
   data _null_;
      call symput("fdate",left(put("&sysdate9"d,&fmt)));
   run;
%mend fdate;
%fdate(worddate.)
title "Tests for &fdate";
```

If you execute this macro on July 28, 2008, SAS sees the statements:

```
DATA _NULL_;
   CALL SYMPUT("FDATE",LEFT(PUT("28JUL2008"D,WORDDATE.)));
RUN;
TITLE "Tests for July 28, 2008";
```

For another method of formatting the current date, see the %SYSFUNC and %QSYSFUNC functions.

## SYSDAY Automatic Macro Variable

Contains the day of the week on which a SAS job or session began executing.

**Type:** Automatic macro variable (read only)

## Details

You can use SYSDAY to check the current day before executing code that you want to run on certain days of the week, provided you initialized your SAS session today.

## Example: Identifying the Day When a SAS Session Started

The following statement identifies the day and date on which a SAS session started running.

```
%put This SAS session started running on: &sysday, &sysdate9.;
```

When this statement executes on Wednesday, December 19, 2007 for a SAS session that began executing on Monday, December 17, 2007, the following line is written to the log:

```
This SAS session started running on: Monday, 17DEC2007
```

# SYSDEVIC Automatic Macro Variable

Obsolete

# SYSDMG Automatic Macro Variable

Contains a return code that reflects an action taken on a damaged data set.

**Type:** Automatic macro variable (read and write)

**Default:** 0

## Details

You can use the value of SYSDMG as a condition to determine further action to take.

SYSDMG can contain the following values:

***Table 14.1*** *SYSDMG Values and Descriptions*

| Value | Description |
|---|---|
| 0 | No repair of damaged data sets in this session. (Default) |
| 1 | One or more automatic repairs of damaged data sets have occurred. |
| 2 | One or more user-requested repairs of damaged data sets have occurred. |
| 3 | One or more opens failed because the file was damaged. |

| Value | Description |
|---|---|
| 4 | One or more SAS tasks were terminated because of a damaged data set. |
| 5 | One or more automatic repairs of damaged data sets have occurred; the last-repaired data set has index file removed, as requested. |
| 6 | One or more user requested repairs have occurred; the last-repaired data set has index file removed, as requested. |

# SYSDSN Automatic Macro Variable

Contains the libref and name of the most recently created SAS data set.

**Type:** Automatic macro variable (read and write)

**See:** "SYSLAST Automatic Macro Variable" on page 209

## Details

The libref and data set name are displayed in two left-aligned fields. If no SAS data set has been created in the current program, SYSDSN returns eight blanks followed by _NULL_ followed by two more blanks.

*Note:* The macro processor always stores the value of SYSDSN in unquoted form. To quote the resolved value of SYSDSN, use the %SUPERQ macro quoting function.

## Comparisons

- Assigning a value to SYSDSN is the same as specifying a value for the _LAST_= system option.
- The value of SYSLAST is often more useful than SYSDSN because the value of SYSLAST is formatted so that you can insert a reference to it directly into SAS code in place of a data set name.

## Example: Comparing Values Produced by SYSDSN and SYSLAST

Create a data set Work.Test and then enter the following statements:

```
%put Sysdsn produces:  *&sysdsn*;
%put Syslast produces: *&syslast*;
```

When these statements execute, the following lines are written to the log:

```
Sysdsn produces:  *WORK    TEST    *
Syslast produces: *WORK.TEST    *
```

When the libref or data set name contain fewer than eight characters, SYSDSN maintains the blanks for the unused characters. SYSDSN does not display a period between the libref and data set name fields.

## SYSENCODING Automatic Macro Variable

Contains the name of the SAS session encoding.

**Type:** Automatic macro variable (read only)

### Details

SYSENCODING displays the name with a maximum length of 12 bytes.

### Example: Using SYSENCODING to Display the SAS Session Encoding

The following statement displays the encoding for the SAS session:

```
%put The encoding for this SAS session is: &sysencoding;
```

When this statement executes, the following comment is written to the log:

```
The encoding for this SAS session is: wlatin1
```

## SYSENDIAN Automatic Macro Variable

Contains an indication of the byte order of the current session. The possible values are LITTLE or BIG.

**Type:** Automatic macro variable (read only)

### Details

The SYSENDIAN automatic macro variable indicates the byte order of the current SAS session. There are two possible values: LITTLE and BIG.

## SYSENV Automatic Macro Variable

Reports whether SAS is running interactively.

**Type:** Automatic macro variable (read-only)

**Default:** BACK

**See:** “Automatic Macro Variables in Linux Environments” on page 415

### Details

The value of SYSENV is independent of the source of input. The following are values for SYSENV:

FORE
: when the SAS system option TERMINAL is in effect. For example, the value is FORE when you run SAS interactively through a windowing environment.

BACK
when the SAS system option NOTERMINAL is in effect. For example, the value is BACK when you submit a SAS job in batch mode.

*Note:* NOTERMINAL system option is the default for batch and line mode versions of SAS Viya.

You can use SYSENV to check the execution mode before submitting code that requires interactive processing. To use a %INPUT statement, the value of SYSENV must be FORE. For more information, see the SAS documentation for your operating environment.

*Operating Environment Information*
Some operating environments do not support the submission of jobs in batch mode. In this case the value of SYSENV is always FORE. For more information, see the SAS documentation for your operating environment.

## SYSERR Automatic Macro Variable

Contains a return code status set by some SAS procedures and the DATA step.

**Type:** Automatic macro variable (read only)

### Details

You can use the value of SYSERR as a condition to determine further action to take or to decide which parts of a SAS program to execute. SYSERR is used to detect major system errors, such as out of memory or failure of the component system when used in some procedures and DATA steps. SYSERR automatic macro variable is reset at each step boundary. For the return code of a complete job, see "SYSCC Automatic Macro Variable" on page 195.

SYSERR can contain the following values:

***Table 14.2*** *SYSERR Values*

| Value | Description |
|---|---|
| 0 | Execution completed successfully and without warning messages. |
| 1 | Execution was canceled by a user with a RUN CANCEL statement. |
| 2 | Execution was canceled by a user with an ATTN or BREAK command. |
| 3 | An error in a program run in batch mode caused SAS to enter syntax-check mode. |
| 4 | Execution completed successfully but with warning messages. |
| 5 | Execution was canceled by a user with an ABORT CANCEL statement. |
| 6 | Execution was canceled by a user with an ABORT CANCEL FILE statement. |

| Value | Description |
|---|---|
| >6 | An error occurred. The value returned is procedure-dependent. |

The following table contains warning return codes. The codes do not indicate any specific problems. These codes are guidelines to identify the nature of a problem.

***Table 14.3*** *SYSERR Warning Codes*

| Warning Code | Description |
|---|---|
| 108 | Problem with one or more BY groups |
| 112 | Error with one or more BY groups |
| 116 | Memory problems with one or more BY groups |
| 120 | I/O problems with one or more BY groups |

The following table contains error return codes. The codes do not indicate any specific problems. These codes are guidelines to identify the nature of a problem.

***Table 14.4*** *SYSERR Error Codes*

| Error Code | Description |
|---|---|
| 1008 | General data problem |
| 1012 | General error condition |
| 1016 | Out-of-memory condition |
| 1020 | I/O problem |
| 2000 | Semantic action problem |
| 2001 | Attribute processing problem |
| 3000 | Syntax error |
| 4000 | Not a valid procedure |
| 9999 | Bug in the procedure |
| 20000 | A step was stopped or an ABORT statement was issued. |
| 20001 | An ABORT RETURN statement was issued. |
| 20002 | An ABORT ABEND statement was issued. |
| 25000 | Severe system error. The system cannot initialize or continue. |

## Example: Using SYSERR

The example creates an error message and uses %PUT &SYSERR to write the return code number (1012) to the log.

```
data NULL;
   set doesnotexist;
run;
%put &syserr;
```

The following log output contains the return code number:

```
2
3     data NULL;
4       set doesnotexist;
ERROR: File WORK.DOESNOTEXIST.DATA does not exist.
5     run;

NOTE: The SAS System stopped processing this step because of errors.
WARNING: The data set WORK.NULL may be incomplete.  When this step was stopped
there were 0 observations and 0 variables.
NOTE: DATA statement used (Total process time):
      real time           1:03.70
      cpu time            0.07 seconds


6     %put &=syserr;
SYSERR=1012
```

To retrieve error and warning text instead of the return code number, see "SYSERRORTEXT Automatic Macro Variable" on page 205 and "SYSWARNINGTEXT Automatic Macro Variable" on page 224.

# SYSERRORTEXT Automatic Macro Variable

Contains the text of the last error message formatted for display in the log.

**Type:** Automatic macro variable (read only)

## Details

The value of SYSERRORTEXT is the text of the last error message generated in the log. For a list of SYSERR warnings and errors, see "SYSERR Automatic Macro Variable" on page 203.

*Note:* If the last error message text that was generated contains an **&** or **%** and you are using the %PUT statement, you must use the %SUPERQ macro quoting function to mask the special characters to prevent further resolution of the value. The following example uses the %PUT statement and the %SUPERQ macro quoting function:

```
%put %superq(syserrortext);
```

For more information, see "%SUPERQ Function" on page 267.

### Example: Using SYSERRORTEXT

This example creates an error message:

```
data NULL;
   set doesnotexist;
run;
%put &syserrortext;
```

When these statements are executed, the following record is written to the log:

```
1   data NULL;
2   set doesnotexist;
ERROR: File WORK.DOESNOTEXIST.DATA does not exist.
3   run;
NOTE: The SAS System stopped processing this step because of errors.
WARNING: The data set WORK.NULL might be incomplete. When this step was
         stopped there were 0 observations and 0 variables.
NOTE: DATA statement used (Total process time):
real time       11.16 seconds
cpu time        0.07 seconds
4  %put &syserrortext;
File WORK.DOESNOTEXIST.DATA does not exist.
```

## SYSFILRC Automatic Macro Variable

Contains the return code from the last FILENAME statement.

**Type:** Automatic macro variable (read and write)

### Details

SYSFILRC checks whether the file or storage location referenced by the last FILENAME statement exists. You can use SYSFILRC to confirm that a file or location is allocated before attempting to access an external file.

The following are values for SYSFILRC:

***Table 14.5*** *SYSFILRC Values and Descriptions*

| Value | Description |
|---|---|
| 0 | The last FILENAME statement executed correctly. |
| ≠0 | The last FILENAME statement did not execute correctly. |

## SYSHOSTINFOLONG Automatic Macro Variable

Contains the operating environment information that is displayed when the HOSTINFOLONG option is specified.

**Type:** Automatic macro variable (read-only)

### Details

Contains the operating environment information that is displayed when the HOSTINFOLONG option is specified. For more information, see "HOSTINFOLONG System Option" in *SAS Viya System Options: Reference*.

## SYSHOSTNAME Automatic Macro Variable

Contains the host name of the computer that is running the SAS process.

**Type:** Automatic macro variable (read only)

### Details

SYSHOSTNAME contains the host name of the system that is running a single TCPIP stack. If you are running multiple TCPIP stacks, use the SYSTCPIPHOSTNAME automatic macro variable. For more information about TCPIP stacks, see your SAS host companion documentation.

### See Also

"SYSTCPIPHOSTNAME Automatic Macro Variable" on page 219

## SYSINCLUDEFILEDEVICE Automatic Macro Variable

Contains the device type of the current %INCLUDE file.

**Type:** Automatic macro variable (read-only)

### Details

You can use SYSINCLUDEFILEDEVICE to determine the device type on the current %INCLUDE file.

## SYSINCLUDEFILEDIR Automatic Macro Variable

Contains the directory where the current %INCLUDE file was found.

**Type:** Automatic macro variable (read-only)

### Details

You can use SYSINCLUDEFILEDIR to determine which directory the current %INCLUDE file was found.

## SYSINCLUDEFILEFILEREF Automatic Macro Variable

Contains the fileref that is associated with the current %INCLUDE file or blank.

**Type:** Automatic macro variable (read-only)

### Details

You can use SYSINCLUDEFILEFILEREF to determine if a fileref was used to access the current %INCLUDE file. If no fileref was used, then the value is blank.

## SYSINCLUDEFILENAME Automatic Macro Variable

Contains the filename of the current %INCLUDE file.

**Type:** Automatic macro variable (read-only)

### Details

You can use SYSINCLUDEFILENAME to determine the name of the current %INCLUDE file.

## SYSINDEX Automatic Macro Variable

Contains the number of macros that have started execution in the current SAS job or session.

**Type:** Automatic macro variable (read only)

### Details

You can use SYSINDEX in a program that uses macros when you need a unique number that changes after each macro invocation.

## SYSINFO Automatic Macro Variable

Contains return codes provided by some SAS procedures.

**Type:** Automatic macro variable (read only)

### Details

Values of SYSINFO are described with the procedures that use it. You can use the value of SYSINFO as a condition for determining further action to take or parts of a SAS program to execute.

For example, PROC COMPARE, which compares two data sets, uses SYSINFO to store a value that provides information about the result of the comparison.

## SYSJOBID Automatic Macro Variable

Contains the name of the current batch job or user ID.

**Type:** Automatic macro variable (read only)

**See:** "Automatic Macro Variables in Linux Environments" on page 415

### Details

The value stored in SYSJOBID depends on the operating environment that you use to run SAS. You can use SYSJOBID to check who is currently executing the job to restrict certain processing or to issue commands that are specific to a user.

## SYSLAST Automatic Macro Variable

Contains the name of the SAS data file created most recently.

**Type:** Automatic macro variable (read and write)

**See:** "SYSDSN Automatic Macro Variable" on page 201

### Details

The name is stored in the form *libref.dataset*. You can insert a reference to SYSLAST directly into SAS code in place of a data set name. If no SAS data set has been created in the current program, the value of SYSLAST is _NULL_, with no leading or trailing blanks.

*Note:* The macro processor always stores the value of SYSLAST in unquoted form. To quote the resolved value of SYSLAST, use the %SUPERQ macro quoting function.

### Comparisons

- Assigning a value to SYSLAST is the same as specifying a value for the _LAST_= system option.
- The value of SYSLAST is often more useful than SYSDSN because the value of SYSLAST is formatted so that you can insert a reference to it directly into SAS code in place of a data set name.

### Example: Comparing Values Produced by SYSLAST and SYSDSN

Create the data set FirstLib.SalesRpt and then enter the following statements:

```
%put Sysdsn produces:  *&sysdsn*;
%put Syslast produces: *&syslast*;
```

When these statements are executed, the following is written to the log:

```
Sysdsn produces:  *FIRSTLIBSALESRPT*
Syslast produces: *FIRSTLIB.SALESRPT*
```

The name stored in SYSLAST contains the period between the libref and data set name.

## SYSLCKRC Automatic Macro Variable

Contains the return code from the most recent LOCK statement.

**Type:** Automatic macro variable (read and write)

### Details

The LOCK statement is a SAS software statement used to acquire and release an exclusive lock on data objects in data libraries accessed through SAS/SHARE software. The following are values for SYSLCKRC:

***Table 14.6*** *LCKRC Values and Descriptions*

| Value | Description |
|---|---|
| 0 | The last LOCK statement was successful. |
| >0 | The last LOCK statement was not successful. |
| <0 | The last LOCK statement was completed, but a WARNING or NOTE was written to the log. |

For more information, see the documentation for SAS/SHARE software.

## SYSLIBRC Automatic Macro Variable

Contains the return code from the last LIBNAME statement.

**Type:** Automatic macro variable (read and write)

### Details

The code reports whether the last LIBNAME statement executed correctly. SYSLIBRC checks whether the SAS library referenced by the last LIBNAME statement exists. For example, you could use SYSLIBRC to confirm that a libref is allocated before you attempt to access a permanent data set.

The following are values for SYSLIBRC:

***Table 14.7*** *SYSLIBRC Values and Descriptions*

| Value | Description |
|---|---|
| 0 | The last LIBNAME statement executed correctly. |
| ≠0 | The last LIBNAME statement did not execute correctly. |

## SYSLOGAPPLNAME Automatic Macro Variable

Contains the value of the LOGAPPLNAME= system option.

**Type:** Automatic macro variable (read only)

**Default:** null

### Details

The following code, when submitted from the current SAS session, writes the LOGAPPLNAME for the current SAS session to the log:

```
%put &syslogapplname;
```

## SYSMACRONAME Automatic Macro Variable

Returns the name of the currently executing macro.

**Type:** Automatic macro variable (read only)

### Details

When referenced outside of an executing macro, SYSMACRONAME returns the null string.

## SYSMAXLONG Automatic Macro Variable

Returns the maximum long integer value allowed under Linux.

**Type:** Automatic macro variable (read-only)

### Details

The SYSMAXLONG automatic macro variable returns the maximum long integer value allowed under Linux, which is 2,147,483,647. On 64-bit systems, the maximum is 9,007,199,254,740,992.

## SYSMENV Automatic Macro Variable

Contains the invocation status of the macro that is currently executing.

**Type:** Automatic macro variable (read only)

### Details

The following are values for SYSMENV:

*Table 14.8* SMENV Values and Descriptions

| Value | Description |
|---|---|
| S | The macro currently executing was invoked as part of a SAS program. |
| D | Obsolete |

## SYSMSG Automatic Macro Variable

Obsolete

## SYSNCPU Automatic Macro Variable

Contains the current number of processors available to SAS for computations.

**Type:** Automatic Macro Variable (Read Only)

### Details

SYSNCPU is an automatic macro variable that provides the current value of the CPUCOUNT option. For more information, see "CPUCOUNT= System Option" in *SAS Viya System Options: Reference*.

### Comparisons

The following example shows the option CPUCOUNT set to 265.

```
options cpucount=265;
%put &sysncpu;
```

The output of the above example is 265.

## SYSNOBS Automatic Macro Variable

Contains the number of observations read from the last data set that was closed by the previous procedure or DATA step.

**Type:** Automatic macro variable (read and write)

### Details

SYSNOBS automatic macro variable contains the number of observations read from the last data set that was closed by the previous procedure or DATA step.

*Note:* If the number of observations for the data set was not calculated by the previous procedure or DATA step, the value of SYSNOBS is set to -1.

## SYSODSESCAPECHAR Automatic Macro Variable

Displays the value of the ODS ESCAPECHAR= from within the program.

**Type:** Automatic macro variable (read only)

### Details

SYSODSESCAPECHAR automatic macro variable contains the current ODS escape character.

## SYSODSPATH Automatic Macro Variable

Contains the current Output Delivery System (ODS) pathname.

**Type:** Automatic macro variable (read only)

**Restriction:** The SYSODSPATH automatic macro variable exists only when an ODS or PROC TEMPLATE statement is invoked.

### Details

The SYSODSPATH automatic macro variable contains the current ODS pathname.

## SYSPARM Automatic Macro Variable

Contains a character string that can be passed from the operating environment to SAS program steps.

**Type:** Automatic macro variable (read and write)

### Details

SYSPARM enables you to pass a character string from the operating environment to SAS program steps and provides a means of accessing or using the string while a program is executing. For example, you can use SYSPARM from the operating environment to pass a title statement or a value for a program to process. You can also set the value of SYSPARM within a SAS program. SYSPARM can be used anywhere in a SAS program. The default value of SYSPARM is null (zero characters).

SYSPARM is most useful when specified at invocation of SAS. For more information, see the SAS documentation for your operating environment.

*Note:* The macro processor always stores the value of SYSPARM in unquoted form. To quote the resolved value of SYSPARM, use the %SUPERQ macro quoting function.

### Comparisons

- Assigning a value to SYSPARM is the same as specifying a value for the SYSPARM= system option.
- Retrieving the value of SYSPARM is the same as using the SYSPARM() SAS function.

## Example: Passing a Value to a Procedure

In this example, you invoke SAS on a Linux operating environment on September 20, 2011 (the librefs Dept and Test are defined in the config.sas file) with a command like the following:

```
sas program-name -sysparm dept.projects -config /myid/config.sas
```

Macro variable SYSPARM supplies the name of the data set for PROC REPORT:

```
proc report data=&sysparm
     report=test.resorces.priority.rept;
title "%sysfunc(date(),worddate.)";
title2;
title3 'Active Projects By Priority';
run;
```

SAS sees the following:

```
proc report data=dept.projects
     report=test.resorces.priority.rept;
title "September 20, 2011";
title2;
title3 'Active Projects By Priority';
run;
```

# SYSPBUFF Automatic Macro Variable

Contains text supplied as macro parameter values.

**Type:** Automatic macro variable (read and write, local scope)

## Details

SYSPBUFF resolves to the text supplied as parameter values in the invocation of a macro that is defined with the PARMBUFF option. For name-style invocations, this text includes the parentheses and commas. Using the PARMBUFF option and SYSPBUFF, you can define a macro that accepts a varying number of parameters at each invocation.

If the macro definition includes both a set of parameters and the PARMBUFF option, the macro invocation causes the parameters to receive values and the entire invocation list of values to be assigned to SYSPBUFF.

*Note:* The SYSPBUFF automatic macro variable can be modified only within the scope that it resides. Any attempt to assign a value to SYSPBUFF within an inner scope not already containing an instance of SYSPBUFF causes a new instance of SYSPBUFF to be created within that inner scope.

## Example: Using SYSPBUFF to Display Macro Parameter Values

The macro PRINTZ uses the PARMBUFF option to define a varying number of parameters and SYSPBUFF to display the parameters specified at invocation.

```
%macro printz/parmbuff;
   %put Syspbuff contains: &syspbuff;
   %let num=1;
```

```
    %let dsname=%scan(&syspbuff,&num);
    %do %while(&dsname ne);
       proc print data=&dsname;
       run;
       %let num=%eval(&num+1);
       %let dsname=%scan(&syspbuff,&num);
    %end;
 %mend printz;
 %printz(purple,red,blue,teal)
```

When this program executes, this line is written to the log:

```
Syspbuff contains: (purple,red,blue,teal)
```

## SYSPRINTTOLIST Automatic Macro Variable

Contains the path of the LIST file prior to redirection by the PRINTTO procedure.

**Type:** Automatic macro variable (read only)

### Details

The SYSPRINTTOLIST automatic macro variable contains the destination path for the LIST file set by the PRINTTO procedure in the current execution scope.

*Note:* If no redirection of the LIST file has occurred, then the value of the SYSPRINTTOLIST automatic macro variable is null.

## SYSPRINTTOLOG Automatic Macro Variable

Contains the path of the LOG file prior to redirection by the PRINTTO procedure.

**Type:** Automatic macro variable (read only)

### Details

The SYSPRINTTOLOG automatic macro variable contains the destination path for the LOG file set by the PRINTTO procedure in the current execution scope.

*Note:* If no redirection of the LOG file has occurred, then the value of the SYSPRINTTOLOG automatic macro variable is null.

## SYSPROCESSID Automatic Macro Variable

Contains the process ID of the current SAS process.

**Type:** Automatic macro variable (read-only)

**Default:** null

### Details

The value of SYSPROCESSID is a SAS internally generated 32-character hexadecimal string. The default value is null.

### Example: Using SYSPROCESSID to Display the Current SAS Process ID

The following code writes the current SAS process ID to the log:

```
%put &sysprocessid;
```

A process ID, such as the following, is written to the log:

```
41D1B269F86C7C5F4010000000000000
```

## SYSPROCESSMODE Automatic Macro Variable

Contains the name of the current SAS session run mode or server type.

**Type:** Automatic macro variable (read-only)

### Details

SYSPROCESSMODE is a read-only automatic macro variable, which contains the name of the current SAS session run mode or server type, such as the following:

- SAS Studio Session
- SAS Batch Mode
- SAS Line Mode
- SAS/CONNECT Session
- SAS Share Server
- SAS IntrNet Server
- SAS Workspace Server
- SAS Pooled Workspace Server
- SAS Stored Process Server
- SAS OLAP Server
- SAS Table Server
- SAS Metadata Server

### Example: Using SYSPROCESSMODE to Display the Current SAS Process Run Mode or Server Type

```
%put &sysprocessmode;
```

A run mode or server type, such as the following is written to the log:

```
SAS IntrNet Server
```

## SYSPROCESSNAME Automatic Macro Variable

Contains the process name of the current SAS process.

**Type:** Automatic macro variable (read only)

### Example: Using SYSPROCESSNAME to Display the Current SAS Process Name

The following statement writes the name of the current SAS process to the log:

```
%put &sysprocessname;
```

If you submit this statement in the SAS windowing environment of your second SAS session, the following line is written to the log:

```
OBJECT_EXECUTIVE
```

## SYSPROCNAME Automatic Macro Variable

Contains the name of the procedure (or DATASTEP for DATA steps) currently being processed by the SAS Language Processor.

**Type:** Automatic macro variable (read only)

### Details

The value of SYSPROCNAME contains the name of the procedure specified by the user in the PROC statement until a step boundary is reached.

## SYSRC Automatic Macro Variable

Obsolete

## SYSSCP and SYSSCPL Automatic Macro Variables

Contain an identifier for your operating environment.

**Type:** Automatic macro variable (read-only)

**See:** “Automatic Macro Variables in Linux Environments” on page 415

### Details

SYSSCP and SYSSCPL resolve to an abbreviation of the name of your operating environment. In some cases, SYSSCPL provides a more specific value than SYSSCP. You could use SYSSCP and SYSSCPL to check the operating environment to execute appropriate system commands. Here is an example:

```
1          %put &=sysscp;
SYSSCP=LIN X64
```

## SYSSCPL Automatic Macro Variable

Contains the name of your operating environment.

**Type:** Automatic macro variable (read only)

**See:** "Automatic Macro Variables in Linux Environments" on page 415

### Details

See "SYSSCP and SYSSCPL Automatic Macro Variables" on page 217

## SYSSITE Automatic Macro Variable

Contains the number assigned to your site.

**Type:** Automatic macro variable (read only)

### Details

SAS assigns a site number to each site that licenses SAS software. The number is displayed in the log.

## SYSSIZEOFLONG Automatic Macro Variable

Contains the length in bytes of a long integer in the current session.

**Type:** Automatic macro variable (read only)

### Details

The SYSSIZEOFLONG automatic macro variable contains the length of a long integer in the current SAS session.

## SYSSIZEOFPTR Automatic Macro Variable

Contains the size in bytes of a pointer.

**Type:** Automatic macro variable (read only)

### Details

The SYSSIZEOFPTR automatic macro variable contains the size in bytes of a pointer.

## SYSSIZEOFUNICODE Automatic Macro Variable

Contains the length in bytes of a Unicode character in the current session.

**Type:** Automatic macro variable (read only)

### Details

The SYSSIZEOFUNICODE automatic macro variable contains the length of the Unicode character in the current SAS session.

## SYSTCPIPHOSTNAME Automatic Macro Variable

Contains the host names of the local and remote computers when multiple TCP/IP stacks are supported.

**Type:** Automatic macro variable (read only)

### Details

SYSTCPIPHOSTNAME contains the host name of the system that is running multiple TCPIP stacks. If you are running a single TCPIP stack, use the SYSHOSTNAME automatic macro variable. For more information about TCPIP stacks, see your SAS host companion documentation.

### See Also

"SYSHOSTNAME Automatic Macro Variable" on page 207

## SYSTIME Automatic Macro Variable

Contains the time at which a SAS job or session began executing.

**Type:** Automatic macro variable (read only)

### Details

The value is displayed in TIME5. format and does not change during the individual job or session.

### Example: Using SYSTIME to Display the Time That a SAS Session Started

The following statement displays the time at which a SAS session started.

```
%put This SAS session started running at: &systime;
```

When this statement executes at 3 p.m., but your SAS session began executing at 9:30 a.m., the following comment is written to the log:

```
This SAS session started running at: 09:30
```

## SYSTIMEZONE Automatic Macro Variable

Contains the time zone name based on TIMEZONE option.

**Type:** Automatic macro variable (read only)

### Details

SYSTIMEZONE contains the time zone name based on the current value of the TIMEZONE option. For more information about the TIMEZONE option, see the SAS documentation for your operating environment.

***Example Code 14.1*** *Using SYSTIMEZONE*

```
option timezone='america/new_york';
%put &=systimezone;

option timezone='america/chicago';
%put &=systimezone;

option timezone='america/denver';
%put &=systimezone;

option timezone='america/los_angeles';
%put &=systimezone;
```

***Log 14.1*** *Output*

```
114   option timezone='america/new_york';
115   %put &=systimezone;
SYSTIMEZONE=EDT
116   option timezone='america/chicago';
117   %put &=systimezone;
SYSTIMEZONE=CDT
118   option timezone='america/denver';
119   %put &=systimezone;
SYSTIMEZONE=MDT
120   option timezone='america/los_angeles';
121   %put &=systimezone;
SYSTIMEZONE=PDT
```

## SYSTIMEZONEIDENT Automatic Macro Variable

Contains the time zone ID based on the TIMEZONE= system option.

**Type:** Automatic macro variable (read only)

## Details

SYSTIMEZONEIDENT contains the time zone ID based on the current value of the TIMEZONE= system option. For more information about the TIMEZONE= option, see the SAS documentation for your operating environment.

***Example Code 14.2*** *Using SYSTIMEZONEIDENT*

```
option timezone='america/new_york';
%put &=systimezoneident;

option timezone='america/chicago';
%put &=systimezoneident;

 option timezone='america/denver';
%put &=systimezoneident;

option timezone='america/los_angeles';
%put &=systimezoneident;
```

***Log 14.2*** *Output*

```
12   option timezone='america/new_york';
13   %put &=systimezoneident;
SYSTIMEZONEIDENT=AMERICA/NEW_YORK
14
15   option timezone='america/chicago';
16   %put &=systimezoneident;
SYSTIMEZONEIDENT=AMERICA/CHICAGO
17
18   option timezone='america/denver';
19   %put &=systimezoneident;
SYSTIMEZONEIDENT=AMERICA/DENVER
20
21   option timezone='america/los_angeles';
22   %put &=systimezoneident;
SYSTIMEZONEIDENT=AMERICA/LOS_ANGELES
```

# SYSTIMEZONEOFFSET Automatic Macro Variable

Contains the current time zone offset based on TIMEZONE option.

**Type:** Automatic Macro Variable

## Details

SYSTIMEZONEOFFSET contains the time zone offset based on the current value of the TIMEZONE option. For more information about the TIMEZONE option, see the SAS documentation for your operating environment.

***Example Code 14.3*** *Using SYSTIMEZONEOFFSET*

```
option timezone='america/new_york';
%put &=systimezoneoffset;
```

```
option timezone='america/chicago';
%put &=systimezoneoffset;

option timezone='america/denver';
%put &=systimezoneoffset;

option timezone='america/los_angeles';
%put &=systimezoneoffset;
```

***Log 14.3*** *Output*

```
153   option timezone='america/new_york';
154   %put &=systimezoneoffset;
SYSTIMEZONEOFFSET=-14400
155   option timezone='america/chicago';
156   %put &=systimezoneoffset;
SYSTIMEZONEOFFSET=-18000
157   option timezone='america/denver';
158   %put &=systimezoneoffset;
SYSTIMEZONEOFFSET=-21600
159   option timezone='america/los_angeles';
160   %put &=systimezoneoffset;
SYSTIMEZONEOFFSET=-25200
```

## SYSUSERID Automatic Macro Variable

Contains the user ID or login of the current SAS process.

**Type:** Automatic macro variable (read only)

### Example: Using SYSUSERID to Display the User ID for the Current SAS Process

The following code, when submitted from the current SAS process, writes the user ID or login for the current SAS process to the log:

```
%put &sysuserid;
```

A user ID, such as the following, is written to the log:

```
MyUserid
```

## SYSVER Automatic Macro Variable

Contains the release version of SAS software that is running.

**Type:** Automatic macro variable (read only)

**See:** “SYSVLONG Automatic Macro Variable” on page 223 and “SYSVLONG4 Automatic Macro Variable” on page 223

### Comparisons

SYSVER provides the release version of the SAS software that is running. You can use SYSVER to check for the release of SAS before running a job with newer features.

### Example: Identifying SAS Software Release

The following statement displays the release version of a user's SAS software.

```
%put I am using release: &sysver;
```

Submitting this statement (for a user of SAS Viya) writes the following to the log:

```
I am using release: V.03.01
```

## SYSVLONG Automatic Macro Variable

Contains the release version and maintenance level of SAS software that is running.

**Type:** Automatic macro variable (read only)

**See:** "SYSVER Automatic Macro Variable" on page 222 and "SYSVLONG4 Automatic Macro Variable" on page 223

### Comparisons

SYSVLONG provides the release version and maintenance level of SAS software, in addition to the release version.

### Example: Identifying a SAS Maintenance Release

The following statement displays information identifying the SAS release being used.

```
%put I am using release: &sysvlong;
```

Submitting this statement (for a user of SAS Viya) writes the following to the log:

```
I am using release: V.03.01M0P082916
```

## SYSVLONG4 Automatic Macro Variable

Contains the release version and maintenance level of SAS software that is running and has a four-digit year.

**Type:** Automatic macro variable (read only)

**See:** "SYSVER Automatic Macro Variable" on page 222 and "SYSVLONG Automatic Macro Variable" on page 223

## Comparisons

SYSVLONG4 provides a four-digit year and the release version and maintenance level of SAS software. SYSVLONG does not contain the four-digit year but everything else is the same.

## Example: Using SYSVLONG4 Automatic Macro Variable

The following statement displays information that identifies the SAS release being used.

```
%put I am using maintenance release: &sysvlong4;
```

Submitting this statement (for a user of SAS Viya) writes this comment to the log:

```
I am using maintenance release: V.03.01M0P08292016
```

# SYSWARNINGTEXT Automatic Macro Variable

Contains the text of the last warning message formatted for display in the log.

**Type:** Automatic macro variable (read only)

## Details

The value of SYSWARNINGTEXT is the text of the last warning message generated in the log. For a list of SYSERR warnings and errors, see "SYSERR Automatic Macro Variable" on page 203.

*Note:* If the last warning message text that was generated contains an **&** or **%** and you are using the %PUT statement, you must use the %SUPERQ macro quoting function to mask the special characters to prevent further resolution of the value. The following example uses the %PUT statement and the %SUPERQ macro quoting function:

```
%put %superq(syswarningtext);
```

For more information, see "%SUPERQ Function" on page 267.

## Example: Using SYSWARNINGTEXT

This example creates a warning message:

```
data NULL;
    set doesnotexist;
run;
%put &syswarningtext;
```

When these statements execute, the following comments are written to the log:

```
1  data NULL;
2  set doesnotexist;
ERROR: File WORK.DOESNOTEXIST.DATA does not exist.
3  run;
NOTE: The SAS System stopped processing this step because of errors.
WARNING: The data set WORK.NULL might be incomplete.  When this step
         was stopped there were 0 observations and 0 variables.
NOTE: DATA statement used (Total process time):
    real time           11.16 seconds
    cpu time            0.07 seconds
4  %put &syswarningtext;
The data set WORK.NULL might be incomplete.  When this step was
stopped there were 0 observations and 0 variables.
```

*Chapter 15*

# DATA Step Call Routines for Macros

**DATA Step Call Routines for Macros** . . . . . **227**

**Dictionary** . . . . . **227**
CALL EXECUTE Routine . . . . . 227
CALL SYMDEL Routine . . . . . 229
CALL SYMPUT Routine . . . . . 230
CALL SYMPUTN Routine . . . . . 234
CALL SYMPUTX Routine . . . . . 235

## DATA Step Call Routines for Macros

You can interact with the Macro Facility using DATA step call routines.

## Dictionary

### CALL EXECUTE Routine

Resolves the argument, and issues the resolved value for execution at the next step boundary.

**Type:** DATA step CALL routine

#### Syntax

**CALL EXECUTE**(*argument*);

##### *Required Argument*

***argument***
can be one of the following:

- a character string, enclosed in quotation marks. *Argument* within single quotation marks resolves during program execution. *Argument* within double quotation marks resolves while the DATA step is being constructed. For example, to invoke the macro SALES, you can use the following code:

```
call execute('%sales');
```

- the name of a DATA step character variable whose value is a text expression or a SAS statement to be generated. Do not enclose the name of the DATA step variable in quotation marks. For example, to use the value of the DATA step variable FINDOBS, which contains a SAS statement or text expression, you can use the following code:

```
call execute(findobs);
```

- a character expression that is resolved by the DATA step to a macro text expression or a SAS statement. For example, to generate a macro invocation whose parameter is the value of the variable MONTH, you use the following code:

```
call execute('%sales('||month||')');
```

## Details

If an EXECUTE routine argument is a macro invocation or resolves to one, the macro executes immediately. Execution of SAS statements generated by the execution of the macro will be delayed until after a step boundary. SAS macro statements, including macro variable references, will execute immediately.

*Note:* Because of the delay of the execution of the SAS statements until after a step boundary, references in SAS macro statements to macro variables created or updated by the SAS statements will not resolve properly.

*Note:* Macro references execute immediately and SAS statements do not execute until after a step boundary. You cannot use CALL EXECUTE to invoke a macro that contains references for macro variables that are created by CALL SYMPUT in that macro. For a workaround, see the following TIP.

**TIP** The following example uses the %NRSTR macro quoting function to mask the macro statement. This function will delay the execution of macro statements until after a step boundary.

```
call execute('%nrstr(%sales('||month||'))');
```

## Comparisons

Unlike other elements of the macro facility, a CALL EXECUTE statement is available regardless of the setting of the SAS system option MACRO | NOMACRO. In both cases, EXECUTE places the value of its argument in the program stack. However, when NOMACRO is set, any macro calls or macro functions in the argument are not resolved.

## Examples

### *Example 1: Executing a Macro Conditionally*

The following DATA step uses CALL EXECUTE to execute a macro only if the DATA step writes at least one observation to the temporary data set.

```
%macro overdue;
   proc print data=late;
      title "Overdue Accounts As of &sysdate";
   run;
%mend overdue;
data late;
   set Sashelp.Orsales end=final;
   if datedue<=today()-30 then
```

```
      do;
         n+1;
         output;
      end;
   if final and n then call execute('%overdue');
run;
```

### Example 2: Passing DATA Step Values into a Parameter List

CALL EXECUTE passes the value of the DATE variable in the Dates data set to macro REPT for its DAT parameter, the value of the VAR1 variable in the REPTDATA data set for its A parameter, and REPTDATA as the value of its DSN parameter. After the DATA _NULL_ step finishes, three PROC GCHART statements are submitted, one for each of the three dates in the Dates data set.

```
data dates;
   input date $;
datalines;
10nov11
11nov11
12nov11
;
data reptdata;
   input date $ var1 var2;
datalines;
10nov11 25 10
10nov11 50 11
11nov11 23 10
11nov11 30 29
12nov11 33 44
12nov11 75 86
;
%macro rept(dat,a,dsn);
   proc chart data=&dsn;
       title "Chart for &dat";
       where(date="&dat");
       vbar &a;
   run;
%mend rept;
data _null_;
   set dates;
   call execute('%rept('||date||','||'var1,reptdata)');
run;
```

## CALL SYMDEL Routine

Deletes the specified variable from the macro global symbol table.

**Type:** DATA step CALL routine

### Syntax

**CALL SYMDEL**(*macro-variable*<, *option*>);

### Required Arguments

***macro-variable***
can be any of the following:

- the name of a macro variable within quotation marks but without an ampersand. When a macro variable value contains another macro variable reference, SYMDEL does not attempt to resolve the reference.
- the name of a DATA step character variable, specified with no quotation marks, which contains the name of a macro variable. If the value is not a valid SAS name, or if the macro processor cannot find a macro variable of that name, SAS writes a warning to the log.
- a character expression that constructs a macro variable name.

***option***

**NOWARN**
suppresses the warning message when an attempt is made to delete a non-existent macro variable. NOWARN must be within quotation marks.

## Details

CALL SYMDEL issues a warning when an attempt is made to delete a non-existent macro variable. To suppress this message, use the NOWARN option.

# CALL SYMPUT Routine

Assigns a value produced in a DATA step to a macro variable.

**Type:** DATA step CALL routine

**Restriction:** The SYMPUT CALL routine is not supported by the CAS engine.

**See:** “SYMGET Function” on page 242 and “CALL SYMPUTX Routine” on page 235

## Syntax

**CALL SYMPUT**(*macro-variable*, *value*);

### Required Arguments

***macro-variable***
can be one of the following items:

- a character string that is a SAS name, enclosed in quotation marks. For example, to assign the character string **`testing`** to macro variable NEW, submit the following statement:

```
call symput('new','testing');
```

- the name of a character variable whose values are SAS names. For example, this DATA step creates the three macro variables SHORTSTP, PITCHER, and FRSTBASE and respectively assign them the values ANN, TOM, and BILL.

```
data team1;
   input position : $8. player : $12.;
   call symput(position,player);
datalines;
```

```
shortstp Ann
pitcher Tom
frstbase Bill
;
```

- a character expression that produces a macro variable name. This form is useful for creating a series of macro variables. For example, the CALL SYMPUT statement builds a series of macro variable names by combining the character string POS and the left-aligned value of _N_ . Values are assigned to the macro variables POS1, POS2, and POS3.

```
data team2;
   input position : $12. player $12.;
   call symput('POS'||left(_n_), position);
   datalines;
shortstp Ann
pitcher Tom
frstbase Bill
;
```

***value***
is the value to be assigned, which can be

- a string enclosed in quotation marks. For example, this statement assigns the string **testing** to the macro variable NEW:

```
call symput('new','testing');
```

- the name of a numeric or character variable. The current value of the variable is assigned as the value of the macro variable. If the variable is numeric, SAS performs an automatic numeric-to-character conversion and writes a message in the log. Later sections on formatting rules describe the rules that SYMPUT follows in assigning character and numeric values of DATA step variables to macro variables.

  *Note:* This form is most useful when *macro-variable* is also the name of a SAS variable or a character expression that contains a SAS variable. A unique macro variable name and value can be created from each observation, as shown in the previous example for creating the data set Team1.

  If *macro-variable* is a character string, SYMPUT creates only one macro variable, and its value changes in each iteration of the program. Only the value assigned in the last iteration remains after program execution is finished.

- a DATA step expression. The value returned by the expression in the current observation is assigned as the value of *macro-variable*. In this example, the macro variable named HOLDATE receives the value **July 4,1997**:

```
data c;
   input holiday mmddyy.;
   call symput('holdate',trim(left(put(holiday,worddate.))));
datalines;
070497
;
run;
```

  If the expression is numeric, SAS performs an automatic numeric-to-character conversion and writes a message in the log. Later sections on formatting rules describe the rules that SYMPUT follows in assigning character and numeric values of expressions to macro variables.

## Details

If *macro-variable* exists in any enclosing scope, *macro-variable* is updated. If *macro-variable* does not exist, SYMPUT creates it. (See below to determine in which scope SYMPUT creates *macro-variable*.) SYMPUT makes a macro variable assignment when the program executes.

SYMPUT can be used in all SAS language programs, including SCL programs. Because it resolves variables at program execution instead of macro execution, SYMPUT should be used to assign macro values from DATA step views, SQL views, and SCL programs.

*Scope of Variables Created with SYMPUT*

SYMPUT puts the macro variable in the most local nonempty symbol table. A symbol table is nonempty if it contains the following:

- a value
- a computed %GOTO (A computed %GOTO contains `%`or `&` and resolves to a label.)
- the macro variable &SYSPBUFF, created at macro invocation time.

However, there are three cases where SYMPUT creates the variable in the local symbol table, even if that symbol table is empty:

- If SYMPUT is used after a PROC SQL, the variable will be created in a local symbol table.
- If an executing macro contains a computed %GOTO statement and uses SYMPUT to create a macro variable, the variable is created in the local symbol table.
- If an executing macro uses &SYSPBUFF and SYMPUT to create a macro variable, the macro variable is created in the local symbol table.

For more information about creating a variable with SYMPUT, see "Scopes of Macro Variables" on page 47.

*Problem Trying to Reference a SYMPUT-Assigned Value Before It Is Available*

One of the most common problems in using SYMPUT is trying to reference a macro variable value assigned by SYMPUT before that variable is created. The failure generally occurs because the statement referencing the macro variable compiles before execution of the CALL SYMPUT statement that assigns the variable's value. The most important fact to remember in using SYMPUT is that it assigns the value of the macro variable during program execution. Macro variable references resolve during the compilation of a step, a global statement used outside a step, or an SCL program. As a result:

- You cannot use a macro variable reference to retrieve the value of a macro variable in the same program (or step) in which SYMPUT creates that macro variable and assigns it a value.
- You must specify a step boundary statement to force the DATA step to execute before referencing a value in a global statement following the program (for example, a TITLE statement). The boundary could be a RUN statement or another DATA or PROC statement. For example:

```
data x;
   x='December';
   call symput('var',x);
proc print;
title "Report for &var";
run;
```

Processing on page 37 provides details about compilation and execution.

*Formatting Rules For Assigning Character Values*

If *value* is a character variable, SYMPUT writes it using the $*w*. format, where *w* is the length of the variable. Therefore, a value shorter than the length of the program variable is written with trailing blanks. For example, in the following DATA step the length of variable C is 8 by default. Therefore, SYMPUT uses the $8. format and assigns the letter **x** followed by seven trailing blanks as the value of CHAR1. To eliminate the blanks, use the TRIM function as shown in the second SYMPUT statement.

```
data char1;
   input c $;
   call symput('char1',c);
   call symput('char2',trim(c));
   datalines;
x
;
run;
%put char1 = ***&char1***;
%put char2 = ***&char2***;
```

When this program executes, these lines are written to the log:

```
char1 = ***x       ***
char2 = ***x***
```

*Formatting Rules For Assigning Numeric Values*

If *value* is a numeric variable, SYMPUT writes it using the BEST12. format. The resulting value is a 12-byte string with the value right-aligned within it. For example, this DATA step assigns the value of numeric variable X to the macro variables NUM1 and NUM2. The last CALL SYMPUT statement deletes undesired leading blanks by using the LEFT function to left-align the value before the SYMPUT routine assigns the value to NUM2.

```
data _null_;
   x=1;
   call symput('num1',x);
   call symput('num2',left(x));
   call symput('num3',trim(left(put(x,8.)))); /*preferred technique*/
run;
%put num1 = ***&num1***;
%put num2 = ***&num2***;
%put num3 = ***&num3***;
```

When this program executes, these lines are written to the log:

```
num1 = ***           1***
num2 = ***1           ***
num3 = ***1***
```

## Comparisons

- SYMPUT assigns values produced in a DATA step to macro variables during program execution, but the SYMGET function returns values of macro variables to the program during program execution.
- SYMPUT is available in DATA step and SCL programs, but SYMPUTN is available only in SCL programs.
- SYMPUT assigns character values, but SYMPUTN assigns numeric values.

### Example: Creating Macro Variables and Assigning Them Values from a Data Set

```
data dusty;
   input dept $ name $ salary @@;
   datalines;
bedding Watlee 18000    bedding Ives 16000
bedding Parker 9000     bedding George 8000
bedding Joiner 8000     carpet Keller 20000
carpet Ray 12000        carpet Jones 9000
gifts Johnston 8000     gifts Matthew 19000
kitchen White 8000      kitchen Banks 14000
kitchen Marks 9000      kitchen Cannon 15000
tv Jones 9000           tv Smith 8000
tv Rogers 15000         tv Morse 16000
;
proc means noprint;
   class dept;
   var salary;
   output out=stats sum=s_sal;
run;
data _null_;
   set stats;
   if _n_=1 then call symput('s_tot',trim(left(s_sal)));
   else call symput('s'||dept,trim(left(s_sal)));
run;
%put _user_;
```

When this program executes, this list of variables is written to the log:

```
GLOBAL SCARPET 41000
GLOBAL SKITCHEN 46000
GLOBAL STV 48000
GLOBAL SGIFTS 27000
GLOBAL SBEDDING 59000
GLOBAL S_TOT 221000
```

## CALL SYMPUTN Routine

In SCL programs, assigns a numeric value to a global macro variable.

**Type:** SCL call routine

**Restriction:** The SYMPUTN CALL routine is not supported by the CAS engine.

**See:** “SYMGET Function” on page 242, “SYMGETN Function” on page 245, and “CALL SYMPUT Routine” on page 230

### Syntax

**CALL SYMPUTN**('*macro-variable*', *value*);

### Required Arguments

***macro-variable***
is the name of a global macro variable with no ampersand – note the single quotation marks. Or, it is the name of an SCL variable that contains the name of a global macro variable.

***value***
is the numeric value to assign, which can be a number or the name of a numeric SCL variable.

## Details

The SYMPUTN routine assigns a numeric value to a global SAS macro variable. SYMPUTN assigns the value when the SCL program executes. You can also use SYMPUTN to assign the value of a macro variable whose name is stored in an SCL variable. For example, to assign the value of SCL variable UNITNUM to SCL variable UNITVAR, which contains 'UNIT', submit the following:

```
call symputn(unitvar,unitnum)
```

You must use SYMPUTN with a CALL statement.

*Note:* It is inefficient to use an ampersand (**&**) to reference a macro variable that was created with CALL SYMPUTN. Instead, use SYMGETN. It is also inefficient to use CALL SYMPUTN to store a variable that does not contain a numeric value.

## Comparisons

- SYMPUTN assigns numeric values, but SYMPUT assigns character values.
- SYMPUTN is available only in SCL programs, but SYMPUT is available in DATA step programs and SCL programs.
- SYMPUTN assigns numeric values, but SYMGETN retrieves numeric values.

## Example: Storing the Value 1000 in the Macro Variable UNIT When the SCL Program Executes

This statement stores the value 1000 in the macro variable UNIT when the SCL program executes:

```
call symputn('unit',1000);
```

# CALL SYMPUTX Routine

Assigns a value to a macro variable, and removes both leading and trailing blanks.

**Category:** Macro

**Restriction:** The SYMPUTX CALL routine is not supported by the CAS engine.

**See:** “CALL SYMPUTX Routine” in *SAS Viya Functions and CALL Routines: Reference*

## Syntax

**CALL SYMPUTX**(*macro-variable*, *value* <, *symbol-table*>);

### Required Arguments

***macro-variable***
can be one of the following items:

- a character string that is a SAS name, enclosed in quotation marks.
- the name of a character variable whose values are SAS names.
- a character expression that produces a macro variable name. This form is useful for creating a series of macro variables.
- a character constant, variable, or expression. Leading and trailing blanks are removed from the value of name, and the result is then used as the name of the macro variable.

***value***
is the value to be assigned, which can be

- a string enclosed in quotation marks.
- the name of a numeric or character variable. The current value of the variable is assigned as the value of the macro variable. If the variable is numeric, SAS performs an automatic numeric-to-character conversion and writes a message in the log.

  *Note:* This form is most useful when *macro-variable* is also the name of a SAS variable or a character expression that contains a SAS variable. A unique macro variable name and value can be created from each observation.
- a DATA step expression. The value returned by the expression in the current observation is assigned as the value of *macro-variable*.

  If the expression is numeric, SAS performs an automatic numeric-to-character conversion and writes a message in the log.

### Optional Argument

***symbol-table***
specifies a character constant, variable, or expression. If it is a character constant and not a variable name, then quotation marks are required. The value of *symbol-table* is not case sensitive. The first non-blank character in *symbol-table* specifies the symbol table in which to store the macro variable. The following values are valid as the first non-blank character in *symbol-table*:

**G**
specifies that the macro variable is stored in the global symbol table, even if the local symbol table exists.

**L**
specifies that the macro variable is stored in the most local symbol table that exists, which will be the global symbol table, if used outside a macro.

**F**
specifies that if the macro variable exists in any symbol table, CALL SYMPUTX uses the version in the most local symbol table in which it exists. If the macro variable does not exist, CALL SYMPUTX stores the variable in the most local symbol table.

*Note:* If you omit *symbol-table*, or if *symbol-table* is blank, CALL SYMPUTX stores the macro variable in the same symbol table as does the CALL SYMPUT routine.

## Comparisons

CALL SYMPUTX is similar to CALL SYMPUT. Here are the differences.

- CALL SYMPUTX does not write a note to the SAS log when the second argument is numeric. CALL SYMPUT, however, writes a note to the log stating that numeric values were converted to character values.
- CALL SYMPUTX uses a field width of up to 32 characters when it converts a numeric second argument to a character value. CALL SYMPUT uses a field width of up to 12 characters.
- CALL SYMPUTX left-justifies both arguments and trims trailing blanks. CALL SYMPUT does not left-justify the arguments, and trims trailing blanks from the first argument only. Leading blanks in the value of name cause an error.
- CALL SYMPUTX enables you to specify the symbol table in which to store the macro variable, whereas CALL SYMPUT does not.

## Example

The following example shows the results of using CALL SYMPUTX.

```
data _null_;
   call symputx('  items  ', '   leading and trailing blanks removed   ',
                'lplace');
   call symputx('  x   ', 123.456);
run;

%put items=!&items!;
%put x=!&x!;
```

The following lines are written to the SAS log:

```
----+----1----+----2----+----3----+----4----+----5
items=!leading and trailing blanks removed!
x=!123.456!
```

*Chapter 16*

# DATA Step Functions for Macros

**DATA Step Functions for Macros** . . . . . **239**

**Dictionary** . . . . . **239**
RESOLVE Function . . . . . 239
SYMEXIST Function . . . . . 241
SYMGET Function . . . . . 242
SYMGETN Function . . . . . 245
SYMGLOBL Function . . . . . 246
SYMLOCAL Function . . . . . 247

## DATA Step Functions for Macros

You can interact with the Macro Facility using DATA step functions.

## Dictionary

### RESOLVE Function

Resolves the value of a text expression during DATA step execution.

**Type:** DATA step function

#### Syntax

**RESOLVE**(*argument*)

#### *Required Argument*

***argument***
can be one of the following items:

- a text expression enclosed in single quotation marks (to prevent the macro processor from resolving the argument while the DATA step is being constructed). When a macro variable value contains a macro variable reference, RESOLVE attempts to resolve the reference. If *argument* references a

nonexistent macro variable, RESOLVE returns the unresolved reference. These examples using text expressions show how to assign the text generated by macro LOCATE or assign the value of the macro variable NAME:

```
x=resolve('%locate');
x=resolve('&name');
```

- the name of a DATA step variable whose value is a text expression. For example, this example assigns the value of the text expression in the current value of the DATA step variable ADDR1 to X:

```
addr1='&locate';
x=resolve(addr1);
```

- a character expression that produces a text expression for resolution by the macro facility. For example, this example uses the current value of the DATA step variable STNUM in building the name of a macro:

```
x=resolve('%state'||left(stnum));
```

The RESOLVE function should not reference secure macros.

## Details

The RESOLVE function returns a character value that is the maximum length of a DATA step character variable unless you specifically assign the target variable a shorter length. A returned value that is longer is truncated.

If RESOLVE cannot locate the macro variable or macro identified by the argument, it returns the argument without resolution and the macro processor issues a warning message.

You can create a macro variable with the SYMPUT routine and use RESOLVE to resolve it in the same DATA step.

## Comparisons

- RESOLVE resolves the value of a text expression during execution of a DATA step or SCL program. Whereas a macro variable reference resolves when a DATA step is being constructed or an SCL program is being compiled. For this reason, the resolved value of a macro variable reference is constant during execution of a DATA step or SCL program. However, RESOLVE can return a different value for a text expression in each iteration of the program.
- RESOLVE accepts a wider variety of arguments than the SYMGET function accepts. SYMGET resolves only a single macro variable but RESOLVE resolves any macro expression. Using RESOLVE might result in the execution of macros and resolution of more than one macro variable.
- When a macro variable value contains an additional macro variable reference, RESOLVE attempts to resolve the reference, but SYMGET does not.
- If *argument* references a nonexistent macro variable, RESOLVE returns the unresolved reference, whereas SYMGET returns a missing value.
- Because of its greater flexibility, RESOLVE requires slightly more computer resources than SYMGET.

## Example: Resolving Sample References

This example shows RESOLVE used with a macro variable reference, a macro invocation, and a DATA step variable whose value is a macro invocation.

```
%let event=Holiday;
%macro date;
   New Year
%mend date;
data test;
   length var1-var3 $ 15;
   when='%date';
   var1=resolve('&event'); /* macro variable reference */
   var2=resolve('%date');  /* macro invocation */
   var3=resolve(when);     /* DATA step variable with macro invocation */
   put var1=  var2=  var3=;
run;
```

When this program executes, these lines are written to the log:

```
VAR1=Holiday  VAR2=New Year  VAR3=New Year
NOTE: The data set WORK.TEST has 1 observations and 4 variables.
```

# SYMEXIST Function

Returns an indication of the existence of a macro variable.

**Type:** DATA step function

## Syntax

**SYMEXIST**(*argument*)

### *Required Argument*

***argument***
can be one of the following items:

- the name of a macro variable within quotation marks but without an ampersand
- the name of a DATA step character variable, specified with no quotation marks, which contains a macro variable name
- a character expression that constructs a macro variable name

## Details

The SYMEXIST function searches any enclosing local symbol tables and then the global symbol table for the indicated macro variable. The SYMEXIST function returns one of the following values:

- `1` if the macro variable is found
- `0` if the macro variable is not found

## Example: Using SYMEXIST Function

The following example of the %TEST macro contains the SYMEXIST function:

```
%global x;
```

```
%macro test;
%local y;
data null;
   if symexist("x") then put "x EXISTS";
                         else put "x does not EXIST";
   if symexist("y") then put "y EXISTS";
                         else put "y does not EXIST";
   if symexist("z") then put "z EXISTS";
                         else put "z does not EXIST";
run;
%mend test;
%test;
```

In the previous example, executing the %TEST macro, which contains the SYMEXIST function, writes the following output to the log:

```
x EXISTS
y EXISTS
z does not EXIST
```

## SYMGET Function

Returns the value of a macro variable to the DATA step during DATA step execution.

**Type:** DATA step function

**Restriction:** The SYMGET function is not supported by the CAS engine.

**See:** "RESOLVE Function" on page 239, "SYMGETN Function" on page 245, "CALL SYMPUT Routine" on page 230, and "CALL SYMPUTN Routine" on page 234

### Syntax

**SYMGET**(*argument*)

#### *Required Argument*

***argument***
can be one of the following items:

- the name of a macro variable within quotation marks but without an ampersand. When a macro variable value contains another macro variable reference, SYMGET does not attempt to resolve the reference. If *argument* references a nonexistent macro variable, SYMGET returns a missing value. This example shows how to assign the value of the macro variable G to the DATA step variable X.

```
x=symget('g');
```

- the name of a DATA step character variable, specified with no quotation marks, which contains names of one or more macro variables. If the value is not a valid SAS name, or if the macro processor cannot find a macro variable of that name, SAS writes a note to the log that the function has an invalid argument and sets the resulting value to missing. For example, these statements assign the value stored in the DATA step variable CODE, which contains a macro variable name, to the DATA step variable KEY:

```
length key $ 8;
input code $;
key=symget(code);
```

Each time the DATA step iterates, the value of CODE supplies the name of a macro variable whose value is then assigned to KEY.

- a character expression that constructs a macro variable name. For example, this statement assigns the letter **s** and the number of the current iteration (using the automatic DATA step variable _N_).

```
score=symget('s'||left(_n_));
```

## Details

SYMGET returns a character value that is the maximum length of a DATA step character variable. A returned value that is longer is truncated.

If SYMGET cannot locate the macro variable identified as the argument, it returns a missing value, and the program issues a message for an invalid argument to a function.

SYMGET can be used in all SAS language programs, including SCL programs. Because it resolves variables at program execution instead of macro execution, SYMGET should be used to return macro values to DATA step views, SQL views, and SCL programs.

## Comparisons

- SYMGET returns values of macro variables during program execution, whereas the SYMPUT function assigns values that are produced by a program to macro variables during program execution.
- SYMGET accepts fewer types of arguments than the RESOLVE function. SYMGET resolves only a single macro variable. Using RESOLVE might result in the execution of macros and further resolution of values.
- SYMGET is available in all SAS programs, but SYMGETN is available only in SCL programs.

## Example: Retrieving Variable Values Previously Assigned from a Data Set

```
data dusty;
   input dept $ name $ salary @@;
   datalines;
bedding Watlee 18000    bedding Ives 16000
bedding Parker 9000     bedding George 8000
bedding Joiner 8000     carpet Keller 20000
carpet Ray 12000        carpet Jones 9000
gifts Johnston 8000     gifts Matthew 19000
kitchen White 8000      kitchen Banks 14000
kitchen Marks 9000      kitchen Cannon 15000
tv Jones 9000           tv Smith 8000
tv Rogers 15000         tv Morse 16000
;
proc means noprint;
   class dept;
   var salary;
   output out=stats sum=s_sal;
```

```
run;
proc print data=stats;
   var dept s_sal;
   title "Summary of Salary Information";
   title2 "For Dusty Department Store";
run;
data _null_;
   set stats;
   if _n_=1 then call symput('s_tot',s_sal);
   else call symput('s'||dept,s_sal);
run;
data new;
   set dusty;
   pctdept=(salary/symget('s'||dept))*100;
   pcttot=(salary/&s_tot)*100;
run;
proc print data=new split="*";
   label dept   ="Department"
         name   ="Employee"
         pctdept="Percent of *Department* Salary"
         pcttot ="Percent of *   Store  * Salary";
   format pctdept pcttot 4.1;
   title  "Salary Profiles for Employees";
   title2 "of Dusty Department Store";
run;
```

This program produces the following output:

***Output 16.1*** *Summary of Salary Information*

**Summary of Salary Information**
**For Dusty Department Store**

| Obs | dept | s_sal |
|---|---|---|
| 1 | | 221000 |
| 2 | bedding | 59000 |
| 3 | carpet | 41000 |
| 4 | gifts | 27000 |
| 5 | kitchen | 46000 |
| 6 | tv | 48000 |

***Output 16.2*** *Salary Profiles for Employees*

**Salary Profiles for Employees of Dusty Department Store**

| Obs | Department | Employee | salary | Percent of Department Salary | Percent of Store Salary |
|---|---|---|---|---|---|
| 1 | bedding | Watlee | 18000 | 30.5 | 8.1 |
| 2 | bedding | Ives | 16000 | 27.1 | 7.2 |
| 3 | bedding | Parker | 9000 | 15.3 | 4.1 |
| 4 | bedding | George | 8000 | 13.6 | 3.6 |
| 5 | bedding | Joiner | 8000 | 13.6 | 3.6 |
| 6 | carpet | Keller | 20000 | 48.8 | 9.0 |
| 7 | carpet | Ray | 12000 | 29.3 | 5.4 |
| 8 | carpet | Jones | 9000 | 22.0 | 4.1 |
| 9 | gifts | Johnston | 8000 | 29.6 | 3.6 |
| 10 | gifts | Matthew | 19000 | 70.4 | 8.6 |
| 11 | kitchen | White | 8000 | 17.4 | 3.6 |
| 12 | kitchen | Banks | 14000 | 30.4 | 6.3 |
| 13 | kitchen | Marks | 9000 | 19.6 | 4.1 |
| 14 | kitchen | Cannon | 15000 | 32.6 | 6.8 |
| 15 | tv | Jones | 9000 | 18.8 | 4.1 |
| 16 | tv | Smith | 8000 | 16.7 | 3.6 |
| 17 | tv | Rogers | 15000 | 31.3 | 6.8 |
| 18 | tv | Morse | 16000 | 33.3 | 7.2 |

## SYMGETN Function

In SAS Component Control Language (SCL) programs, returns the value of a global macro variable as a numeric value.

**Type:** SCL function

**Restriction:** The SYMGETN function is not supported by the CAS engine.

**See:** “SYMGET Function” on page 242, “CALL SYMPUT Routine” on page 230, and “CALL SYMPUTN Routine” on page 234

## Syntax

*SCL-variable*=***SYMGETN***('*macro-variable*');

### *Required Arguments*

***SCL variable***
is the name of a numeric SCL variable to contain the value stored in *macro-variable*.

***macro-variable***
is the name of a global macro variable with no ampersand – note the single quotation marks. Or, the name of an SCL variable that contains the name of a global macro variable.

## Details

SYMGETN returns the value of a global macro variable as a numeric value and stores it in the specified numeric SCL variable. You can also use SYMGETN to retrieve the value of a macro variable whose name is stored in an SCL variable. For example, to retrieve the value of SCL variable UNITVAR, whose value is 'UNIT', submit the following code:

```
unitnum=symgetn(unitvar)
```

SYMGETN returns values when SCL programs execute. If SYMGETN cannot locate *macro-variable*, it returns a missing value.

To return the value stored in a macro variable when an SCL program compiles, use a macro variable reference in an assignment statement:

```
SCL variable=&macro-variable;
```

*Note:* It is inefficient to use SYMGETN to retrieve values that are not assigned with SYMPUTN and values that are not numeric.

## Comparisons

- SYMGETN is available only in SCL programs, but SYMGET is available in DATA step programs and SCL programs.
- SYMGETN retrieves values, but SYMPUTN assigns values.

## Example: Storing a Macro Variable Value as a Numeric Value in an SCL Program

This statement stores the value of the macro variable UNIT in the SCL variable UNITNUM when the SCL program executes:

```
unitnum=symgetn('unit');
```

# SYMGLOBL Function

Returns an indication as to whether a macro variable is global in scope to the DATA step during DATA step execution.

**Type:** DATA step function

## Syntax

**SYMGLOBL**(*argument*)

### *Required Argument*

***argument***
can be one of the following items:

- the name of a macro variable within quotation marks but without an ampersand
- the name of a DATA step character variable, specified with no quotation marks, that contains a macro variable name
- a character expression that constructs a macro variable name

## Details

The SYMGLOBL function searches enclosing scopes for the indicated macro variable and returns a value of `1` if the macro variable is found in the global symbol table, otherwise it returns a `0`. For more information about the global and local symbol tables and macro variable scopes, see "Scopes of Macro Variables" on page 47.

## Example: Using SYMGLOBL Function

The following example of the %TEST macro contains the SYMGLOBL function:

```
%global x;
      %macro test;
      %local y;
      data null;
         if symglobl("x") then put "x is GLOBAL";
                               else put "x is not GLOBAL";
         if symglobl("y") then put "y is GLOBAL";
                               else put "y is not GLOBAL";
         if symglobl("z") then put "z is GLOBAL";
                               else put "z is not GLOBAL";
      run;
      %mend test;
      %test;
```

In the previous example, executing the %TEST macro, which contains the SYMGLOBL function, writes the following output to the log:

```
x is GLOBAL
y is not GLOBAL
z is not GLOBAL
```

# SYMLOCAL Function

Returns an indication as to whether a macro variable is local in scope to the DATA step during DATA step execution.

**Type:** DATA step function

## Syntax

**SYMLOCAL**(*argument*)

### *Required Argument*

***argument***
can be one of the following items:

- the name of a macro variable within quotation marks but without an ampersand
- the name of a DATA step character variable, specified with no quotation marks, that contains a macro variable name
- a character expression that constructs a macro variable name

## Details

The SYMLOCAL function searches enclosing scopes for the indicated macro variable and returns a value of `1` if the macro variable is found in a local symbol table, otherwise it returns a `0`. For more information about the global and local symbol tables and macro variable scopes, see "Scopes of Macro Variables" on page 47.

## Example: Using SYMLOCAL Function

The following example of the %TEST macro contains the SYMLOCAL function:

```
%global x;
     %macro test;
     %local y;
     data null;
        if symlocal("x") then put "x is LOCAL";
                              else put "x is not LOCAL";
        if symlocal("y") then put "y is LOCAL";
                              else put "y is not LOCAL";
        if symlocal("z") then put "z is LOCAL";
                              else put "z is not LOCAL";
     run;
     %mend test;
     %test;
```

In the previous example, executing the %TEST macro, which contains the SYMLOCAL function, writes the following output to the log:

```
x is not LOCAL
y is LOCAL
z is not LOCAL
```

*Chapter 17*

# Macro Functions

**Macro Functions** . . . . . **249**

**Dictionary** . . . . . **250**
%BQUOTE and %NRBQUOTE Functions . . . . . 250
%EVAL Function . . . . . 251
%INDEX Function . . . . . 253
%LENGTH Function . . . . . 254
%NRBQUOTE Function . . . . . 254
%NRQUOTE Function . . . . . 255
%NRSTR Function . . . . . 255
%QSCAN Function . . . . . 255
%QSUBSTR Function . . . . . 256
%QSYSFUNC Function . . . . . 256
%QUOTE and %NRQUOTE Functions . . . . . 256
%QUPCASE Function . . . . . 258
%SCAN and %QSCAN Functions . . . . . 258
%STR and %NRSTR Functions . . . . . 262
%SUBSTR and %QSUBSTR Functions . . . . . 265
%SUPERQ Function . . . . . 267
%SYMEXIST Function . . . . . 268
%SYMGLOBL Function . . . . . 269
%SYMLOCAL Function . . . . . 270
%SYSEVALF Function . . . . . 271
%SYSFUNC and %QSYSFUNC Functions . . . . . 273
%SYSGET Function . . . . . 277
%SYSGET Function . . . . . 278
%SYSMACEXEC Function . . . . . 278
%SYSMACEXIST Function . . . . . 279
%SYSMEXECDEPTH Function . . . . . 279
%SYSMEXECNAME Function . . . . . 281
%SYSPROD Function . . . . . 282
%UNQUOTE Function . . . . . 282
%UPCASE and %QUPCASE Functions . . . . . 283

## Macro Functions

A macro language function processes one or more arguments and produces a result.

# Dictionary

## %BQUOTE and %NRBQUOTE Functions

Mask special characters and mnemonic operators in a resolved value at macro execution.

**Type:** Macro quoting function

**See:** "%QUOTE and %NRQUOTE Functions" on page 256 and "%SUPERQ Function" on page 267

### Syntax

**%BQUOTE**(*character-string* | *text-expression*)

**%NRBQUOTE**(*character-string* | *text-expression*)

### Details

The %BQUOTE and %NRBQUOTE functions mask a character string or resolved value of a text expression during execution of a macro or macro language statement. They mask the following special characters and mnemonic operators:

```
' " ( ) + - * / < > = ¬ ^ ~ ; , # blank
AND OR NOT EQ NE LE LT GE GT IN
```

In addition, %NRBQUOTE masks:

```
& %
```

%NRBQUOTE is most useful when the resolved value of an argument might contain

- strings that look like macro variable references but are not, so the macro processor should not attempt to resolve them when it next encounters them.
- macro invocations that you do not want the macro processor to attempt to resolve when it next encounters them.

*Note:* The maximum level of nesting for the macro quoting functions is 10.

*Tip:* You can use %BQUOTE and %NRBQUOTE for all execution-time macro quoting because they mask all characters and mnemonic operators that can be interpreted as elements of macro language.

Quotation marks (**' "**) do not have to be marked.

For a description of quoting in SAS macro language, see "Macro Quoting" on page 80.

### Comparisons

%NRBQUOTE and the %SUPERQ function mask the same items. However, %SUPERQ does not attempt to resolve a macro variable reference or a macro invocation that occurs in the value of the specified macro variable. %NRBQUOTE does attempt to resolve such references.%BQUOTE and %NRBQUOTE do not require that you mark quotation marks.

## Example: Quoting a Variable

This example tests whether a filename passed to the macro FILEIT starts with a quotation mark. Based on that evaluation, the macro creates the correct FILE command.

```
%macro fileit(infile);
  %if %bquote(&infile) NE %then
     %do;
         %let char1 = %bquote(%substr(&infile,1,1));
         %if %bquote(&char1) = %str(%')
             or %bquote(&char1) = %str(%")
         %then %let command=FILE &infile;
         %else %let command=FILE "&infile";
     %end;
  %put &command;
%mend fileit;
%fileit(myfile)
%fileit('myfile')
```

When this program executes, the following is written to the log:

```
FILE "myfile"
FILE 'myfile'
```

# %EVAL Function

Evaluates arithmetic and logical expressions using integer arithmetic.

**Type:** Macro evaluation function

**See:** "%SYSEVALF Function" on page 271

## Syntax

**%EVAL**(*arithmetic* | *logical-expression*)

## Details

The %EVAL function evaluates integer arithmetic or logical expressions. %EVAL operates by converting its argument from a character value to a numeric or logical expression. Then, it performs the evaluation. Finally, %EVAL converts the result back to a character value and returns that value.

If all operands can be interpreted as integers, the expression is treated as arithmetic. If at least one operand cannot be interpreted as numeric, the expression is treated as logical. If a division operation results in a fraction, the fraction is truncated to an integer.

Logical, or Boolean, expressions return a value that is evaluated as true or false. In the macro language, any numeric value other than 0 is true and a value of 0 is false.

%EVAL accepts only operands in arithmetic expressions that represent integers (in standard or hexadecimal form). Operands that contain a period character cause an error when they are part of an integer arithmetic expression. The following examples show correct and incorrect usage, respectively:

```
%let d=%eval(10+20);       /* Correct usage   */
```

```
%let d=%eval(10.0+20.0);   /* Incorrect usage */
```

Because %EVAL does not convert a value containing a period to a number, the operands are evaluated as character operands. When %EVAL encounters a value containing a period, it displays an error message about finding a character operand where a numeric operand is required.

An expression that compares character values in the %EVAL function uses the sort sequence of the operating environment for the comparison. For more information about operating environment sort sequences, see "SORT" in *SAS Viya Data Management and Utility Procedures Guide*.

All parts of the macro language that evaluate expressions (for example, %IF and %DO statements) call %EVAL to evaluate the condition. For a complete discussion of how macro expressions are evaluated, see Chapter 6, "Macro Expressions," on page 71.

## Comparisons

%EVAL performs integer evaluations, but %SYSEVALF performs floating point evaluations.

## Examples

### *Example 1: Illustrating Integer Arithmetic Evaluation*

These statements illustrate different types of evaluations:

```
%let a=1+2;
%let b=10*3;
%let c=5/3;
%let eval_a=%eval(&a);
%let eval_b=%eval(&b);
%let eval_c=%eval(&c);
%put &a is &eval_a;
%put &b is &eval_b;
%put &c is &eval_c;
```

When these statements are submitted, the following is written to the log:

```
1+2 is 3
10*3 is 30
5/3 is 1
```

The third %PUT statement shows that %EVAL discards the fractional part when it performs division on integers that would result in a fraction:

### *Example 2: Incrementing a Counter*

The macro TEST uses %EVAL to increment the value of the macro variable I by 1. Also, the %DO %WHILE statement calls %EVAL to evaluate whether I is greater than the value of the macro variable FINISH.

```
%macro test(finish);
   %let i=1;
   %do %while (&i<&finish);
      %put the value of i is &i;
      %let i=%eval(&i+1);
   %end;
%mend test;
```

```
%test(5)
```

When this program executes, these lines are written to the log:

```
The value of i is 1
The value of i is 2
The value of i is 3
The value of i is 4
```

### *Example 3: Evaluating Logical Expressions*

Macro COMPARE compares two numbers.

```
%macro compare(first,second);
   %if &first>&second %then %put &first > &second;
   %else %if &first=&second %then %put &first = &second;
   %else %put &first<&second;
%mend compare;
%compare(1,2)
%compare(-1,0)
```

When this program executes, these lines are written to the log:

```
1 < 2
-1 < 0
```

## %INDEX Function

Returns the position of the first character of a string.

**Type:** Macro function

## Syntax

**%INDEX**(*source*, *string*)

### *Required Arguments*

***source***
is a character string or text expression.

***string***
is a character string or text expression.

## Details

The %INDEX function searches *source* for the first occurrence of *string* and returns the position of its first character. If *string* is not found, the function returns 0.

## Example: Locating a Character

The following statements find the first character **v** in a string:

```
%let a=a very long value;
%let b=%index(&a,v);
%put V appears at position &b..;
```

When these statements execute, the following line is written to the log:

```
V appears at position 3.
```

## %LENGTH Function

Returns the length of a string.

**Type:** Macro function

### Syntax

**%LENGTH**(*character-string* | *text-expression*)

### Details

If the argument is a character string, %LENGTH returns the length of the string. If the argument is a text expression, %LENGTH returns the length of the resolved value. If the argument has a null value, %LENGTH returns 0.

### Example: Returning String Lengths

The following statements find the lengths of character strings and text expressions.

```
%let a=Happy;
%let b=Birthday;
%put The length of &a is %length(&a).;
%put The length of &b is %length(&b).;
%put The length of &a &b To You is %length(&a &b to you).;
```

When these statements execute, the following is written to the log:

```
The length of Happy is 5.
The length of Birthday is 8.
The length of Happy Birthday To You is 21.
```

## %NRBQUOTE Function

Masks special characters, including & and %, and mnemonic operators in a resolved value at macro execution.

**Type:** Macro quoting function

**See:** "%BQUOTE and %NRBQUOTE Functions" on page 250

### Syntax

**%NRBQUOTE**(*character-string* | *text-expression*)

### Without Arguments

Note that the maximum level of nesting for the macro quoting functions is 10.

## %NRQUOTE Function

Masks special characters, including & and %, and mnemonic operators in a resolved value at macro execution.

**Type:** Macro quoting function

**See:** "%QUOTE and %NRQUOTE Functions" on page 256

### Syntax

**%NRQUOTE**(*character-string* | *text-expression*)

### Without Arguments

Note that the maximum level of nesting for the macro quoting functions is 10.

## %NRSTR Function

Masks special characters, including & and %, and mnemonic operators in constant text during macro compilation.

**Type:** Macro quoting function

**See:** "%STR and %NRSTR Functions" on page 262

### Syntax

**%NRSTR**(*character-string*)

### Without Arguments

Note that the maximum level of nesting for the macro quoting functions is 10.

## %QSCAN Function

Searches for a word and masks special characters and mnemonic operators.

**Type:** Macro function

### Syntax

**%QSCAN**(*argument*,*n*<,*charlist*<,*modifiers*> >)

### Without Arguments

"%SCAN and %QSCAN Functions" on page 258

## %QSUBSTR Function

Produces a substring and masks special characters and mnemonic operators.

**Type:** Macro function

### Syntax

**%QSUBSTR**(*argument*, *position*<, *length*>)

#### *Without Arguments*

See "%SUBSTR and %QSUBSTR Functions" on page 265

## %QSYSFUNC Function

Executes functions and masks special characters and mnemonic operators.

**Type:** Macro function

### Syntax

**%QSYSFUNC**(*function*(*argument(s)*)<, *format*>)

#### *Without Arguments*

See"%SYSFUNC and %QSYSFUNC Functions" on page 273

## %QUOTE and %NRQUOTE Functions

Mask special characters and mnemonic operators in a resolved value at macro execution.

**Type:** Macro quoting function

**See:** "%BQUOTE and %NRBQUOTE Functions" on page 250, "%NRBQUOTE Function" on page 254, "%NRSTR Function" on page 255, and "%SUPERQ Function" on page 267

### Syntax

**%QUOTE**(*character-string* | *text-expression*)

**%NRQUOTE**(*character-string* | *text-expression*)

### Details

The %QUOTE and %NRQUOTE functions mask a character string or resolved value of a text expression during execution of a macro or macro language statement. They mask the following special characters and mnemonic operators:

```
+ - * / < > = ¬ ^ ~ ; , # blank
AND OR NOT EQ NE LE LT GE GT IN
```

They also mask the following characters when they occur in pairs and when they are not matched and are marked by a preceding **%**

```
' "
```

In addition, %NRQUOTE masks

```
& %
```

%NRQUOTE is most useful when an argument might contain a macro variable reference or macro invocation that you do not want resolved.

For a description of quoting in SAS macro language, see "Macro Quoting" on page 80.

Note that the maximum level of nesting for the macro quoting functions is 10.

## Comparisons

- %QUOTE and %NRQUOTE mask the same items as %STR and %NRSTR, respectively. However, %STR and %NRSTR mask constant text instead of a resolved value. And, %STR and %NRSTR work when a macro compiles, and %QUOTE and %NRQUOTE work when a macro executes.
- The %BQUOTE and %NRBQUOTE functions do not require that quotation marks without a match be marked with a preceding **%**, and %QUOTE and %NRQUOTE do.
- %QUOTE and %NRQUOTE mask resolved values, and the %SUPERQ function prevents resolution of any macro invocations or macro variable references that might occur in a value.

## Example: Quoting a Value That Might Contain a Mnemonic Operator

The macro DEPT1 receives abbreviations for states and therefore might receive the value OR for Oregon.

```
%macro dept1(state);
      /* without %quote -- problems might occur */
   %if &state=nc %then
       %put North Carolina Department of Revenue;
   %else %put Department of Revenue;
%mend dept1;
%dept1(or)
```

When the macro DEPT1 executes, the %IF condition executes a %EVAL function, which evaluates **or** as a logical operator in this expression. Then the macro processor produces an error message for an invalid operand in the expression **or=nc**.

The macro DEPT2 uses the %QUOTE function to treat characters that result from resolving &STATE as text:

```
%macro dept2(state);
      /* with %quote function--problems are prevented */
   %if %quote(&state)=nc %then
       %put North Carolina Department of Revenue;
   %else %put Department of Revenue;
%mend dept2;
%dept2(or)
```

The %IF condition now compares the strings **or** and **nc** and writes to the SAS log:

```
Department of Revenue
```

## %QUPCASE Function

Converts a value to uppercase and returns a result that masks special characters and mnemonic operators.

**Type:** Macro function

### Syntax

**%QUPCASE**(*character-string* | *text-expression*)

#### *Without Arguments*

See "%UPCASE and %QUPCASE Functions" on page 283

## %SCAN and %QSCAN Functions

Search for a word that is specified by its position in a string.

**Type:** Macro function

**See:** "%NRBQUOTE Function" on page 254 and "%STR and %NRSTR Functions" on page 262

"Macro Functions in Linux Environments" on page 416

### Syntax

**%SCAN**(*argument*, *n*<,*charlist* <,*modifiers*> >)

**%QSCAN**(*argument*, *n*<,*charlist* <,*modifiers*> >)

#### *Required Arguments*

***argument***
is a character string or a text expression. If *argument* might contain a special character or mnemonic operator, listed below, use %QSCAN. If *argument* contains a comma, enclose *argument* in a quoting function such as %BQUOTE(*argument*).

***n***
is an integer or a text expression that yields an integer, which specifies the position of the word to return. (An implied %EVAL gives *n* numeric properties.) If *n* is greater than the number of words in *argument*, the functions return a null string.

*Note:* When you are using Version 8 or greater, if *n* is negative, %SCAN examines the character string and selects the word that starts at the end of the string and searches backward.

***charlist***
specifies an optional character expression that initializes a list of characters. This list determines which characters are used as the delimiters that separate words. The following rules apply:

- By default, all characters in *charlist* are used as delimiters.
- If you specify the K modifier in the *modifier* argument, then all characters that are not in *charlist* are used as delimiters.

**Tip** You can add more characters to *charlist* by using other modifiers.

***modifier***
specifies a character constant, a variable, or an expression in which each non-blank character modifies the action of the %SCAN function. Blanks are ignored. You can use the following characters as modifiers:

a or A adds alphabetic characters to the list of characters.

b or B scans backward from right to left instead of from left to right, regardless of the sign of the *count* argument.

c or C adds control characters to the list of characters.

d or D adds digits to the list of characters.

f or F adds an underscore and English letters (that is, valid first characters in a SAS variable name using VALIDVARNAME=V7) to the list of characters.

g or G adds graphic characters to the list of characters. Graphic characters are characters that, when printed, produce an image on paper.

h or H adds a horizontal tab to the list of characters.

i or I ignores the case of the characters.

k or K causes all characters that are not in the list of characters to be treated as delimiters. That is, if K is specified, then characters that are in the list of characters are kept in the returned value rather than being omitted because they are delimiters. If K is not specified, then all characters that are in the list of characters are treated as delimiters.

l or L adds lowercase letters to the list of characters.

m or M specifies that multiple consecutive delimiters, and delimiters at the beginning or end of the *string* argument, refer to words that have a length of zero. If the M modifier is not specified, then multiple consecutive delimiters are treated as one delimiter, and delimiters at the beginning or end of the *string* argument are ignored.

n or N adds digits, an underscore, and English letters (that is, the characters that can appear in a SAS variable name using VALIDVARNAME=V7) to the list of characters.

o or O processes the *charlist* and *modifier* arguments only once, rather than every time the %SCAN function is called. Using the O modifier in the DATA step (excluding WHERE clauses), or in the SQL procedure can make %SCAN run faster when you call it in a loop where the *charlist* and *modifier* arguments do not change. The O modifier applies separately to each instance of the %SCAN function in your SAS code, and does not cause all instances of the %SCAN function to use the same delimiters and modifiers.

p or P adds punctuation marks to the list of characters.

q or Q ignores delimiters that are inside substrings that are enclosed in quotation marks. If the value of the *string* argument contains

unmatched quotation marks, then scanning from left to right will produce different words than scanning from right to left.

r or R — removes leading and trailing blanks from the word that %SCAN returns. If you specify both the Q and R modifiers, then the %SCAN function first removes leading and trailing blanks from the word. Then, if the word begins with a quotation mark, %SCAN also removes one layer of quotation marks from the word.

s or S — adds space characters to the list of characters (blank, horizontal tab, vertical tab, carriage return, line feed, and form feed).

t or T — trims trailing blanks from the *string* and *charlist* arguments. If you want to remove trailing blanks from only one character argument instead of both character arguments, then use the TRIM function instead of the %SCAN function with the T modifier.

u or U — adds uppercase letters to the list of characters.

w or W — adds printable (writable) characters to the list of characters.

x or X — adds hexadecimal characters to the list of characters.

**Tip** If the *modifier* argument is a character constant, then enclose it in quotation marks. Specify multiple modifiers in a single set of quotation marks. A *modifier* argument can also be expressed as a character variable or expression.

## Details

The %SCAN and %QSCAN functions search *argument* and return the *n*th word. A word is one or more characters separated by one or more delimiters.

%SCAN does not mask special characters or mnemonic operators in its result, even when the argument was previously masked by a macro quoting function. %QSCAN masks the following special characters and mnemonic operators in its result:

```
& % ' " ( ) + - * / < > = ¬ ^ ~ ; , # blank
AND OR NOT EQ NE LE LT GE GT IN
```

*Definition of "Delimiter" and "Word"*

A delimiter is any of several characters that are used to separate words. You can specify the delimiters in the *charlist* and *modifier* arguments.

If you specify the Q modifier, then delimiters inside substrings that are enclosed in quotation marks are ignored.

In the %SCAN function, "word" refers to a substring that has all of the following characteristics:

- is bounded on the left by a delimiter or the beginning of the string
- is bounded on the right by a delimiter or the end of the string
- contains no delimiters

A word can have a length of zero if there are delimiters at the beginning or end of the string, or if the string contains two or more consecutive delimiters. However, the %SCAN function ignores words that have a length of zero unless you specify the M modifier.

*Using Default Delimiters in ASCII and EBCDIC Environments*

If you use the %SCAN function with only two arguments, then the default delimiters depend on whether your computer uses ASCII or EBCDIC characters.

- If your computer uses ASCII characters, then the default delimiters are as follows:

  blank ! $ % & ( ) * + , - . / ; < ^|

  In ASCII environments that do not contain the ^ character, the %SCAN function uses the ~ character instead.

- If your computer uses EBCDIC characters, then the default delimiters are as follows:

  blank ! $ % & ( ) * + , - . / ; < ¬ | ¢|

If you use the *modifier* argument without specifying any characters as delimiters, then the only delimiters that will be used are delimiters that are defined by the *modifier* argument. In this case, the lists of default delimiters for ASCII and EBCDIC environments are not used. In other words, modifiers add to the list of delimiters that are specified by the *charlist* argument. Modifiers do not add to the list of default modifiers.

*Using the %SCAN Function with the M Modifier*

If you specify the M modifier, then the number of words in a string is defined as one plus the number of delimiters in the string. However, if you specify the Q modifier, delimiters that are inside quotation marks are ignored.

If you specify the M modifier, then the %SCAN function returns a word with a length of zero if one of the following conditions is true:

- The string begins with a delimiter and you request the first word.
- The string ends with a delimiter and you request the last word.
- The string contains two consecutive delimiters and you request the word that is between the two delimiters.

*Using the %SCAN Function without the M Modifier*

If you do not specify the M modifier, then the number of words in a string is defined as the number of maximal substrings of consecutive non-delimiters. However, if you specify the Q modifier, delimiters that are inside quotation marks are ignored.

If you do not specify the M modifier, then the %SCAN function does the following:

- ignores delimiters at the beginning or end of the string
- treats two or more consecutive delimiters as if they were a single delimiter

If the string contains no characters other than delimiters, or if you specify a count that is greater in absolute value than the number of words in the string, then the %SCAN function returns one of the following:

- a single blank when you call the %SCAN function from a DATA step
- a string with a length of zero when you call the %SCAN function from the macro processor

*Using Null Arguments*

The %SCAN function allows character arguments to be null. Null arguments are treated as character strings with a length of zero. Numeric arguments cannot be null.

## Comparisons

%QSCAN masks the same characters as the %NRBQUOTE function.

### Example: Comparing the Actions of %SCAN and %QSCAN

This example illustrates the actions of %SCAN and %QSCAN.

```
%macro a;
   aaaaaa
%mend a;
%macro b;
   bbbbbb
%mend b;
%macro c;
   cccccc
%mend c;
%let x=%nrstr(%a*%b*%c);
%put X: &x;
%put The third word in X, with SCAN: %scan(&x,3,*);
%put The third word in X, with QSCAN: %qscan(&x,3,*);
```

The %PUT statement writes these lines to the log:

```
X: %a*%b*%c
The third word in X, with SCAN: cccccc
The third word in X, with QSCAN: %c
```

## %STR and %NRSTR Functions

Mask special characters and mnemonic operators in constant text at macro compilation.

**Type:** Macro quoting function

**See:** "%NRQUOTE Function" on page 255

### Syntax

**%STR**(*character-string*)

**%NRSTR**(*character-string*)

### Details

The %STR and %NRSTR functions mask a character string during compilation of a macro or macro language statement. They mask the following special characters and mnemonic operators:

```
+ - * / < > = ¬ ^ ~ ; ,  # blank
AND OR NOT EQ NE LE LT GE GT IN
```

They also mask the following characters when they occur in pairs and when they are not matched and are marked by a preceding **%**

```
' " ( )
```

In addition, %NRSTR also masks the following characters:

```
& %
```

***Table 17.1*** *Using %STR and %NSTR Arguments*

| Argument | Use |
|---|---|
| Percent sign before a quotation mark - for example, %' or %”, | Percent sign with quotation mark<br><br>EXAMPLE: %let percent=%str(Jim%'s office); |
| Percent sign before a parenthesis - for example, %( or %) | Two percent signs (%%):<br><br>EXAMPLE: %let x=%str(20%%); |
| Character string with the comment symbols /* or --> | %STR with each character<br><br>EXAMPLE: %str(/) %str(*) *comment-text* %str(*)%str(/) |

%STR is most useful for character strings that contain

- a semicolon that should be treated as text rather than as part of a macro program statement
- blanks that are significant
- a quotation mark or parenthesis without a match

Putting the same argument within nested %STR and %QUOTE functions is redundant. This example shows an argument that is masked at macro compilation by the %STR function and remains masked at macro execution. Thus, in this example, the %QUOTE function used here has no effect.

```
%quote(%str(argument))
```

***CAUTION:***

**Do not use %STR to enclose other macro functions or macro invocations that have a list of parameter values.** Because %STR masks parentheses without a match, the macro processor does not recognize the arguments of a function or the parameter values of a macro invocation.

For a description of quoting in SAS macro language, see “Macro Quoting” on page 80.

*Note:* The maximum level of nesting for macro quoting functions is 10.

## Comparisons

- Of all the macro quoting functions, only %NRSTR and %STR take effect during compilation. The other macro quoting functions take effect when a macro executes.
- %STR and %NRSTR mask the same items as %QUOTE and %NRQUOTE. However, %QUOTE and %NRQUOTE work during macro execution.
- If resolution of a macro expression produces items that need to be masked, use the %BQUOTE or %NRBQUOTE function instead of the %STR or %NRSTR function.

## Examples

### *Example 1: Maintaining Leading Blanks*

This example enables the value of the macro variable TIME to contain leading blanks.

```
%let time=%str(   now);
%put Text followed by the value of time:&time;
```

When this example is executed, these lines are written to the log:

```
Text followed by the value of time:   now
```

### Example 2: Protecting a Blank So That It Will Be Compiled as Text

This example specifies that %QSCAN use a blank as the delimiter between words.

```
%macro words(string);
   %local count word;
   %let count=1;
   %let word=%qscan(&string,&count,%str( ));
   %do %while(&word ne);
      %let count=%eval(&count+1);
      %let word=%qscan(&string,&count,%str( ));
   %end;
   %let count=%eval(&count-1);
   %put The string contains &count words.;
%mend words;
%words(This is a very long string)
```

When this program executes, these lines are written to the log:

```
The string contains 6 words.
```

### Example 3: Quoting a Value That Might Contain a Macro Reference

The macro REVRS reverses the characters produced by the macro TEST. %NRSTR in the %PUT statement protects **`%test&test`** so that it is compiled as text and not interpreted.

```
%macro revrs(string);
   %local nstring;
   %do i=%length(&string) %to 1 %by -1;
      %let nstring=&nstring%qsubstr(&string,&i,1);
   %end;
 &nstring
%mend revrs;
%macro test;
   Two words
%mend test;
%put %nrstr(%test%test) - %revrs(%test%test);
```

When this program executes, the following lines are written to the log:

```
1          %macro revrs(string);
2             %local nstring;
3             %do i=%length(&string) %to 1 %by -1;
4                %let nstring=&nstring%qsubstr(&string,&i,1);
5             %end;&nstring
6          %mend revrs;
7
8          %macro test;
9             Two words
10         %mend test;
11
12         %put %nrstr(%test%test) - %revrs(%test%test);
%test%test - sdrow owTsdrow owT
NOTE: SAS Institute Inc., SAS Campus Drive, Cary, NC USA 27513-2414
NOTE: The SAS System used:
      real time           0.28 seconds
      cpu time            0.12 seconds
```

# %SUBSTR and %QSUBSTR Functions

Produce a substring of a character string.

**Type:** Macro function

**See:** "%NRBQUOTE Function" on page 254

## Syntax

**%SUBSTR**(*argument*, *position*<, *length*>)

**%QSUBSTR**(*argument*, *position*<, *length*>)

### *Required Arguments*

***argument***
is a character string or a text expression. If *argument* might contain a special character or mnemonic operator, listed below, use %QSUBSTR.

***position***
is an integer or an expression (text, logical, or arithmetic) that yields an integer, which specifies the position of the first character in the substring. If *position* is greater than the number of characters in the string, %SUBSTR and %QSUBSTR issue a warning message and return a null value. An automatic call to %EVAL causes *n* to be treated as a numeric value.

***length***
is an optional integer or an expression (text, logical, or arithmetic) that yields an integer that specifies the number of characters in the substring. If *length* is greater than the number of characters following *position* in *argument*, %SUBSTR and %QSUBSTR issue a warning message and return a substring containing the characters from *position* to the end of the string. By default, %SUBSTR and %QSUBSTR produce a string containing the characters from *position* to the end of the character string.

## Details

The %SUBSTR and %QSUBSTR functions produce a substring of *argument*, beginning at *position*, for *length* number of characters.

%SUBSTR does not mask special characters or mnemonic operators in its result, even when the argument was previously masked by a macro quoting function. %QSUBSTR masks the following special characters and mnemonic operators:

```
& % ' " ( ) + - * / < > = ¬ ^ ~ ; , #  blank
AND OR NOT EQ NE LE LT GE GT IN
```

## Comparisons

%QSUBSTR masks the same characters as the %NRBQUOTE function.

## Examples

### *Example 1: Limiting a Fileref to Eight Characters*

The macro MAKEFREF uses %SUBSTR to assign the first eight characters of a parameter as a fileref, in case a user assigns one that is longer.

```
%macro makefref(fileref,file);
   %if %length(&fileref) gt 8 %then
       %let fileref = %substr(&fileref,1,8);
   filename &fileref "&file";
%mend makefref;
%makefref(humanresource,/dept/humanresource/report96)
```

SAS sees the following statement:

```
FILENAME HUMANRES "/dept/humanresource/report96";
```

### *Example 2: Storing a Long Macro Variable Value in Segments*

The macro SEPMSG separates the value of the macro variable MSG into 40-character units and stores each unit in a separate variable.

```
%macro sepmsg(msg);
   %let i=1;
   %let start=1;
   %if %length(&msg)>40 %then
      %do;
          %do %until(%length(&&msg&i)<40);
             %let msg&i=%qsubstr(&msg,&start,40);
             %put Message &i is: &&msg&i;
             %let i=%eval(&i+1);
             %let start=%eval(&start+40);
             %let msg&i=%qsubstr(&msg,&start);
          %end;
          %put Message &i is: &&msg&i;
      %end;
   %else %put No subdivision was needed.;
%mend sepmsg;
%sepmsg(%nrstr(A character operand was found in the %EVAL function
or %IF condition where a numeric operand is required.  A character
operand was found in the %EVAL function or %IF condition where a
numeric operand is required.));
```

When this program executes, these lines are written to the log:

```
Message 1 is: A character operand was found in the %EV
Message 2 is: AL function or  %IF condition where a nu
Message 3 is: meric operand is required.  A character
```

```
Message 4 is: operand was  found in the %EVAL function
Message 5 is:  or %IF condition where a numeric operan
Message 6 is: d is required.
```

### Example 3: Comparing Actions of %SUBSTR and %QSUBSTR

Because the value of C is masked by %NRSTR, the value is not resolved at compilation. %SUBSTR produces a resolved result because it does not mask special characters and mnemonic operators in C before processing it, even though the value of C had previously been masked with the %NRSTR function.

```
%let a=one;
%let b=two;
%let c=%nrstr(&a &b);
%put C: &c;
%put With SUBSTR: %substr(&c,1,2);
%put With QSUBSTR: %qsubstr(&c,1,2);
```

When these statements execute, these lines are written to the log:

```
C: &a &b
With SUBSTR: one
With QSUBSTR: &a
```

## %SUPERQ Function

Masks all special characters and mnemonic operators at macro execution but prevents further resolution of the value.

**Type:** Macro quoting function

**See:** "%NRBQUOTE Function" on page 254 and "%BQUOTE and %NRBQUOTE Functions" on page 250

### Syntax

**%SUPERQ**(*argument*)

#### Required Argument

***argument***

is the name of a macro variable with no leading ampersand or a text expression that produces the name of a macro variable with no leading ampersand.

### Details

The %SUPERQ function returns the value of a macro variable without attempting to resolve any macros or macro variable references in the value. %SUPERQ masks the following special characters and mnemonic operators:

```
& % ' " ( ) + - * / < > = ¬ ^ ~ ; , #  blank
AND OR NOT EQ NE LE LT GE GT IN
```

%SUPERQ is particularly useful for masking macro variables that might contain an ampersand or a percent sign when they are used with the %INPUT statement, or the SYMPUT routine.

For a description of quoting in SAS macro language, see "Macro Quoting" on page 80.

*Note:* The maximum level of nesting for the macro quoting functions is 10.

## Comparisons

- %SUPERQ is the only quoting function that prevents the resolution of macro variables and macro references in the value of the specified macro variable.
- %SUPERQ accepts only the name of a macro variable as its argument, without an ampersand, and the other quoting functions accept any text expression, including constant text, as an argument.
- %SUPERQ masks the same characters as the %NRBQUOTE function. However, %SUPERQ does not attempt to resolve anything in the value of a macro variable. %NRBQUOTE attempts to resolve any macro references or macro variable values in the argument before masking the result.

## Example: Passing Unresolved Macro Variable Values

In this example, %SUPERQ prevents the macro processor from attempting to resolve macro references in the values of MV1 and MV2 before assigning them to macro variables TESTMV1 and TESTMV2.

```
data _null_;
   call symput('mv1','Smith&Jones');
   call symput('mv2','%macro abc;');
run;
%let testmv1=%superq(mv1);
%let testmv2=%superq(mv2);
%put Macro variable TESTMV1 is &testmv1;
%put Macro variable TESTMV2 is &testmv2;
```

When this program executes, these lines are written to the log:

```
Macro variable TESTMV1 is Smith&Jones
Macro variable TESTMV2 is %macro abc;
```

You might think of the values of TESTMV1 and TESTMV2 as "pictures" of the original values of MV1 and MV2. The %PUT statement then writes the pictures in its text. The macro processor does not attempt resolution. It does not issue a warning message for the unresolved reference **&JONES** or an error message for beginning a macro definition inside a %LET statement.

# %SYMEXIST Function

Returns an indication of the existence of a macro variable.

**Type:** Macro function

## Syntax

**%SYMEXIST**(*macro-variable-name*)

### Required Argument

***macro-variable-name***
is the name of a macro variable or a text expression that yields the name of a macro variable.

## Details

The %SYMEXIST function searches any enclosing local symbol tables and then the global symbol table for the indicated macro variable and returns one of the following values:

- `1` if the macro variable is found
- `0` if the macro variable is not found

## Example: Using %SYMEXIST Macro Function

The following example uses the %IF %THEN %ELSE macro statement to change the value of `1` and `0` to **`TRUE`** and **`FALSE`** respectively:

```
%global x;
%macro test;
    %local y;
        %if %symexist(x) %then %put %nrstr(%symexist(x)) = TRUE;
                         %else %put %nrstr(%symexist(x)) = FALSE;
        %if %symexist(y) %then %put %nrstr(%symexist(y)) = TRUE;
                         %else %put %nrstr(%symexist(y)) = FALSE;
        %if %symexist(z) %then %put %nrstr(%symexist(z)) = TRUE;
                         %else %put %nrstr(%symexist(z)) = FALSE;
%mend test;
%test;
```

In the previous example, executing the %TEST macro writes the following output to the log:

```
%symexist(x) = TRUE
%symexist(y) = TRUE
%symexist(z) = FALSE
```

# %SYMGLOBL Function

Returns an indication as to whether a macro variable is global in scope.

**Type:** Macro function

## Syntax

**%SYMGLOBL**(*macro-variable-name*)

### Required Argument

***macro-variable-name***
is a name of a macro variable or a text expression that yields the name of a macro variable.

## Details

The %SYMGLOBL function searches enclosing scopes for the indicated macro variable and returns a value of `1` if the macro variable is found in the global symbol table, otherwise it returns a `0`. For more information about the global and local symbol tables and macro variable scopes, see "Scopes of Macro Variables" on page 47.

## Example: Using %SYMGLOBL Macro Function

The following example uses the %IF %THEN %ELSE macro statement to change the values of `1` and `0` to **`TRUE`** and **`FALSE`** respectively:

```
%global x;
    %macro test;
        %local y;
        %if %symglobl(x) %then %put %nrstr(%symglobl(x)) = TRUE;
                         %else %put %nrstr(%symglobl(x)) = FALSE;
        %if %symglobl(y) %then %put %nrstr(%symglobl(y)) = TRUE;
                         %else %put %nrstr(%symglobl(y)) = FALSE;
        %if %symglobl(z) %then %put %nrstr(%symglobl(z)) = TRUE;
                         %else %put %nrstr(%symglobl(z)) = FALSE;
%mend test;
%test;
```

In the example above, executing the %TEST macro writes the following output to the log:

```
%symglobl(x) = TRUE
%symglobl(y) = FALSE
%symglobl(z) = FALSE
```

# %SYMLOCAL Function

Returns an indication as to whether a macro variable is local in scope.

**Type:** Macro function

## Syntax

**%SYMLOCAL**(*macro-variable-name*)

### Required Argument

***macro-variable-name***
is the name of a macro variable or a text expression that yields the name of a macro variable.

## Details

The %SYMLOCAL searches enclosing scopes for the indicated macro variable and returns a value of **1** if the macro variable is found in a local symbol table, otherwise it returns a **0**. For more information about the global and local symbol tables and macro variable scopes, see "Scopes of Macro Variables" on page 47.

## Example: Using %SYMLOCAL Macro Function

The following example uses the %IF %THEN %ELSE macro statement to change the values of **1** and **0** to **TRUE** and **FALSE** respectively:

```
%global x;
%macro test;
    %local y;
        %if %symlocal(x) %then %put %nrstr(%symlocal(x)) = TRUE;
                               %else %put %nrstr(%symlocal(x)) = FALSE;
        %if %symlocal(y) %then %put %nrstr(%symlocal(y)) = TRUE;
                               %else %put %nrstr(%symlocal(y)) = FALSE;
        %if %symlocal(z) %then %put %nrstr(%symlocal(z)) = TRUE;
                               %else %put %nrstr(%symlocal(z)) = FALSE;
%mend test;
%test;
```

In the example above, executing the %TEST macro writes the following output to the log:

```
%symlocal(x) = FALSE
%symlocal(y) = TRUE
%symlocal(z) = FALSE
```

# %SYSEVALF Function

Evaluates arithmetic and logical expressions using floating-point arithmetic.

**Type:** Macro function

**See:** "%EVAL Function" on page 251

## Syntax

**%SYSEVALF**(*expression*<, *conversion-type*>)

### *Required Arguments*

***expression***
is an arithmetic or logical expression to evaluate.

***conversion-type***
converts the value returned by %SYSEVALF to the type of value specified. The value can then be used in other expressions that require a value of that type. *Conversion-type* can be one of the following:

**BOOLEAN**
returns

- 0 if the result of the expression is 0 or missing
- 1 if the result is any other value.

Here is an example:

```
%sysevalf(1/3,boolean)      /* returns 1 */
%sysevalf(10+.,boolean)     /* returns 0 */
```

**CEIL**
returns a character value representing the smallest integer that is greater than or equal to the result of the expression. If the result is within $10^{-12}$ of an integer, the function returns a character value representing that integer. An expression containing a missing value returns a missing value along with a message noting that fact:

```
%sysevalf(1 + 1.1,ceil)       /* returns  3 */
%sysevalf(-1 -2.4,ceil)       /* returns -3 */
%sysevalf(-1 + 1.e-11,ceil)   /* returns  0 */
%sysevalf(10+.)               /* returns  . */
```

**FLOOR**
returns a character value representing the largest integer that is less than or equal to the result of the expression. If the result is within $10^{-12}$ of an integer, the function returns that integer. An expression with a missing value produces a missing value:

```
%sysevalf(-2.4,floor)         /* returns -3 */
%sysevalf(3,floor)            /* returns  3 */
%sysevalf(1.-1.e-13,floor)    /* returns  1 */
%sysevalf(.,floor)            /* returns  . */
```

**INTEGER**
returns a character value representing the integer portion of the result (truncates the decimal portion). If the result of the expression is within $10^{-12}$ of an integer, the function produces a character value representing that integer. If the result of the expression is positive, INTEGER returns the same result as FLOOR. If the result of the expression is negative, INTEGER returns the same result as CEIL. An expression with a missing value produces a missing value:

```
%put %sysevalf(2.1,integer);        /* returns  2 */
%put %sysevalf(-2.4,integer);       /* returns -2 */
%put %sysevalf(3,integer);          /* returns  3 */
%put %sysevalf(-1.6,integer);       /* returns -1 */
%put %sysevalf(1.-1.e-13,integer);  /* returns  1 */
```

## Details

The %SYSEVALF function performs floating-point arithmetic and returns a value that is formatted using the BEST32. format. The result of the evaluation is always text. %SYSEVALF is the only macro function that can evaluate logical expressions that contain floating-point or missing values. Specify a conversion type to prevent problems when %SYSEVALF returns one of the following:

- missing or floating-point values to macro expressions
- macro variables that are used in other macro expressions that require an integer value

If the argument to the %SYSEVALF function contains no operator and no conversion type is specified, then the argument is returned unchanged.

For more information about evaluation of expressions by the SAS macro language, see Chapter 6, "Macro Expressions," on page 71.

## Comparisons

- %SYSEVALF supports floating-point numbers. However, %EVAL performs only integer arithmetic.
- You must use the %SYSEVALF macro function in macros to evaluate floating-point expressions. However, %EVAL is used automatically by the macro processor to evaluate macro expressions.

## Example: Illustrating Floating-Point Evaluation

The macro FIGUREIT performs all types of conversions for SYSEVALF values.

```
%macro figureit(a,b);
   %let y=%sysevalf(&a+&b);
   %put The result with SYSEVALF is: &y;
   %put  The BOOLEAN value is: %sysevalf(&a +&b, boolean);
   %put  The CEIL value is: %sysevalf(&a +&b, ceil);
   %put  The FLOOR value is: %sysevalf(&a +&b, floor);
   %put  The INTEGER value is: %sysevalf(&a +&b, int);
%mend figureit;
%figureit(100,1.597)
```

When this program executes, these lines are written to the log:

```
The result with SYSEVALF is: 101.597
The BOOLEAN value is: 1
The CEIL value is: 102
The FLOOR value is: 101
The INTEGER value is: 101
```

# %SYSFUNC and %QSYSFUNC Functions

Execute SAS functions or user-written functions.

**Type:** Macro function

**Tip:** %SYSFUNC and %QSYSFUNC support SAS function names up to 32 characters.

## Syntax

**%SYSFUNC**(*function*(*argument(s)*)<, *format*>)

**%QSYSFUNC**(*function*(*argument(s)*)<, *format*>)

### *Required Arguments*

***function***
is the name of the function to execute. This function can be a SAS function, a function written with SAS/TOOLKIT software, or a function created using the "FCMP" in the *SAS Viya Data Management and Utility Procedures Guide*. The function cannot be a macro function.

All SAS functions, except those listed in Table 17.2 on page 275, can be used with %SYSFUNC and %QSYSFUNC.

You cannot nest functions to be used with a single %SYSFUNC. However, you can nest %SYSFUNC calls:

```
%let x=%sysfunc(trim(%sysfunc(left(&num))));
```

Syntax for Selected Functions Used with the %SYSFUNC Function on page 409 shows the syntax of SAS functions used with %SYSFUNC that were introduced with SAS 6.12.

***argument(s)***
is one or more arguments used by *function*. An argument can be a macro variable reference or a text expression that produces arguments for a function. If *argument* might contain a special character or mnemonic operator, listed below, use %QSYSFUNC.

***format***
is an optional format to apply to the result of *function*. This format can be provided by SAS, generated by PROC FORMAT, or created with SAS/TOOLKIT. There is no default value for *format*. If you do not specify a *format*, the SAS macro facility does not perform a *format* operation on the result and uses the default of the *function*.

## Details

Because %SYSFUNC is a macro function, you do not need to enclose character values in quotation marks as you do in DATA step functions. For example, the arguments to the OPEN function are enclosed in quotation marks when the function is used alone, but do not require quotation marks when used within %SYSFUNC. These statements show the difference:

- 
```
dsid=open("sashelp.Houses","i");
```
- 
```
dsid=open("&mydata","&mode");
```
- 
```
%let dsid = %sysfunc(open(sashelp.Houses,i));
```
- 
```
%let dsid=%sysfunc(open(&mydata,&mode));
```

All arguments in DATA step functions within %SYSFUNC must be separated by commas. You cannot use argument lists preceded by the word OF.

*Note:* The arguments to %SYSFUNC are evaluated according to the rules of the SAS macro language. This includes both the function name and the argument list to the function. In particular, an empty argument position will not generate a NULL argument, but a zero length argument.

%SYSFUNC does not mask special characters or mnemonic operators in its result. %QSYSFUNC masks the following special characters and mnemonic operators in its result:

```
& % ' " ( ) + - * / < > = ¬ ^ ~ ; , #  blank
AND OR NOT EQ NE LE LT GE GT IN
```

When a function called by %SYSFUNC or %QSYSFUNC requires a numeric argument, the macro facility converts the argument to a numeric value. %SYSFUNC and

%QSYSFUNC can return a floating point number when the function that they execute supports floating point numbers.

***Table 17.2*** *SAS Functions Not Available with %SYSFUNC and %QSYSFUNC*

| | | |
|---|---|---|
| All Variable Information Functions | ALLCOMB | ALLPERM |
| DIF | DIM | HBOUND |
| IORCMSG | INPUT | LAG |
| LBOUND | LEXCOMB | LEXCOMBI |
| LEXPERK | LEXPERM | MISSING |
| PUT | RESOLVE | SYMGET |

*Note:* Instead of INPUT and PUT, which are not available with %SYSFUNC and %QSYSFUNC, use INPUTN, INPUTC, PUTN, and PUTC.

*Note:* The Variable Information functions include functions such as VNAME and VLABEL. For a complete list, see "Definitions of Functions and CALL Routines" in *SAS Viya Functions and CALL Routines: Reference*.

***CAUTION:***

**Values returned by SAS functions might be truncated.** Although values returned by macro functions are not limited to the length imposed by the DATA step, values returned by SAS functions do have that limitation.

## Comparisons

%QSYSFUNC masks the same characters as the %NRBQUOTE function.

## Examples

### *Example 1: Formatting the Current Date in a TITLE Statement*

This example formats a TITLE statement containing the current date using the DATE function and the WORDDATE. format:

```
title "%sysfunc(date(),worddate.) Absence Report";
```

When the program is executed on July 18, 2008, the statement produces the following TITLE statement:

```
title "July 18, 2008 Absence Report"
```

### *Example 2: Formatting a Value Produced by %SYSFUNC*

In this example, the TRY macro transforms the value of PARM using the PUTN function and the CATEGORY. format.

```
proc format;
```

```
  value category
  Low-<0  = 'Less Than Zero'
  0       = 'Equal To Zero'
  0<-high = 'Greater Than Zero'
  other   = 'Missing';
run;
%macro try(parm);
  %put &parm is %sysfunc(putn(&parm,category.));
%mend;
%try(1.02)
%try(.)
%try(-.38)
```

When these statements are executed, these lines are written to the log:

```
1.02 is Greater Than Zero
. is Missing
-.38 is Less Than Zero
```

### Example 3: Translating Characters

%SYSFUNC executes the TRANSLATE function to translate the Ns in a string to Ps.

```
%let string1 = V01N01-V01N10;
%let string1 = %sysfunc(translate(&string1,P, N));
%put With N translated to P, V01N01-V01N10 is &string1;
```

When these statements are executed, these lines are written to the log:

```
With N translated to P, V01N01-V01N10 is V01P01-V01P10
```

### Example 4: Confirming the Existence of a SAS Data Set

The macro CHECKDS uses %SYSFUNC to execute the EXIST function, which checks the existence of a data set:

```
%macro checkds(dsn);
   %if %sysfunc(exist(&dsn)) %then
      %do;
         proc print data=&dsn;
         run;
      %end;
      %else
         %put The data set &dsn does not exist.;
%mend checkds;
%checkds(sashelp.Houses)
```

When the program is executed, the following statements will be produced:

```
PROC PRINT DATA=sashelp.HOUSES;
RUN;
```

### Example 5: Determining the Number of Variables and Observations in a Data Set

Many solutions have been generated in the past to obtain the number of variables and observations present in a SAS data set. Most past solutions have used a combination of _NULL_ DATA steps, SET statement with NOBS=, and arrays to obtain this information. Now, you can use the OPEN and ATTRN functions to obtain this information quickly and without interfering with step boundary conditions.

```
%macro obsnvars(ds);
   %global dset nvars nobs;
   %let dset=&ds;
   %let dsid = %sysfunc(open(&dset));
   %if &dsid %then
      %do;
         %let nobs =%sysfunc(attrn(&dsid,NOBS));
         %let nvars=%sysfunc(attrn(&dsid,NVARS));
         %let rc = %sysfunc(close(&dsid));
         %put &dset has &nvars  variable(s) and &nobs observation(s).;
      %end;
   %else
      %put Open for data set &dset failed - %sysfunc(sysmsg());
%mend obsnvars;
%obsnvars(sashelp.Houses)
```

When the program is executed, the following message will appear in the log:

```
sashelp.houses has 6 variable(s) and 15 observation(s).
```

# %SYSGET Function

Returns the value of the specified operating environment variable.

**Type:** Macro function

**See:** "Macro Functions in Linux Environments" on page 416

## Syntax

**%SYSGET**(*environment-variable*)

### *Required Argument*

***environment-variable***
is the name of an environment variable. The case of *environment-variable* must agree with the case that is stored on the operating environment.

## Details

The %SYSGET function returns the value as a character string. If the value is truncated or the variable is not defined on the operating environment, %SYSGET displays a warning message in the log.

You can use the value returned by %SYSGET as a condition for determining further action to take or parts of a SAS program to execute. For example, your program can restrict certain processing or issue commands that are specific to a user.

For more information, see the SAS documentation for your operating environment.

## Example: Using SYSGET in a Linux Operating Environment

This example returns the ID of a user on a Linux operating environment:

```
%let person=%sysget(USER);
%put User is &person;
```

When these statements execute for user ABCDEF, the following is written to the log:

```
User is abcdef
```

## %SYSGET Function

Returns the value of the specified operating environment variable.

**Type:** Macro function

**See:** "Macro Functions in Linux Environments" on page 416

### Syntax

**%SYSGET**(*environment-variable*)

#### *Required Argument*

***environment-variable***
is the name of an environment variable. The case of *environment-variable* must agree with the case that is stored on the operating environment.

### Details

The %SYSGET function returns the value as a character string. If the value is truncated or the variable is not defined on the operating environment, %SYSGET displays a warning message in the log.

You can use the value returned by %SYSGET as a condition for determining further action to take or parts of a SAS program to execute. For example, your program can restrict certain processing or issue commands that are specific to a user.

For more information, see the SAS documentation for your operating environment.

### Example: Using SYSGET in a Linux Operating Environment

This example returns the ID of a user on a Linux operating environment:

```
%let person=%sysget(USER);
%put User is &person;
```

When these statements execute for user ABCDEF, the following is written to the log:

```
User is abcdef
```

## %SYSMACEXEC Function

Returns an indication of the execution status of a macro.

**Type:** Macro function

## Syntax

**%SYSMACEXEC**(*macro_name*)

### *Required Argument*

***macro_name***
the name of a macro or a text expression that yields the name of the macro.

## Details

The %SYSMACEXEC function returns the number 1 if the macro is currently executing. Otherwise, if the macro is not executing, the number 0 is returned.

# %SYSMACEXIST Function

Returns an indication of the existence of a macro definition in the Work.SASMACR catalog. Otherwise, the returned value is 0.

**Type:** Macro function

## Syntax

**%SYSMACEXIST**(*macro-name*)

### *Required Argument*

***macro-name***
the name of a macro or a text expression that yields the name of a macro.

## Details

The %SYSMACEXIST function returns the number 1 if a definition for the macro exists in the Work.SASMACR catalog. If there is not a macro definition, the returned value is 0.

# %SYSMEXECDEPTH Function

Returns the nesting depth of macro execution from the point of the call to %SYSMEXECDEPTH.

**Type:** Macro Function

**Tip:** %SYSMEXECDEPTH and %SYSMEXECNAME were implemented to be used together, but it is not required.

**See:** %SYSMEXECNAME Function

## Syntax

**%SYSMEXECDEPTH**

## Details

To retrieve the nesting level of the currently executing macro, use the %SYSMEXECDEPTH. This function returns a number indicating the depth of the macro in nested macro calls. The following are the %SYSMEXECDEPTH return value descriptions:

| | |
|---|---|
| 0 | open code |
| >0 | nesting level |

See the following example and explanations that follow it.

```
8          %macro A;
9             %put %sysmexecdepth;
10         %mend A;   /* The macro execution depth
                                    of a macro called from open code */
11         %A;         /* is one  */
1
12
13         %macro B;
14            %put %nrstr(%%)sysmexecdepth=%sysmexecdepth;
15            %put %nrstr(%%)sysmexecname(1)=%sysmexecname(1);
16            %put %nrstr(%%)sysmexecname(2)=%sysmexecname(2);
17            %put %nrstr(%%)sysmexecname(0)=%sysmexecname(0);
18            %put %nrstr(%%)sysmexecname(%nrstr(%%)sysmexecdepth-1)=
                   %sysmexecname(%sysmexecdepth-1);
19         %mend B;
20
21         %macro C;
22         %B;
23         %mend;
24         %C;
%sysmexecdepth=2
%sysmexecname(1)=C
%sysmexecname(2)=B
%sysmexecname(0)=OPEN CODE
%sysmexecname(%sysmexecdepth-1)=C
25
26         %macro level1;
27         %level2;
28         %mend;
29         %macro level2;
30         %level3;
31         %mend;
32         %macro level3;
33         %level4;
34         %mend;
35         %macro level4;
36         %do i = %sysmexecdepth+1 %to -1 %by -1;
37            %put %nrstr(%%)sysmexecname(&i)=%sysmexecname(&i);
38         %end;
39         %mend;
40
41         %level1;
WARNING: Argument 1 to %SYSMEXECNAME function is out of range.
%sysmexecname(5)=
```

```
%sysmexecname(4)=LEVEL4
%sysmexecname(3)=LEVEL3
%sysmexecname(2)=LEVEL2
%sysmexecname(1)=LEVEL1
%sysmexecname(0)=OPEN CODE
WARNING: Argument 1 to %SYSMEXECNAME function is out of range.
%sysmexecname(-1)=
42
```

- Macro **A** calls macro **B**. Macro **C** calls macro **B**. A call to %SYSMEXECDEPTH placed in macro **C** would return the value **2** for macro **B**.
- If the macro **C** wanted to know the name of the macro that had called it, it could call %SYSMEXECNAME with **%SYSMEXECNAME(%SYSMEXECDEPTH-1** (the value of the *n* argument being %SYSMEXECDEPTH, its own nesting level, minus one). That call to %SYSMEXECNAME would return the value B.

# %SYSMEXECNAME Function

Returns the name of the macro executing at a requested nesting level.

**Type:** Macro Function

**Tip:** %SYSMEXECNAME and %SYSMEXECDEPTH were implemented to be used together, but it is not required.

**See:** %SYSMEXECDEPTH function

## Syntax

**%SYSMEXECNAME**(*n*)

### *Required Argument*

***n***

The nesting level at which you are requesting the macro name.

0 open code

>0 nesting level

## Details

The %SYSMEXECNAME function returns the name of the macro executing at the *n* nesting level. The following three scenarios are shown in the example below.

- If *n = 0*, **open code** is returned.
- If *n >%SYSMEXECDEPTH*, a null string is returned and a WARNING diagnostic message is issued to the SAS log.
- If *n<0*, a null string is returned and a WARNING diagnostic message is issued to the SAS log.

```
3          %put %sysmexecdepth; /* The macro execution depth of
                                   Open Code is zero */
0
```

```
4          %put %sysmexecname(%sysmexecdepth);
OPEN CODE
5          %put %sysmexecname(%sysmexecdepth + 1);
WARNING: Argument 1 to %SYSMEXECNAME function is out of range.

6          %put %sysmexecname(%sysmexecdepth - 1);
WARNING: Argument 1 to %SYSMEXECNAME function is out of range.
```

## %SYSPROD Function

Reports whether a SAS software product is licensed at the site.

**Type:** Macro function

**See:** "%SYSEXEC Statement" on page 326, "SYSSCP and SYSSCPL Automatic Macro Variables" on page 217, and "SYSVER Automatic Macro Variable" on page 222

### Syntax

**%SYSPROD**(*product*)

#### *Required Argument*

***product***

can be a character string or text expression that yields a code for a SAS product.

For codes for SAS software products, see your on-site SAS support personnel.

### Details

%SYSPROD can return the following values:

***Table 17.3*** *%SYSPROD Values and Descriptions*

| Value | Description |
|---|---|
| 1 | The SAS product is licensed. |
| 0 | The SAS product is not licensed. |
| −1 | The product is not Institute software (for example, if the product code is misspelled). |

## %UNQUOTE Function

During macro execution, unmasks all special characters and mnemonic operators for a value.

**Type:** Macro function

**See:** "%BQUOTE and %NRBQUOTE Functions" on page 250, "%NRBQUOTE Function" on page 254, "%NRQUOTE Function" on page 255, "%NRSTR Function" on page

255, “%QUOTE and %NRQUOTE Functions” on page 256, “%STR and %NRSTR Functions” on page 262, and “%SUPERQ Function” on page 267

## Syntax

**%UNQUOTE**(*character-string* | *text-expression*)

## Details

The %UNQUOTE function unmasks a value so that special characters that it might contain are interpreted as macro language elements instead of as text. The most important effect of %UNQUOTE is to restore normal tokenization of a value whose tokenization was altered by a previous macro quoting function. %UNQUOTE takes effect during macro execution.

For more information, see “Macro Quoting” on page 80.

## Example: Using %UNQUOTE to Unmask Values

This example demonstrates a problem that can arise when the value of a macro variable is assigned using a macro quoting function and then the variable is referenced in a later DATA step. If the value is not unmasked before it reaches the SAS compiler, the DATA step does not compile correctly and it produces error messages. Although several macro functions automatically unmask values, a variable might not be processed by one of those functions.

The following program generates error messages in the log because the value of TESTVAL is still masked when it reaches the SAS compiler.

```
%let val = aaa;
%let testval = %str(%'&val%');
data _null_;
  val = &testval;
  put 'VAL =' val;
run;
```

This version of the program runs correctly because %UNQUOTE unmasks the value of TESTVAL.

```
%let val = aaa;
%let testval = %str(%'&val%');
data _null_;
  val = %unquote(&testval);
  put 'VAL =' val;
run;
```

This program prints the following to the log:

```
VAL=aaa
```

# %UPCASE and %QUPCASE Functions

Convert values to uppercase.

**Type:** Macro function

**See:** "%LOWCASE and %QLOWCASE Autocall Macros" on page 180, "%NRBQUOTE Function" on page 254, and "%QLOWCASE Autocall Macro" on page 182

## Syntax

**%UPCASE**(*character-string* | *text-expression*)

**%QUPCASE**(*character-string* | *text-expression*)

## Details

The %UPCASE and %QUPCASE functions convert lowercase characters in the argument to uppercase. %UPCASE does not mask special characters or mnemonic operators in its result, even when the argument was previously masked by a macro quoting function.

If the argument contains a special character or mnemonic operator, listed below, use %QUPCASE. %QUPCASE masks the following special characters and mnemonic operators in its result:

```
& % ' " ( ) + - * / < > = ¬ ^ ~ ; , # blank
AND OR NOT EQ NE LE LT GE GT IN
```

%UPCASE and %QUPCASE are useful in the comparison of values because the macro facility does not automatically convert lowercase characters to uppercase before comparing values.

## Comparisons

- %QUPCASE masks the same characters as the %NRBQUOTE function.
- To convert characters to lowercase, use the %LOWCASE or %QLOWCASE autocall macro.

## Examples

### *Example 1: Capitalizing a Value to Be Compared*

In this example, the macro RUNREPT compares a value input for the macro variable MONTH to the string DEC. If the uppercase value of the response is DEC, then PROC FSVIEW runs on the data set Reports.EndYear. Otherwise, PROC FSVIEW runs on the data set with the name of the month in the Reports data library.

```
%macro runrept(month);
   %if %upcase(&month)=DEC %then
       %str(proc fsview data=reports.endyear; run;);
   %else %str(proc fsview data=reports.&month; run;);
%mend runrept;
```

You can invoke the macro in any of these ways to satisfy the %IF condition:

```
%runrept(DEC)
%runrept(Dec)
%runrept(dec)
```

### *Example 2: Comparing %UPCASE and %QUPCASE*

These statements show the results produced by %UPCASE and %QUPCASE:

```
%let a=begin;
```

```
%let b=%nrstr(&a);
%put UPCASE produces: %upcase(&b);
%put QUPCASE produces: %qupcase(&b);
```

When these statements execute, the following is written to the log:

```
UPCASE produces: begin
QUPCASE produces: &A
```

*Chapter 18*

# SQL Clauses for Macros

**SQL Clauses for Macros** . . . . . **287**

**Dictionary** . . . . . **287**
INTO Clause . . . . . 287

## SQL Clauses for Macros

Structured Query Language (SQL) is a standardized, widely used language for retrieving and updating data in databases and relational tables.

## Dictionary

### INTO Clause

Assigns values produced by PROC SQL to macro variables.

**Type:** SELECT statement, PROC SQL

#### Syntax

**INTO :** *macro-variable-specification-1* <, : *macro-variable-specification-2* …>

##### *Required Argument*

***macro-variable-specification***
names one or more macro variables to create or update. Precede each macro variable name with a colon (:). The macro variable specification can be in any one or more of the following forms:

**:** ***macro-variable***
specify one or more macro variables. Leading and trailing blanks are not trimmed from values before they are stored in macro variables:

```
select style, sqfeet
   into :type, :size
   from sasuser.houses;
```

**:*macro-variable-1* – : *macro-variable-n* <NOTRIM>**
**:*macro-variable-1* THROUGH : *macro-variable-n* <NOTRIM>**
**:*macro-variable-1* THRU : *macro-variable-n* <NOTRIM>**
specifies a numbered list of macro variables. Leading and trailing blanks are trimmed from values before they are stored in macro variables. If you do not want the blanks to be trimmed, use the NOTRIM option. NOTRIM is an option in each individual element in this form of the INTO clause, so you can use it on one element and not on another element:

```
select style, sqfeet
   into :type1 - :type4 notrim, :size1 - :size3
   from sasuser.houses;
```

**:*macro-variable* SEPARATED BY '*characters* ' <NOTRIM>**
specifies one macro variable to contain all the values of a column. Values in the list are separated by one or more *characters*. This form of the INTO clause is useful for building a list of items. Leading and trailing blanks are trimmed from values before they are stored in the macro variable. If you do not want the blanks to be trimmed, use the NOTRIM option. You can use the DISTINCT option in the SELECT statement to store only the unique column (variable) values:

```
select distinct style
   into :types separated by ','
   from sasuser.houses;
```

## Details

The INTO clause for the SELECT statement can assign the result of a calculation or the value of a data column (variable) to a macro variable. If the macro variable does not exist, INTO creates it. You can check the PROC SQL macro variable SQLOBS to see the number of rows (observations) produced by a SELECT statement.

The INTO clause can be used only in the outer query of a SELECT statement and not in a subquery. The INTO clause cannot be used when you are creating a table (CREATE TABLE) or a view (CREATE VIEW).

Macro variables created with INTO follow the scoping rules for the %LET statement. For more information, see "%LET Statement" on page 311.

Values assigned by the INTO clause use the BEST8. format.

## Comparisons

In the SQL procedure, the INTO clause performs a role similar to the SYMPUT routine.

## Examples

### *Example 1: Storing Column Values in Declared Macro Variables*

This example is based on the data set SASUser.Houses and stores the values of columns (variables) STYLE and SQFEET from the first row of the table (or observation in the data set) in macro variables TYPE and SIZE. The %LET statements strip trailing blanks from TYPE and leading blanks from SIZE because this type of specification with INTO does not strip those blanks by default.

```
proc sql noprint;
   select style, sqfeet
      into :type, :size
      from sasuser.houses;
```

```
%let type=&type;
%let size=&size;
%put The first row contains a &type with &size square feet.;
```

When this program executes, the following is written to the log:

```
The first row contains a RANCH with 1250 square feet.
```

### Example 2: Storing Row Values in a List of Macro Variables

This example creates two lists of macro variables, TYPE1 through TYPE4 and SIZE1 through SIZE4, and stores values from the first four rows (observations) of the SASUser.Houses data set in them. The NOTRIM option for TYPE1 through TYPE4 retains the trailing blanks for those values.

```
proc sql noprint;
   select style, sqfeet
      into :type1 - :type4 notrim, :size1 - :size4
      from sasuser.houses;
%macro putit;
   %do i=1 %to 4;
      %put Row&i: Type=**&&type&i**   Size=**&&size&i**;
   %end;
%mend putit;
%putit
```

When this program executes, these lines are written to the log:

```
Row1: Type=**RANCH   **  Size=**1250**
Row2: Type=**SPLIT   **  Size=**1190**
Row3: Type=**CONDO   **  Size=**1400**
Row4: Type=**TWOSTORY**  Size=**1810**
```

### Example 3: Storing Values of All Rows in One Macro Variable

This example stores all values of the column (variable) STYLE in the macro variable TYPES and separates the values with a comma and a blank.

```
proc sql;
   select distinct quote(style)
      into :types separated by ', '
      from sasuser.houses;
%put Types of houses=&types.;
```

When this program executes, this line is written to the log:

```
Types of houses="CONDO   ", "RANCH   ", "SPLIT   ", "TWOSTORY"
```

*Chapter 19*

# Macro Statements

**Macro Statements** . . . . . **291**

**Dictionary** . . . . . **292**
%ABORT Statement . . . . . 292
%* Macro Comment Statement . . . . . 294
%COPY Statement . . . . . 296
%DO Statement . . . . . 297
%DO, Iterative Statement . . . . . 298
%DO %UNTIL Statement . . . . . 300
%DO %WHILE Statement . . . . . 301
%END Statement . . . . . 302
%GLOBAL Statement . . . . . 303
%GOTO Statement . . . . . 305
%IF-%THEN/%ELSE Statement . . . . . 306
%INPUT Statement . . . . . 309
%label Statement . . . . . 310
%LET Statement . . . . . 311
%LOCAL Statement . . . . . 312
%MACRO Statement . . . . . 314
%MEND Statement . . . . . 319
%PUT Statement . . . . . 320
%RETURN Statement . . . . . 323
%SYMDEL Statement . . . . . 324
%SYSCALL Statement . . . . . 325
%SYSEXEC Statement . . . . . 326
%SYSLPUT Statement . . . . . 326
%SYSMACDELETE Statement . . . . . 327
%SYSMSTORECLEAR Statement . . . . . 328
%SYSRPUT Statement . . . . . 328

## Macro Statements

A macro language statement instructs the macro processor to perform an operation. It consists of a string of keywords, SAS names, and special characters and operators, and it ends in a semicolon. Some macro language statements are used only in macro definitions, but you can use others anywhere in a SAS session or job, either inside or outside macro definitions (referred to as open code).

# Dictionary

## %ABORT Statement

Stops the macro that is executing along with the current DATA step, SAS job, or SAS session.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

### Syntax

**%ABORT** <ABEND | CANCEL | <FILE> | RETURN | <*n*>>;

#### *Required Arguments*

**ABEND**
causes abnormal termination of the current macro and SAS job or session. Results depend on the method of operation:

- batch mode.
  - stops processing immediately.
  - sends an error message to the log that states that execution was terminated by the ABEND option of the %ABORT macro statement
  - does not execute any subsequent statements or check syntax
  - returns control to the operating environment. Further action is based on how your operating environment and your site treat jobs that end abnormally.
- windowing environment and interactive line mode.
  - causes your interactive line mode to stop processing immediately and return you to your operating environment.

**CANCEL <FILE>**
causes the cancellation of the current submitted statements. The results depend on the method of operation.

If the method of operation is batch mode, use the CANCEL option to do the following:

- The entire SAS program and SAS system are terminated.
- The error message is written to the log.

If the method of operation is windowing environment and interactive line mode, use the CANCEL option to do the following:

- It only clears the current submitted program.
- Other subsequent submitted programs are not affected.
- The error message is written to the log.

If the method of operation is workspace server and stored process server, use the CANCEL option to do the following:

- It only clears currently submitted program.
- Other subsequent submit calls are not affected.
- The error message is written to the log.

If the method of operation is SAS IntrNet application server, use the CANCEL option to do the following:

- A separate execution is created for each request. The execution submits the request code. A CANCEL in the request code clears the current submitted code but does not terminate the execution or the SAS session.

**FILE**
when coded as an option to the CANCEL argument in an autoexec file or in a %INCLUDE file, causes only the contents of the autoexec file or %INCLUDE file to be cleared by the %ABORT statement. Other submitted source statements will be executed after the autoexec or %INCLUDE file.

**Restriction** The CANCEL argument cannot be submitted using SAS/SHARE, SAS/CONNECT, or SAS/AF.

**CAUTION** **When %ABORT CANCEL FILE option is executed within a %INCLUDE file, all open macros are closed and execution resumes at the next source line of code.**

**RETURN**
causes abnormal termination of the current macro and SAS job or session. Results depend on the method of operation:

- batch mode
  - stops processing immediately
  - sends an error message to the log that states that execution was terminated by the RETURN option of the %ABORT macro statement
  - does not execute any subsequent statements or check syntax
  - returns control to the operating environment with a condition code indicating an error
- windowing environment and interactive line mode
  - causes your interactive line mode to stop processing immediately and return you to your operating environment

***n***
an integer value that enables you to specify a condition code:

- When used with the CANCEL argument, the value is placed in the SYSINFO automatic macro variable.
- When it is NOT used with the CANCEL statement, SAS returns the value to the operating environment when the execution stops. The range of values for *n* depends on your operating environment.

## Details

If you specify no argument, the %ABORT macro statement produces these results under the following methods of operation:

- batch mode.
  - stops processing the current macro and DATA step and writes an error message to the log. Data sets can contain an incomplete number of observations or no observations, depending on when SAS encountered the %ABORT macro statement.
  - sets the OBS= system option to 0.
  - continues limited processing of the remainder of the SAS job, including executing macro statements, executing system option statements, and syntax checking of program statements.
- windowing environment
  - stops processing the current macro and DATA step
  - creates a data set that contains the observations that are processed before the %ABORT macro statement is encountered
  - prints a message to the log that an %ABORT macro statement terminated the DATA step
- interactive line mode
  - stops processing the current macro and DATA step. Any further DATA steps or procedures execute normally.

## Comparisons

The %ABORT macro statement causes SAS to stop processing the current macro and DATA step. What happens next depends on

- the method that you use to submit your SAS statements
- the arguments that you use with %ABORT
- your operating environment

The %ABORT macro statement usually appears in a clause of an %IF-%THEN macro statement that is designed to stop processing when an error condition occurs.

*Note:* The return code generated by the %ABORT macro statement is ignored by SAS if the system option ERRORABEND is in effect.

*Note:* When you execute an %ABORT macro statement in a DATA step, SAS does not use data sets that were created in the step to replace existing data sets with the same name.

# %* Macro Comment Statement

Designates comment text.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or open code

## Syntax

**%***commentary*;

### Required Argument

***commentary***
is a descriptive message of any length.

## Details

The macro comment statement is useful for describing macro code. Text from a macro comment statement is not constant text and is not stored in a compiled macro. Because a semicolon ends the comment statement, the comment cannot contain internal semicolons unless the internal semicolons are enclosed in quotation marks. Macro comment statements are not recognized when they are enclosed in quotation marks.

Macro comment statements are complete macro statements and are processed by the macro facility. Quotation marks within a macro comment must match.

Only macro comment statements and SAS comments of the form */*commentary*/* in macro definitions or open code might be used to hide macro statements from processing by the macro facility.

## Comparisons

SAS comment statements of the form

```
*commentary;
```

or

```
comment commentary;
```

are complete SAS statements. Consequently, they are processed by the tokenizer and macro facility and cannot contain semicolons or unmatched quotation marks. SAS comment statements of the form

```
*commentary;
```

or

```
comment commentary;
```

are stored as constant text in a compiled macro. These two types will execute any macro statements within a comment. SAS recommends not to use these within a macro definition.

SAS comments in the form

```
/*commentary*/
```

are not tokenized, but are processed as a string of characters. These comments can appear anywhere a single blank can appear and can contain semicolons or unmatched quotation marks. SAS comments in the form

```
/*commentary*/
```

are not stored in a compiled macro.

### Example: Contrasting Comment Types

This code defines and invokes the macro VERDATA, which checks for data errors. It contains a macro comment statement and SAS comments in the form **/*** ***commentary**** **/** and ***** ***commentary;***

```
%macro verdata(in, thresh);
    *%let thresh = 5;
    /* The preceding SAS comment does not hide the %let statement
        as does this type of SAS comment.
        %let thresh = 6;
    */
   %if %length(&in) > 0 %then %do;
         %* infile given;
      data check;
           /* Jim's data */
         infile &in;
         input x y z;
            * check data;
         if x<&thresh or y<&thresh or z<&thresh then list;
      run;
   %end;
   %else %put Error: No infile specified;
%mend verdata;
%verdata(ina, 0)
```

When you execute VERDATA, the macro processor generates the following:

```
DATA CHECK;
   INFILE INA;
   INPUT X Y Z;
      * CHECK DATA;
   IF X<5 OR Y<5 OR Z<5 THEN LIST;
RUN;
```

## %COPY Statement

Copies specified items from a SAS macro library.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or open code

**See:** "%MACRO Statement" on page 314 and "SASMSTORE= System Option" on page 358

### Syntax

**%COPY** *macro-name* / <*option-1* <*option-2*> …> SOURCE

#### *Required Arguments*

***macro-name***
name of the macro that the %COPY statement will use.

**SOURCE**
**SRC**
specifies that the source code of the macro will be copied to the output destination. If the OUTFILE= option is not specified, the source is written to the log.

***option1 <option-2 ...>***
must be one or more of the following options:

**LIBRARY=** ***libref*** **LIB=**
specifies the libref of a SAS library that contains a catalog of stored compiled SAS macros. If no library is specified, the libref specified by the SASMSTORE= option is used.

Restriction: This libref cannot be Work.

**OUTFILE=*fileref* | *'external file'* OUT=**
specifies the output destination of the %COPY statement. The value can be a fileref or an external file.

## Example: Using %COPY Statement

In the following example, the %COPY statement writes the stored source code to the log:

```
/* commentary */ %macro foobar(arg) /store source
     des="This macro does not do much";
%put arg = &arg;
* this is commentary!!!;
%* this is macro commentary;
%mend /* commentary; */;      /* Further commentary */
NOTE: The macro FOOBAR completed compilation without errors.
%copy foobar/source;
```

The following results are written to the log:

```
%macro foobar(arg) /store source
des="This macro does not do much";
%put arg = &arg;
* this is commentary!!!;
%* this is macro commentary;
%mend /* commentary; */;
```

# %DO Statement

Begins a %DO group.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

**See:** "%END Statement" on page 302

## Syntax

**%DO**;
*text and macro language statements*

**%END**;

## Details

The %DO statement designates the beginning of a section of a macro definition that is treated as a unit until a matching %END statement is encountered. This macro section is called a %DO group. %DO groups can be nested.

A simple %DO statement often appears in conjunction with %IF-%THEN/%ELSE statements to designate a section of the macro to be processed depending on whether the %IF condition is true or false.

## Example: Producing One of Two Reports

This macro uses two %DO groups with the %IF-%THEN/%ELSE statement to conditionally print one of two reports.

```
%macro reportit(request);
   %if %upcase(&request)=STAT %then
      %do;
         proc means;
            title "Summary of All Numeric Variables";
         run;
      %end;
   %else %if %upcase(&request)=PRINTIT %then
      %do;
         proc print;
            title "Listing of Data";
         run;
      %end;
   %else %put Incorrect report type. Please try again.;
   title;
%mend reportit;
%reportit(stat)
%reportit(printit)
```

Specifying **`stat`** as a value for the macro variable REQUEST generates the PROC MEANS step. Specifying **`printit`** generates the PROC PRINT step. Specifying any other value writes a customized error message to the log.

# %DO, Iterative Statement

Executes a section of a macro repetitively based on the value of an index variable.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

**See:** "%END Statement" on page 302

## Syntax

**%DO** *macro-variable=start* %TO *stop* <%BY *increment*>;
*text and macro language statements*

**%END**;

### Required Arguments

***macro-variable***
names a macro variable or a text expression that generates a macro variable name. Its value functions as an index that determines the number of times the %DO loop iterates. If the macro variable specified as the index does not exist, the macro processor creates it in the local symbol table.

You can change the value of the index variable during processing. For example, using conditional processing to set the value of the index variable beyond the *stop* value when a certain condition is met ends processing of the loop.

***startstop***
specify integers or macro expressions that generate integers to control the number of times the portion of the macro between the iterative %DO and %END statements is processed.

The first time the %DO group iterates, *macro-variable* is equal to *start*. As processing continues, the value of *macro-variable* changes by the value of *increment* until the value of *macro-variable* is outside the range of integers included by *start* and *stop*.

***increment***
specifies an integer (other than 0) or a macro expression that generates an integer to be added to the value of the index variable in each iteration of the loop. By default, *increment* is 1. *Increment* is evaluated before the first iteration of the loop. Therefore, you cannot change it as the loop iterates.

## Example: Generating a Series of DATA Steps

This example illustrates using an iterative %DO group in a macro definition.

```
%macro create(howmany);
   %do i=1 %to &howmany;
      data month&i;
         infile in&i;
         input product cost date;
      run;
   %end;
%mend create;
%create(3)
```

When you execute the macro CREATE, it generates these statements:

```
DATA MONTH1;
   INFILE IN1;
   INPUT PRODUCT COST DATE;
RUN;
DATA MONTH2;
   INFILE IN2;
   INPUT PRODUCT COST DATE;
RUN;
DATA MONTH3;
   INFILE IN3;
   INPUT PRODUCT COST DATE;
RUN;
```

# %DO %UNTIL Statement

Executes a section of a macro repetitively until a condition is true.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

**See:** "%END Statement" on page 302

## Syntax

**%DO %UNTIL**(*expression*);
*text and macro language statements*

**%END**;

### *Required Argument*

***expression***
can be any macro expression that resolves to a logical value. The macro processor evaluates the expression at the bottom of each iteration. The expression is true if it is an integer other than zero. The expression is false if it has a value of zero. If the expression resolves to a null value or a value containing nonnumeric characters, the macro processor issues an error message.

These examples illustrate expressions for the %DO %UNTIL statement:

•
```
%do %until(&hold=no);
```

•
```
%do %until(%index(&source,&excerpt)=0);
```

## Details

The %DO %UNTIL statement checks the value of the condition at the bottom of each iteration. Thus, a %DO %UNTIL loop always iterates at least once.

## Example: Validating a Parameter

This example uses the %DO %UNTIL statement to scan an option list to test the validity of the parameter TYPE.

```
%macro grph(type);
   %let type=%upcase(&type);
   %let options=BLOCK HBAR VBAR;
   %let i=0;
   %do %until (&type=%scan(&options,&i) or (&i>3)) ;
      %let i = %eval(&i+1);
   %end;
   %if &i>3 %then %do;
      %put ERROR: &type type not supported;
   %end;
   %else %do;
```

```
      proc chart;&type sex / group=dept;
      run;
   %end;
%mend grph;
```

When you invoke the GRPH macro with a value of HBAR, the macro generates these statements:

```
PROC CHART;
HBAR SEX / GROUP=DEPT;
RUN;
```

If you invoke the GRPH macro with a value of PIE, then the %PUT statement writes this line to the log:

```
ERROR: PIE type not supported
```

## %DO %WHILE Statement

Executes a section of a macro repetitively while a condition is true.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

**See:** "%END Statement" on page 302

### Syntax

**%DO %WHILE** (*expression*);
*text and macro program statements*

**%END**;

#### *Required Argument*

***expression***
can be any macro expression that resolves to a logical value. The macro processor evaluates the expression at the top of each iteration. The expression is true if it is an integer other than zero. The expression is false if it has a value of zero. If the expression resolves to a null value or to a value containing nonnumeric characters, the macro processor issues an error message.

These examples illustrate expressions for the %DO %WHILE statement:

- 

```
%do %while(&a<&b);
```

- 

```
%do %while(%length(&name)>20);
```

### Details

The %DO %WHILE statement tests the condition at the top of the loop. If the condition is false the first time the macro processor tests it, the %DO %WHILE loop does not iterate.

### Example: Removing Markup Tags from a Title

This example demonstrates using the %DO %WHILE to strip markup (SGML) tags from text to create a TITLE statement:

```
%macro untag(title);
      %let stbk=%str(<);
      %let etbk=%str(>);
      /* Do loop while tags exist  */
   %do %while (%index(&title,&stbk)>0) ;
      %let pretag=;
      %let posttag=;
      %let pos_et=%index(&title,&etbk);
      %let len_ti=%length(&title);
          /* Is < first character? */
      %if (%qsubstr(&title,1,1)=&stbk) %then %do;
         %if (&pos_et ne &len_ti) %then
            %let posttag=%qsubstr(&title,&pos_et+1);
      %end;
      %else %do;
         %let pretag=%qsubstr(&title,1,(%index(&title,&stbk)-1));
            /* More characters beyond end of tag (>) ? */
         %if (&pos_et ne &len_ti) %then
            %let posttag=%qsubstr(&title,&pos_et+1);
      %end;
         /* Build title with text before and after tag */
      %let title=&pretag&posttag;
   %end;
title "&title";
%mend untag;
```

You can invoke the macro UNTAG as

```
%untag(<title>Total <emph>Overdue </emph>Accounts</title>)
```

The macro then generates this TITLE statement:

```
TITLE "Total Overdue Accounts";
```

If the title text contained special characters such as commas, you could invoke it with the %NRSTR function.

```
%untag(
   %nrstr(<title>Accounts: Baltimore, Chicago, and Los Angeles</title>))
```

## %END Statement

Ends a %DO group.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

### Syntax

**%END**;

## Example: Ending a %DO Group

This macro definition contains a %DO %WHILE loop that ends, as required, with a %END statement:

```
%macro test(finish);
   %let i=1;
   %do %while (&i<&finish);
      %put the value of i is &i;
      %let i=%eval(&i+1);
   %end;
%mend test;
%test(5)
```

Invoking the TEST macro with 5 as the value of *finish* writes these lines to the log:

```
The value of i is 1
The value of i is 2
The value of i is 3
The value of i is 4
```

# %GLOBAL Statement

Creates macro variables that are available during the execution of an entire SAS session.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or open code

**See:** "%LOCAL Statement" on page 312

## Syntax

**%GLOBAL** *macro-variable(s)*;

Or

**%GLOBAL** / READONLY *macro-variable=value*;

### Required Argument

***macro-variable(s)***
is the name of one or more macro variables or a text expression that generates one or more macro variable names. You cannot use a SAS variable list or a macro expression that generates a SAS variable list in a %GLOBAL statement.

### Optional Argument

**READONLY *macro-variable=value***
creates a new read only global macro variable.

*Note:* The READONLY option can be used to create a single new macro variable (local or global).

***macro-variable***
is the name of a macro variable or a text expression that produces a macro variable name. The name must be a new macro variable name.

*value*
is a character string or a text expression.

**TIP** Omitting value produces a null value (0 characters).

**TIP** Leading and trailing blanks in the value are ignored. To have leading and trailing blanks contained in the value, you must enclose the value within the %STR function.

## Details

The %GLOBAL statement creates one or more global macro variables and assigns null values to the variables. Global macro variables are variables that are available during the entire execution of the SAS session or job.

A macro variable created with a %GLOBAL statement has a null value until you assign it some other value. If a global macro variable already exists and you specify that variable in a %GLOBAL statement, the existing value remains unchanged.

%GLOBAL statements that use the READONLY option create a new global macro variable and assign the specified value. Existing macro variables cannot be made read-only. The value of the global macro variable cannot be changed and the variable cannot be deleted. A macro variable that is declared with the READONLY option cannot be re-declared in the same scope or any enclosed scope. All read-only macro variables persist until the scope in which they exist is deleted.

## Comparisons

- Both the %GLOBAL statement and the %LOCAL statement create macro variables with a specific scope. However, the %GLOBAL statement creates global macro variables that exist for the duration of the session or job. The %LOCAL statement creates local macro variables that exist only during the execution of the macro that defines the variable.
- If you define both a global macro variable and a local macro variable with the same name, the macro processor uses the value of the local variable during the execution of the macro that contains the local variable. When the macro that contains the local variable is not executing, the macro processor uses the value of the global variable.

## Example: Creating Global Variables in a Macro Definition

```
%macro vars(first=1,last=);
   %global gfirst glast;
   %let gfirst=&first;
   %let glast=&last;
   var test&first-test&last;
%mend vars;
```

When you submit the following program, the macro VARS generates the VAR statement and the values for the macro variables used in the title statement.

```
proc print;
   %vars(last=50)
   title "Analysis of Tests &gfirst-&glast";
run;
```

SAS sees the following:

```
PROC PRINT;
   VAR TEST1-TEST50;
```

```
   TITLE "Analysis of Tests 1-50";
RUN;
```

# %GOTO Statement

Branches macro processing to the specified label.

**Type:** Macro statement

**Alias:** %GO TO

**Restriction:** Allowed in macro definitions only

**See:** "%label Statement" on page 310

## Syntax

**%GOTO** *label*;

### *Required Argument*

***label***

is either the name of the label that you want execution to branch to or a text expression that generates the label. A text expression that generates a label in a %GOTO statement is called a *computed %GOTO destination*.[1]

The following examples illustrate how to use *label*:

- `%goto findit;  /* branch to the label FINDIT */`
- `%goto &home;  /* branch to the label that is */`
  `/* the value of the macro variable HOME */`

***CAUTION:***

**No percent sign (%) precedes the label name in the %GOTO statement.** The syntax of the %GOTO statement does not include a % in front of the label name. If you use a %, the macro processor attempts to call a macro by that name to generate the label.

## Details

Branching with the %GOTO statement has two restrictions. First, the label that is the target of the %GOTO statement must exist in the current macro; you cannot branch to a label in another macro with a %GOTO statement. Second, a %GOTO statement cannot cause execution to branch to a point inside an iterative %DO, %DO %UNTIL, or %DO %WHILE loop that is not currently executing.

## Example: Providing Exits in a Large Macro

The %GOTO statement is useful in large macros when you want to provide an exit if an error occurs.

```
%macro check(parm);
   %local status;
   %if &parm= %then %do;
```

1 A computed %GOTO contains % or & and resolves to a label.

```
        %put ERROR:  You must supply a parameter to macro CHECK.;
        %goto exit;
    %end;
    more macro statements that test for error conditions
    %if &status > 0 %then %do;
        %put ERROR:  File is empty.;
        %goto exit;
    %end;
    more macro statements that generate text
    %put Check completed successfully.;
%exit: %mend check;
```

## %IF-%THEN/%ELSE Statement

Conditionally performs either the %THEN or %ELSE action..

**Type:** Macro statement

**Restrictions:** Allowed in macro definitions and in open code

No text, other than a comment, is allowed between the semicolon that ends the ACTION and the %ELSE statement.

In open code, you cannot nest the %IF-%THEN/%ELSE statements.

In open code, the ACTION that is associated with both the %THEN and %ELSE statements must be a %DO statement.

### Syntax

**Inside a macro definition:**

**%IF** *expression* **%THEN** *action*;< %ELSE *action*;>

**In open code:**

**%IF** *expression* **%THEN %DO;** *action* **%END**;< %ELSE %DO; *action* %END;>

#### *Required Arguments*

**%IF *expression***

is any macro expression that resolves to an integer. If the expression resolves to an integer other than zero, the expression is true and the %THEN clause is processed. If the expression resolves to zero, then the expression is false and the %ELSE statement, if one is present, is processed. If the expression resolves to a null value or a value containing nonnumeric characters, the macro processor issues an error message. For more information about writing macro expressions and their evaluation, see Chapter 6, “Macro Expressions,” on page 71.

The following examples illustrate using expressions in the %IF-%THEN statement:

- `%if &name=GEORGE %then %let lastname=smith;`
- `%if %upcase(&name)=GEORGE %then %let lastname=smith;`
- `%if &i=10 and &j>5 %then %put check the index variables;`

**%THEN *action***

is either constant text, a text expression, or a macro statement. If *action* contains semicolons (for example, in SAS statements), then the first semicolon after %THEN ends the %THEN clause. Use a %DO group or a quoting function, such as %STR, to

prevent semicolons in *action* from ending the %IF-%THEN statement. The following examples show two ways to conditionally generate text that contains semicolons:

- ```
  %if &city ne %then %do;
                keep citypop statepop;
             %end;
          %else %do;
                keep statepop;
             %end;
  ```

- ```
  %if &city ne %then %str(keep citypop statepop;);
             %else %str(keep statepop;);
  ```

## Details

The macro language does not contain a subsetting %IF statement. Thus, you cannot use %IF without %THEN.

Expressions that compare character values in the %IF-%THEN statement use the sort sequence of the host operating system for the comparison. For more information about host sort sequences, see "SORT" in *SAS Viya Data Management and Utility Procedures Guide*.

No text, other than a comment, is allowed between the semicolon that ends the ACTION and the %ELSE statement. When the following example executes, the extra semicolon is treated as text. Therefore, an error message is written to the log:

```
%if &city ne %then %do;
             keep citypop statepop;
          %end; ;
       %else %do;
             keep statepop;
          %end;
```

*Note:* When using the %IF-%THEN/%ELSE statement in open code, the ACTION must be a %DO statement. %IF-%THEN/%ELSE statements cannot be nested in open code.

## Comparisons

Although they look similar, the %IF-%THEN/%ELSE statement and the IF-THEN/ELSE statement belong to two different languages. In general, %IF-%THEN/%ELSE statement, which is part of the SAS macro language, conditionally generates text. However, the IF-THEN/ELSE statement, which is part of the SAS language, conditionally executes SAS statements during DATA step execution.

The expression that is the condition for the %IF-%THEN/%ELSE statement can contain only operands that are constant text or text expressions that generate text. However, the expression that is the condition for the IF-THEN/ELSE statement can contain only operands that are DATA step variables, character constants, numeric constants, or date and time constants.

When the %IF-%THEN/%ELSE statement generates text that is part of a DATA step, it is compiled by the DATA step compiler and executed. On the other hand, when the IF-THEN/ELSE statement executes in a DATA step, any text generated by the macro facility has been resolved, tokenized, and compiled. No macro language elements exist in the compiled code. "Example 1: Contrasting the %IF-%THEN/%ELSE Statement with the IF-THEN/ELSE Statement" illustrates this difference.

For more information, see "SAS Programs and Macro Processing" on page 13 and Chapter 6, "Macro Expressions," on page 71.

## Examples

### Example 1: Contrasting the %IF-%THEN/%ELSE Statement with the IF-THEN/ELSE Statement

In the SETTAX macro, the %IF-%THEN/%ELSE statement tests the value of the macro variable TAXRATE to control the generation of one of two DATA steps. The first DATA step contains an IF-THEN/ELSE statement that uses the value of the DATA step variable SALE to set the value of the DATA step variable TAX.

```
%macro settax(taxrate);
   %let taxrate = %upcase(&taxrate);
   %if &taxrate = CHANGE %then
      %do;
         data thisyear;
            set lastyear;
            if  sale > 100 then tax = .05;
            else tax = .08;
         run;
      %end;
   %else %if &taxrate = SAME %then
      %do;
         data thisyear;
            set lastyear;
            tax = .03;
            run;
      %end;
%mend settax;
```

If the value of the macro variable TAXRATE is **CHANGE**, then the macro generates the following DATA step:

```
DATA THISYEAR;
   SET LASTYEAR;
   IF SALE > 100 THEN TAX = .05;
   ELSE TAX = .08;
RUN;
```

If the value of the macro variable TAXRATE is **SAME**, then the macro generates the following DATA step:

```
DATA THISYEAR;
   SET LASTYEAR;
   TAX = .03;
RUN;
```

### Example 2: Conditionally Printing Reports

In this example, the %IF-%THEN/%ELSE statement generates statements to produce one of two reports.

```
%macro fiscal(report);
   %if %upcase(&report)=QUARTER %then
      %do;
         title 'Quarterly Revenue Report';
         proc means data=total;
```

```
            var revenue;
         run;
      %end;
   %else
      %do;
         title 'To-Date Revenue Report';
         proc means data=current;
            var revenue;
         run;
      %end;
%mend fiscal;
%fiscal(quarter)
```

When invoked, the macro FISCAL generates these statements:

```
TITLE 'Quarterly Revenue Report';
PROC MEANS DATA=TOTAL;
VAR REVENUE;
RUN;
```

# %INPUT Statement

Supplies values to macro variables during macro execution.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or open code

**See:** "%PUT Statement" on page 320 and "SYSBUFFR Automatic Macro Variable" on page 195

## Syntax

**%INPUT**<*macro-variable(s)*>;

### *Required Arguments*

**no argument**
specifies that all text entered is assigned to the automatic macro variable SYSBUFFR.

***macro-variable(s)***
is the name of a macro variable or a macro text expression that produces a macro variable name. The %INPUT statement can contain any number of variable names separated by blanks.

## Details

The macro processor interprets the line that is submitted immediately after a %INPUT statement as the response to the %INPUT statement. That line can be part of an interactive line mode session, or it can be submitted from within the code editor during a SAS Studio session.

When a %INPUT statement executes as part of an interactive line mode session, the macro processor waits for you to enter a line containing values. In a SAS Studio session, the macro processor does NOT wait for you to input values. Instead, it simply reads the next line that is processed in the program and attempts to assign variable values.

Similarly, if you invoke a macro that contains a %INPUT statement in open code as part of a longer program in SAS Studio, the macro processor reads the next line in the program that follows the macro invocation. When you submit a %INPUT statement in open code from SAS Studio, ensure that the line that follows a %INPUT statement or a macro invocation that includes a %INPUT statement contains the values that you want to assign.

When you name variables in the %INPUT statement, the macro processor matches the variables with the values in your response based on their positions. That is, the first value that you enter is assigned to the first variable named in the %INPUT statement, the second value is assigned to the second variable, and so on.

Each value to be assigned to a particular variable must be a single word or a string enclosed in quotation marks. To separate values, use blanks. After all values have been matched with macro variable names, excess text becomes the value of the automatic macro variable SYSBUFFR.

### Example: Assigning a Response to a Macro Variable

In an interactive line mode session, the following statements display a prompt and assign the response to the macro variable FIRST:

```
%put Enter your first name:;
%input first;
```

## %*label* Statement

Identifies the destination of a %GOTO statement.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

**See:** "%GOTO Statement" on page 305

### Syntax

*%label*: *macro-text*

#### *Required Arguments*

***label***
specifies a SAS name.

***macro-text***
is a macro statement, a text expression, or constant text. The following examples illustrate each:

- `%one: %let book=elementary;`
- `%out: %mend;`
- `%final: data _null_;`

### Details

- The label name is preceded by a %. When you specify this label in a %GOTO statement, do not precede it with a %.

- An alternative to using the %GOTO statement and statement label is to use a %IF-%THEN statement with a %DO group.

## Example: Controlling Program Flow

In the macro INFO, the %GOTO statement causes execution to jump to the label QUICK when the macro is invoked with the value of **short** for the parameter TYPE.

```
%macro info(type);
   %if %upcase(&type)=SHORT %then %goto quick; /* No % here */
      proc contents;
      run;
      proc freq;
         tables _numeric_;
      run;
   %quick: proc print data=_last_(obs=10);     /* Use % here */
      run;
%mend info;
%info(short)
```

Invoking the macro INFO with TYPE equal to **short** generates these statements:

```
PROC PRINT DATA=_LAST_(OBS=10);
   RUN;
```

# %LET Statement

Creates a macro variable and assigns it a value.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or open code

**See:** "%STR and %NRSTR Functions" on page 262

## Syntax

**%LET** *macro-variable*=<*value*>;

### *Required Arguments*

***macro-variable***
is either the name of a macro variable or a text expression that produces a macro variable name. The name can refer to a new or existing macro variable.

***value***
is a character string or a text expression. Omitting *value* produces a null value (0 characters). Leading and trailing blanks in *value* are ignored. To make them significant, enclose *value* with the %STR function.

## Details

If the macro variable that is named in the %LET statement already exists in any enclosing scope, the %LET statement updates the value. If the macro variable that is named in the %LET statement does not exist, it is created in the closest enclosing scope and it is assigned the specified value. A %LET statement can define only one macro variable at a time.

### Example: Sample %LET Statements

This example illustrates several %LET statements:

```
%macro title(text,number);
    %put TITLE&number "&text";
%mend;
%let topic=  The History of Genetics  ; /* Leading and trailing */
                                        /* blanks are removed   */
%title(&topic,1)
%let subject=topic;                     /* &subject resolves    */
%let &subject=Genetics Today;           /* before assignment    */
%title(&topic,2)
%let subject=The Future of Genetics;    /* &subject resolves    */
%let topic= &subject;                   /* before assignment    */
%title(&topic,3)
```

When you submit these statements, the TITLE macro generates the following statements:

```
13   %macro title(text,number);
14       %put TITLE&number "&text";
15   %mend;
16   %let topic=  The History of Genetics  ;
17
18   %title(&topic,1)
TITLE1 "The History of Genetics"
19   %let subject=topic;
20   %let &subject=Genetics Today;
21   %title(&topic,2)
TITLE2 "Genetics Today"
22   %let subject=The Future of Genetics;
23   %let topic= &subject;
24   %title(&topic,3)
TITLE3 "The Future of Genetics"
```

## %LOCAL Statement

Creates macro variables that are available only during the execution of the macro where they are defined.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

**See:** "%GLOBAL Statement" on page 303

### Syntax

**%LOCAL** *macro-variable(s)*;

Or

**%LOCAL** / READONLY *macro-variable=value*;

### Required Argument

***macro-variable(s)***
is the name of one or more macro variables or a text expression that generates one or more macro variable names. You cannot use a SAS variable list or a macro expression that generates a SAS variable list in a %LOCAL statement.

### Optional Argument

**READONLY** ***macro-variable=value***
creates a new read only local macro variable.

*Note:* The READONLY option can be used to create a single new macro variable (local or global).

***macro-variable***
is the name of a macro variable or a text expression that produces a macro variable name. The name must be a new macro variable name.

***value***
is a character string or a text expression.

**TIP** Omitting value produces a null value (0 characters).

**TIP** Leading and trailing blanks in the value are ignored. To have leading and trailing blanks contained in the value, you must enclose the value within the %STR function.

## Details

The %LOCAL statement creates one or more local macro variables. A macro variable created with %LOCAL has a null value until you assign it some other value. Local macro variables are variables that are available only during the execution of the macro in which they are defined.

Use the %LOCAL statement to ensure that macro variables created earlier in a program are not inadvertently changed by values assigned to variables with the same name in the current macro. If a local macro variable already exists and you specify that variable in a %LOCAL statement, the existing value remains unchanged.

%LOCAL statements that use the READONLY option create a new local macro variable and assign the specified value. Existing macro variables cannot be made read-only. The value of the local macro variable cannot be changed and the variable cannot be deleted. A macro variable that is declared with the READONLY option cannot be re-declared in the same scope or any enclosed scope. All read-only macro variables persist until the scope in which they exist is deleted.

## Comparisons

- Both the %LOCAL statement and the %GLOBAL statement create macro variables with a specific scope. However, the %LOCAL statement creates local macro variables that exist only during the execution of the macro that contains the variable, and the %GLOBAL statement creates global macro variables that exist for the duration of the session or job.
- If you define a local macro variable and a global macro variable with the same name, the macro facility uses the value of the local variable during the execution of the macro that contains that local variable. When the macro that contains the local variable is not executing, the macro facility uses the value of the global variable.

### Example: Using a Local Variable with the Same Name as a Global Variable

```
%let variable=1;
%macro routine;
   %put ***** Beginning ROUTINE *****;
   %local variable;
   %let variable=2;
   %put The value of variable inside ROUTINE is &variable;
   %put ***** Ending ROUTINE *****;
%mend routine;
%routine
%put The value of variable outside ROUTINE is &variable;
```

Submitting these statements writes these lines to the log:

```
***** Beginning ROUTINE *****
The value of variable inside ROUTINE is 2
***** Ending ROUTINE *****
The value of variable outside ROUTINE is 1
```

## %MACRO Statement

Begins a macro definition.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or open code

**See:** "%MEND Statement" on page 319 and "SYSPBUFF Automatic Macro Variable" on page 214

### Syntax

**%MACRO** *macro-name* <(*parameter-list*)> </ *option(s)*>;

#### *Required Arguments*

***macro-name***
names the macro. A macro name must be a SAS name, which you supply; you cannot use a text expression to generate a macro name in a %MACRO statement. In addition, do not use macro reserved words as a macro name. (For a list of macro reserved words, see Appendix 1, " Reserved Words in the Macro Facility," on page 365.)

***parameter-list***
names one or more local macro variables whose values you specify when you invoke the macro. Parameters are local to the macro that defines them. You must supply each parameter name; you cannot use a text expression to generate it. A parameter list can contain any number of macro parameters separated by commas. The macro variables in the parameter list are usually referenced in the macro.

- *parameter-list* can be
  - *<positional-parameter-1><,positional-parameter-2 ...>*

- *<keyword-parameter=<value> <,keyword-parameter-2=<value> ...>>*

| | |
|---|---|
| *positional-parameter-1 <,positional-parameter-2 ...>* | specifies one or more positional parameters. You can specify positional parameters in any order, but in the macro invocation, the order in which you specify the values must match the order that you list them in the %MACRO statement. If you define more than one positional parameter, use a comma to separate the parameters. If at invocation that you do not supply a value for a positional parameter, the macro facility assigns a null value to that parameter. |
| *keyword-parameter=<value> <,keyword-parameter-2=<value> ...>* | names one or more macro parameters followed by equal signs. You can specify default values after the equal signs. If you omit a default value after an equal sign, the keyword parameter has a null value. Using default values enables you to write more flexible macro definitions and reduces the number of parameters that must be specified to invoke the macro. To override the default value, specify the macro variable name followed by an equal sign and the new value in the macro invocation. |

*Note:* You can define an unlimited number of parameters. If both positional and keyword parameters appear in a macro definition, positional parameters must come first.

***option(s)***
can be one or more of these optional arguments:

**CMD**
Obsolete

**DES='*text*'**
specifies a description for the macro entry in the macro catalog. The description text can be up to 256 characters in length. Enclose the description in quotation marks. The DES= option is especially useful when you use the stored compiled macro facility.

**MINDELIMITER='*single character*';**
specifies a value that will override the value of the MINDELIMITER= global option. The value must be a single character enclosed in single quotation marks and can appear only once in a %MACRO statement.

**Restriction** The following characters cannot be used as a delimiter

```
%  &  '  "  (  )  ;
```

**MINOPERATOR | NOMINOPERATOR**
specifies that the macro processor recognizes and evaluates the mnemonic **IN** and the special character **#** as logical operators when evaluating arithmetic or logical expressions during the execution of the macro. The setting of this argument overrides the setting of the NOMINOPERATOR global system option.

The NOMINOPERATOR argument specifies that the macro processor does not recognize the mnemonic **IN** and the special character **#** as logical operators when

evaluating arithmetic or logical expressions during the execution of the macro. The setting of this argument overrides the setting of the MINOPERATOR global system option.

**PARMBUFF**

assigns the entire list of parameter values in a macro call, including the parentheses in a name-style invocation, as the value of the automatic macro variable SYSPBUFF. Using the PARMBUFF option, you can define a macro that accepts a varying number of parameter values.

If the macro definition includes both a set of parameters and the PARMBUFF option, the macro invocation causes the parameters to receive values. It also causes the entire invocation list of values to be assigned to SYSPBUFF.

To invoke a macro defined with the PARMBUFF option in a windowing environment or interactive line mode session without supplying a value list, enter an empty set of parentheses or more program statements after the invocation. This action indicates the absence of a value list, even if the macro definition contains no parameters.

**SECURE | NOSECURE**

causes the contents of a macro to be encrypted when stored in a stored compiled macro library. This feature enables you to write *secure* macros that will protect intellectual property that is contained in the macros. The macros are secured using the Encryption Algorithm Manager.

A NOSECURE option has been implemented to aid in the global edit of a source file or library to turn on security. For example, when you are creating several macros that will need to be secure. When creating the macros, use the NOSECURE option. When all macros are completed and ready for production, you can do a global edit and change NOSECURE to SECURE.

If you use the SECURE and SOURCE options on a macro, no output is produced when you use the %COPY statement. The following NOTE is written to the log:

```
NOTE: The macro %name was compiled with the SECURE
option. No output will be produced for this %COPY
statement.
```

**STMT**

specifies that the macro can accept either a name-style invocation or a statement-style invocation. Macros defined with the STMT option are sometimes called *statement-style macros*.

The IMPLMAC system option must be in effect to use statement-style macro invocations. If IMPLMAC is in effect and you have defined a statement-style macro in your program, the macro processor scans the first word of every SAS statement to see whether it is a statement-style macro invocation. When the NOIMPLMAC option is in effect, the macro processor treats only the words following the % symbols as potential macro invocations. If the IMPLMAC option is not in effect, you still can use a name-style invocation for a macro defined with the STMT option.

**SOURCE**
**SRC**

combines and stores the source of the compiled macro with the compiled macro code as an entry in a SAS catalog in a permanent SAS library. The SOURCE option requires that the STORE option and the MSTORED option be set. You can use the SASMSTORE= option to identify a permanent SAS library. You can store a macro or call a stored compiled macro only when the MSTORED option

is in effect. (For more information, see "Storing and Reusing Macros" on page 111.)

*Note:* The source code saved by the SOURCE option begins with the %MACRO keyword and ends with the semi-colon following the %MEND statement.

***CAUTION:***
**The SOURCE option cannot be used on nested macro definitions (macro definitions contained within another macro).**

**STORE**
stores the compiled macro as an entry in a SAS catalog in a permanent SAS library. Use the SAS system option SASMSTORE= to identify a permanent SAS library. You can store a macro or call a stored compiled macro only when the SAS system option MSTORED is in effect. (For more information, see "Storing and Reusing Macros" on page 111.)

## Details

The %MACRO statement begins the definition of a macro, assigns the macro a name, and can include a list of macro parameters, a list of options, or both.

A macro definition must precede the invocation of that macro in your code. The %MACRO statement can appear anywhere in a SAS program, except within data lines. A macro definition cannot contain a CARDS statement, a DATALINES statement, a PARMCARDS statement, or data lines. Use an INFILE statement instead.

By default, a defined macro is an entry in a SAS catalog in the Work library. You can also store a macro in a permanent SAS catalog for future use. However, in SAS 6 and earlier, SAS does not support copying, renaming, or transporting macros.

You can nest macro definitions, but doing so is rarely necessary and is often inefficient. If you nest a macro definition, then it is compiled every time you invoke the macro that includes it. Instead, nesting a macro invocation inside another macro definition is sufficient in most cases.

## Examples

### *Example 1: Using the %MACRO Statement with Positional Parameters*

In this example, the macro PRNT generates a PROC PRINT step. The parameter in the first position is VAR, which represents the SAS variables that appear in the VAR statement. The parameter in the second position is SUM, which represents the SAS variables that appear in the SUM statement.

```
%macro prnt(var,sum);
   proc print data=srhigh;
      var &var;
      sum &sum;
   run;
%mend prnt;
```

In the macro invocation, all text up to the comma is the value of parameter VAR; text following the comma is the value of parameter SUM.

```
%prnt(school district enrollmt, enrollmt)
```

During execution, macro PRNT generates the following statements:

```
PROC PRINT DATA=SRHIGH;
```

```
   VAR SCHOOL DISTRICT ENROLLMT;
   SUM ENROLLMT;
RUN;
```

### Example 2: Using the %MACRO Statement with the PARMBUFF Option

The macro PRINTZ uses the PARMBUFF option to enable you to input a different number of arguments each time you invoke it:

```
%macro printz/parmbuff;
   %let num=1;
   %let dsname=%scan(&syspbuff,&num);
   %do %while(&dsname ne);
      proc print data=&dsname;
      run;
      %let num=%eval(&num+1);
      %let dsname=%scan(&syspbuff,&num);
   %end;
%mend printz;
```

This invocation of PRINTZ contains four parameter values, **PURPLE**, **RED**, **BLUE**, and **TEAL** although the macro definition does not contain any individual parameters:

```
%printz(purple,red,blue,teal)
```

As a result, SAS receives these statements:

```
PROC PRINT DATA=PURPLE;
RUN;
PROC PRINT DATA=RED;
RUN;
PROC PRINT DATA=BLUE;
RUN;
PROC PRINT DATA=TEAL;
RUN;
```

### Example 3: Using the %MACRO Statement with the SOURCE Option

The SOURCE option combines and stores the source of the compiled macro with the compiled macro code. Use the %COPY statement to write the source to the log. For more information about viewing or retrieving the stored source, see "%COPY Statement" on page 296.

```
/* commentary */  %macro foobar(arg) /store source
      des="This macro does not do much";
%put arg = &arg;
* this is commentary!!!;
%* this is macro commentary;
%mend /* commentary; */;      /* Further commentary */
NOTE: The macro FOOBAR completed compilation without errors.
%copy foobar/source;
```

The following results are written to the log:

```
%macro foobar(arg) /store source
des="This macro does not do much";
%put arg = &arg;
* this is commentary!!!;
%* this is macro commentary;
%mend /* commentary; */;
```

### *Example 4: Using the %MACRO Statement with the STORE and SECURE Options*

The SECURE option can be used only in conjunction with the STORE option. The following example demonstrates the use of the STORE and an implied NOSECURE option to create a macro that is stored in plain text.

```
options mstored sasmstore=mylib;
libname mylib "SAS-library";
%macro nonsecure/store; /* This macro is stored in plain text */
  data _null_;
    x=1;
    put "This data step was generated from a non-secure macro.";
  run;
%mend nonsecure;
%nonsecure
filename maccat catalog 'mylib.sasmacr.nonsecure.macro';
data _null_;
  infile maccat;
  input;
  list;
run;
```

The following example demonstrates the use of the STORE and SECURE options to create a macro that is encrypted.

```
options mstored sasmstore=mylib;
libname mylib "SAS-library";
%macro secure/store secure; /* This macro is encrypted */
    data _null_;
      x=1;
      put "This data step was generated from a secure macro.";
    run;
  %mend secure;
  %secure
  filename maccat catalog 'mylib.sasmacr.secure.macro';
  data _null_;
    infile maccat;
    input;
    list;
  run;
```

## %MEND Statement

Ends a macro definition.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions only

## Syntax

**%MEND** <*macro-name*> ;

### Required Argument

***macro-name***
names the macro as it ends a macro definition. Repeating the name of the macro is optional, but it is useful for clarity. If you specify *macro-name*, the name in the %MEND statement should match the name in the %MACRO statement; otherwise, SAS issues a warning message.

## Example: Ending a Macro Definition

```
%macro disc(dsn);
   data &dsn;
      set perm.dataset;
      where month="&dsn";
   run;
%mend disc;
```

# %PUT Statement

Writes text or macro variable information to the log.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or open code

## Syntax

**%PUT** <*text* | _ALL_ | _AUTOMATIC_ | _GLOBAL_ | _LOCAL_ | _READONLY_ | _USER_ | _WRITABLE_>;

### Required Arguments

**no argument**
places a blank line in the log.

***text***
is text or a text expression that is written to the log. If *text* is longer than the current line size, the remainder of the text appears on the next line. The %PUT statement removes leading and trailing blanks from *text* unless you use a macro quoting function.

**_ALL_**
lists the values of all user-generated and automatic macro variables.

**_AUTOMATIC_**
lists the values of automatic macro variables. The automatic variables listed depend on the SAS products installed at your site and on your operating system. The scope is identified as AUTOMATIC.

**_GLOBAL_**
lists user-generated global macro variables. The scope is identified as GLOBAL.

**_LOCAL_**
lists user-generated local macro variables. The scope is the name of the currently executing macro.

**_READONLY_**
lists all user-defined read-only macro variables, regardless of scope. The scope is either GLOBAL, for global macro variables, or the name of the macro in which the macro variable is defined.

**_USER_**
lists user-generated global and local macro variables. The scope is identified either as GLOBAL, or as the name of the macro in which the macro variable is defined.

**_WRITABLE_**
lists all user-defined read and write macro variables, regardless of scope. The scope is either GLOBAL, for global macro variables, or the name of the macro in which the macro variable is defined.

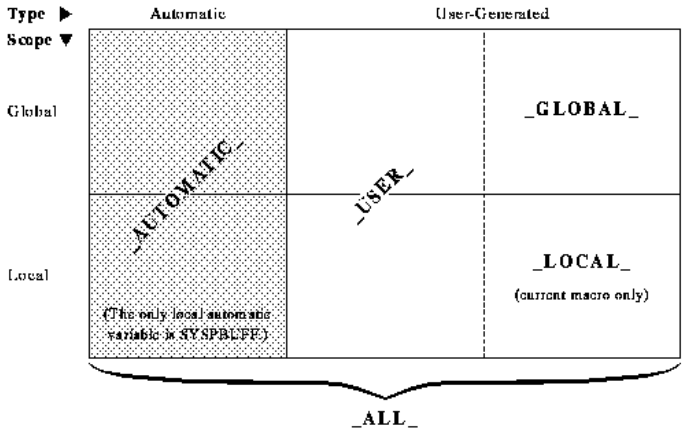
## Details

When you use the %PUT statement to list macro variable descriptions, the %PUT statement includes only the macro variables that exist when statement executes. The description contains the macro variable's scope, name, and value. Macro variables with null values show only the scope and name of the variable. Characters in values that have been quoted with macro quoting functions remain quoted. Values that are too long for the current line size wrap to the next line or lines. Macro variables are listed in order from the current local macro variables outward to the global macro variables.

*Note:* Within a particular scope, macro variables might appear in any order, and the order might change in different executions of the %PUT statement or different SAS sessions. Do not write code that depends on locating a variable in a particular position in the list.

The following figure shows the relationship of these terms.

***Figure 19.1*** *%PUT Arguments by Type and Scope*




The %PUT statement displays text in different colors to generate messages that look like ERROR, NOTE, and WARNING messages generated by SAS. To display text in different colors, the first word in the %PUT statement must be ERROR, NOTE, or WARNING (all uppercase letters), followed immediately by a colon or a hyphen. You might also use the national-language equivalents of these words. Using a hyphen (-) following the ERROR, NOTE, or WARNING keyword causes the text of the %PUT statement to be a continuation of the previous ERROR, NOTE, or WARNING message, respectively. When you use a hyphen, the ERROR, NOTE, or WARNING word is blanked out.

*Note:* If you use the %PUT statement and the last message text that was generated by the SYSWARNINGTEXT and SYSERRORTEXT automatic macro variables contained an **&** or **%**, you must use the %SUPERQ macro quoting function. For more information, see "SYSERRORTEXT Automatic Macro Variable" on page 205 and "SYSWARNINGTEXT Automatic Macro Variable" on page 224.

**TIP** If you place an equal sign between the ampersand and the macro variable name of a direct macro variable reference, the macro variable's name is displayed in the log along with the macro variable's value.

```
%let x=1;
%put &=x;
X=1;
```

## Examples

### Example 1: Displaying Text

The following statements illustrate using the %PUT statement to write text to the log:

```
%put One line of text.;
%put %str(Use a semicolon(;) to end a SAS statement.);
%put %str(Enter the student%'s address.);
```

When you submit these statements, these lines appear in the log:

```
One line of text.
Use a semicolon(;) to end a SAS statement.
Enter the student's address.
```

### Example 2: Displaying Automatic Variables

To display all automatic variables, submit

```
%put _automatic_;
```

The result in the log (depending on the products installed at your site) lists the scope, name, and value of each automatic variable:

```
AUTOMATIC SYSBUFFR
AUTOMATIC SYSCMD
AUTOMATIC SYSDATE 21JUN97
AUTOMATIC SYSDAY Wednesday
AUTOMATIC SYSDSN          _NULL_
AUTOMATIC SYSENV FORE
AUTOMATIC SYSERR 0
AUTOMATIC SYSFILRC 0
AUTOMATIC SYSINDEX 0
AUTOMATIC SYSINFO 0
```

### Example 3: Displaying User-Generated Variables

This example lists the user-generated macro variables in all scopes.

```
%macro myprint(name);
   proc print data=&name;
      title "Listing of &name on &sysdate";
      footnote "&foot";
```

```
   run;
   %put _user_;
%mend myprint;
%let foot=Preliminary Data;
%myprint(consumer)
```

The %PUT statement writes these lines to the log:

```
MYPRINT NAME consumer
GLOBAL FOOT Preliminary Data
```

Notice that SYSDATE does not appear because it is an automatic macro variable.

To display the user-generated variables after macro MYPRINT finishes, submit another %PUT statement.

```
%put _user_;
```

The result in the log does not list the macro variable NAME because it was local to MYPRINT and ceased to exist when MYPRINT finished execution.

```
GLOBAL FOOT Preliminary Data
```

### *Example 4: Displaying Local Variables*

This example displays the macro variables that are local to macro ANALYZE.

```
%macro analyze(name,vars);
   proc freq data=&name;
      tables &vars;
   run;
   %put FIRST LIST:;
   %put _local_;
   %let firstvar=%scan(&vars,1);
   proc print data=&name;
      where &firstvar ne .;
   run;
   %put SECOND LIST:;
   %put _local_;
%mend analyze;
%analyze(consumer,car house stereo)
```

In the result that is printed in the log, the macro variable FIRSTVAR, which was created after the first %PUT _LOCAL_ statement, appears only in the second list.

```
FIRST LIST:
ANALYZE NAME consumer
ANALYZE VARS car house stereo
SECOND LIST:
ANALYZE NAME consumer
ANALYZE VARS car house stereo
ANALYZE FIRSTVAR car
```

## %RETURN Statement

Execution causes normal termination of the currently executing macro.

**Type:** Macro Statement

**Restriction:** Valid only in a macro definition

## Syntax

**%RETURN**;

## Details

The %RETURN macro causes normal termination of the currently executing macro.

## Example: Using %RETURN Statement

In this example, if the error variable is set to 1, then the macro will stop executing and the DATA step will not execute.

```
%macro checkit(error);
   %if &error = 1 %then %return;
    data a;
       x=1;
    run;
%mend checkit;
%checkit(0)
%checkit(1)
```

# %SYMDEL Statement

Deletes the specified variable or variables from the macro global symbol table.

**Type:** Macro Statement

## Syntax

**%SYMDEL** *macro-variable(s)*<*/option*> ;

### *Required Arguments*

***macro-variable(s)***
is the name of one or more macro variables or a text expression that generates one or more macro variable names. You cannot use a SAS variable list or a macro expression that generates a SAS variable list in a %SYMDEL statement.

***option***

**NOWARN**
suppresses the warning message when an attempt is made to delete a non-existent macro variable.

## Details

%SYMDEL statement issues a warning when an attempt is made to delete a non-existent macro variable. To suppress this message, use the NOWARN option.

# %SYSCALL Statement

Invokes a SAS call routine.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or in open code

**See:** "%SYSFUNC and %QSYSFUNC Functions" on page 273

## Syntax

**%SYSCALL** *call-routine*< (*call-routine-argument(s)*)>;

### *Required Arguments*

***call-routine***
is a SAS or user-written CALL routine created with SAS/TOOLKIT software or a routine created using the "FCMP" in the *SAS Viya Data Management and Utility Procedures Guide*. All SAS CALL routines are accessible with %SYSCALL except LABEL, VNAME, SYMPUT, and EXECUTE.

***call-routine-argument(s)***
is one or more macro variable names (with no leading ampersands), separated by commas. You can use a text expression to generate part or all of the CALL routine arguments.

## Details

When %SYSCALL invokes a CALL routine, the value of each macro variable argument is retrieved and passed unresolved to the CALL routine. Upon completion of the CALL routine, the value for each argument is written back to the respective macro variable. If %SYSCALL encounters an error condition, the execution of the CALL routine terminates without updating the macro variable values, an error message is written to the log, and macro processing continues.

*Note:* The arguments to %SYSCALL are evaluated according to the rules of the SAS macro language. This includes both the function name and the argument list to the function. In particular, an empty argument position will not generate a NULL argument, but a zero length argument.

***CAUTION:***
**Do not use leading ampersands on macro variable names.** The arguments in the CALL routine invoked by the %SYSCALL macro are resolved before execution. If you use leading ampersands, then the values of the macro variables are passed to the CALL routine rather than the names of the macro variables.

***CAUTION:***
**Macro variables contain only character data.** When an argument to a function might be either numeric data or character data, %SYSCALL attempts to convert the supplied data to numeric data. This causes truncation of any trailing blanks if the data was character data. %SYSCALL does not modify arguments that might be character data. You can preserve the trailing blanks by using the %QUOTE function when assigning the value to the macro variable that will be supplied as the argument

to the function. To determine whether it is necessary to preserve the trailing blanks using the %QUOTE function, consult the documentation for the desired function to see whether the arguments are numeric only, character only, or either numeric or character. Use the %QUOTE function to quote the value supplied to arguments that are documented to be either numeric or character.

```
%let j=1;
%let x=fax;
%let y=fedex;
%let z=phone;
%put j=&j x=&x y=&y z=&z
j=1 x=fax y=fedex z=phone
%syscall allperm(j,x,y,z);
%put j=&j x=&x y=&y z=&z
j=1 x=250 y=65246 z=phone
```

### Example: Using the RANUNI Call Routine with %SYSCALL

This example illustrates the %SYSCALL statement. The macro statement %SYSCALL RANUNI(A,B) invokes the SAS CALL routine RANUNI.

*Note:* The syntax for RANUNI is **RANUNI(seed,x)**.

```
%let a = 123456;
%let b = 0;
%syscall ranuni(a,b);
%put &a, &b;
```

The %PUT statement writes the following values of the macro variables A and B to the log:

```
1587033266 0.739019954
```

## %SYSEXEC Statement

Obsolete

## %SYSLPUT Statement

Creates a new macro variable or modifies the value of an existing macro variable on a remote host or server.

**Type:** Macro Statement

**Restriction:** Allowed in macro definitions or open code

**Requirement:** SAS/CONNECT

**See:** “Using the Macro Facility with SAS/CONNECT” in *SAS/CONNECT User's Guide*
“%LET Statement” on page 311 and “%SYSRPUT Statement” on page 328

## Syntax

**%SYSLPUT** *macro-variable*=<*value*</REMOTE=*remote-session-identifier*>>;

### *Required Arguments*

***macro-variable***
is either the name of a macro variable or a macro expression that produces a macro variable name. The name can refer to a new or existing macro variable on a remote host or server.

***remote-session-identifier***
is the name of the remote session.

***value***
is a string or a macro expression that yields a string. Omitting the value produces a null (0 characters). Leading and trailing blanks are ignored. To make them significant, enclose the value in the %STR function.

## Details

The %SYSLPUT statement is submitted with SAS/CONNECT software from the local host or client to a remote host or server to create a new macro variable on the remote host or server, or to modify the value of an existing macro variable on the remote host or server.

*Note:* The names of the macro variables on the remote and local hosts must not contain any leading ampersands.

To assign the value of a macro variable on a remote host to a macro variable on the local host, use the %SYSRPUT statement.

To use %SYSLPUT, you must have initiated a link between a local SAS session or client and a remote SAS session or server using the SIGNON command or SIGNON statement. For more information, see the documentation for SAS/CONNECT software.

# %SYSMACDELETE Statement

Deletes a macro definition from the Work.SASMACR catalog.

**Type:** Macro Statement

**Restriction:** Allowed in macro definition and open code

## Syntax

**%SYSMACDELETE** *macro_name* </ *option*>;

### *Required Argument*

***macro_name***
the name of a macro or a text expression that produces a macro variable name.

### *Optional Argument*

**NOWARN**
specifies that no warning diagnostic message should be issued.

## Details

The %SYSMACDELETE statement deletes the macro definition of the specified macro from the Work.SASMACR catalog. If no definition for the macro exists in the Work.SASMACR catalog, a WARNING diagnostic message is issued. If the macro is currently being executed, an ERROR diagnostic message is issued.

# %SYSMSTORECLEAR Statement

Closes the stored compiled macro catalog associated with the libref specified in the SASMSTORE= option and clears the libref.

**Type:** Macro statement

**Restriction:** Allowed in macro definition and open code

**See:** SASMSTORE= system option

## Syntax

**%SYSMSTORECLEAR**;

## Details

Use the %SYSMSTORECLEAR statement to close the stored compiled macro catalog and to clear the previous libref when switching between SASMSTORE= libraries.

*Note:* If any stored compiled macro from the library specified by the SASMSTORE= system option is still executing, the following will occur:

- an ERROR diagnostic message will be issued
- the library will not be closed
- the libref will not be cleared

# %SYSRPUT Statement

Assigns the value of a macro variable on a remote host to a macro variable on the local host.

**Type:** Macro statement

**Restriction:** Allowed in macro definitions or open code

**Requirement:** SAS/CONNECT

**See:** "Using the Macro Facility with SAS/CONNECT" in *SAS/CONNECT User's Guide*
"SYSERR Automatic Macro Variable" on page 203, "SYSINFO Automatic Macro Variable" on page 208, and "%SYSLPUT Statement" on page 326

## Syntax

**%SYSRPUT** *local-macro-variable=remote-macro-variable*;

### *Required Arguments*

***local-macro-variable***
is the name of a macro variable with no leading ampersand or a text expression that produces the name of a macro variable. This name must be a macro variable stored on the local host.

***remote-macro-variable***
is the name of a macro variable with no leading ampersand or a text expression that produces the name of a macro variable. This name must be a macro variable stored on a remote host.

## Details

The %SYSRPUT statement is submitted with SAS/CONNECT to a remote host to retrieve the value of a macro variable stored on the remote host. %SYSRPUT assigns that value to a macro variable on the local host. %SYSRPUT is similar to the %LET macro statement because it assigns a value to a macro variable. However, %SYSRPUT assigns a value to a variable on the local host, not on the remote host where the statement is processed. The %SYSRPUT statement places the macro variable into the global symbol table in the client session.

*Note:* The names of the macro variables on the remote and local hosts must not contain a leading ampersand.

The %SYSRPUT statement is useful for capturing the value of the automatic macro variable SYSINFO and passing that value to the local host. SYSINFO contains return-code information provided by some SAS procedures. Both the UPLOAD and the DOWNLOAD procedures of SAS/CONNECT can update the macro variable SYSINFO and set it to a nonzero value when the procedure terminates due to errors. You can use %SYSRPUT on the remote host to send the value of the SYSINFO macro variable back to the local SAS session. Thus, you can submit a job to the remote host and test whether a PROC UPLOAD or DOWNLOAD step has successfully completed before beginning another step on either the remote host or the local host.

For more information about using %SYSRPUT, see the documentation for SAS/CONNECT Software.

To create a new macro variable or modify the value of an existing macro variable on a remote host or server, use the %SYSLPUT macro statement.

## Example: Checking the Value of a Return Code on a Remote Host

This example illustrates how to download a file and return information about the success of the step from a noninteractive job. When remote processing is completed, the job then checks the value of the return code stored in RETCODE. Processing continues on the local host if the remote processing is successful.

The %SYSRPUT statement is useful for capturing the value returned in the SYSINFO macro variable and passing that value to the local host. The SYSINFO macro variable contains return-code information provided by SAS procedures. In the example, the %SYSRPUT statement follows a PROC DOWNLOAD step, so the value returned by SYSINFO indicates the success of the PROC DOWNLOAD step:

```
rsubmit;
   %macro download;
      proc download data=remote.mydata out=local.mydata;
      run;
      %sysrput retcode=&sysinfo;
   %mend download;
   %download
endrsubmit;
%macro checkit;
   %if &retcode = 0 %then %do;
      further processing on local host
   %end;
%mend checkit;
%checkit
```

A SAS/CONNECT batch (noninteractive) job always returns a system condition code of 0. To determine the success or failure of the SAS/CONNECT noninteractive job, use the %SYSRPUT macro statement to check the value of the automatic macro variable SYSERR. To determine what remote system the SAS/CONNECT conversation is attached to, remote submit the following statement:

```
%sysrput rhost=&sysscp;
```

*Chapter 20*

# System Options for Macros

**System Options for Macros** . . . . . **331**

**Dictionary** . . . . . **332**
CMDMAC System Option . . . . . 332
IMPLMAC System Option . . . . . 332
MACRO System Option . . . . . 333
MAUTOCOMPLOC System Option . . . . . 333
MAUTOLOCDISPLAY System Option . . . . . 334
MAUTOLOCINDES System Option . . . . . 335
MAUTOSOURCE System Option . . . . . 336
MCOMPILE System Option . . . . . 336
MCOMPILENOTE System Option . . . . . 337
MCOVERAGE System Options . . . . . 338
MCOVERAGELOC= System Option . . . . . 342
MERROR System Option . . . . . 342
MEXECNOTE System Option . . . . . 343
MEXECSIZE System Option . . . . . 344
MFILE System Option . . . . . 345
MINDELIMITER= System Option . . . . . 345
MINOPERATOR System Option . . . . . 347
MLOGIC System Option . . . . . 348
MLOGICNEST System Option . . . . . 349
MPRINT System Option . . . . . 351
MPRINTNEST System Option . . . . . 352
MRECALL System Option . . . . . 353
MREPLACE System Option . . . . . 354
MSTORED System Option . . . . . 355
MSYMTABMAX= System Option . . . . . 355
MVARSIZE= System Option . . . . . 356
SASAUTOS= System Option . . . . . 357
SASMSTORE= System Option . . . . . 358
SERROR System Option . . . . . 359
SYMBOLGEN System Option . . . . . 360
SYSPARM= System Option . . . . . 360

## System Options for Macros

There are several SAS system options that apply to the macro facility.

# Dictionary

## CMDMAC System Option

Obsolete

## IMPLMAC System Option

Controls statement-style macro invocation.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOIMPLMAC

### Syntax

**IMPLMAC | NOIMPLMAC**

#### *Required Arguments*

**IMPLMAC**
specifies that the macro processor examine the first word of every submitted statement to see whether it is a statement-style macro invocation.

*Note:* When IMPLMAC is in effect, SAS searches the macro libraries first and executes any macro that it finds with the same name as the first word in the SAS statement that was submitted. Unexpected results can occur.

**NOIMPLMAC**
specifies that no check be made for statement-style macro invocations. This is the default. If the macro processor encounters a statement-style macro call when NOIMPLMAC is in effect, it treats the call as a SAS statement. SAS produces an error message if the statement is not valid or if it is not used correctly.

### Details

The IMPLMAC system option controls whether macros defined as statement-style macros can be invoked with statement-style macro calls or if these macros must be invoked with name-style macro calls. These examples illustrate statement-style and name-style macro calls, respectively:

•

```
macro-name parameter-value-1  parameter-value-2;
```

•

```
%macro-name(parameter-value-1, parameter-value-2)
```

When you use IMPLMAC, processing time is increased because SAS searches the macros compiled during the current session for a name corresponding to the first word of each SAS statement. If the MSTORED option is in effect, the libraries containing compiled stored macros are searched for a name corresponding to that word. If the MAUTOSOURCE option is in effect, the autocall libraries are searched for a name corresponding to that word. If the MRECALL system option is also in effect, processing time can be increased further because the search continues even if a word was not found in a previous search.

Regardless of which option is in effect, you can call any macro with a name-style invocation, including statement-style macros.

### Comparisons

Name-style macros are a more efficient choice to use when you invoke macros because the macro processor searches only for the macro name that corresponds to a word that follows a percent sign.

## MACRO System Option

Controls whether the SAS macro language is available.

| | |
|---|---|
| **Valid in:** | Configuration file, SAS invocation |
| **Category:** | Macro |
| **PROC OPTIONS GROUP=** | MACRO |
| **Type:** | System option |
| **Default:** | MACRO |

### Syntax

**MACRO | NOMACRO**

#### *Required Arguments*

**MACRO**
enables SAS to recognize and process macro language statements, macro calls, and macro variable references.

**NOMACRO**
prevents SAS from recognizing and processing macro language statements, macro calls, and macro variable references. The item generally is not recognized, and an error message is issued. If the macro facility is not used in a job, a small performance gain can be made by setting NOMACRO because there is no overhead of checking for macros or macro variables.

## MAUTOCOMPLOC System Option

Displays in the log the source location of an autocall macro when the autocall macro is compiled.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMAUTOCOMPLOC

## Syntax

**MAUTOCOMPLOC | NOMAUTOCOMPLOC**

### *Required Arguments*

**MAUTOCOMPLOC**
displays the autocall macro source location in the log when the autocall macro is compiled.

**NOMAUTOCOMPLOC**
prevents the autocall macro source location from being written to the log.

## Details

The display created by the MAUTOCOMPLOC system option of the autocall macro source location in the log is not affected by either the MAUTOLOCDISPLAY or the MLOGIC system options.

# MAUTOLOCDISPLAY System Option

Specifies whether to display the source location of the autocall macros in the log when the autocall macro is invoked.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMAUTOLOCDISPLAY

## Syntax

**MAUTOLOCDISPLAY | NOMAUTOLOCDISPLAY**

### *Required Arguments*

**MAUTOLOCDISPLAY**
enables MACRO to display the autocall macro source location in the log when the autocall macro is invoked.

**NOMAUTOLOCDISPLAY**
prevents the autocall macro source location from being displayed in the log when the autocall macro is invoked. NOMAUTOLOCDISPLAY is the default.

## Details

When both MAUTOLOCDISPLAY and MLOGIC options are set, only the MLOGIC listing of the autocall source location is displayed.

# MAUTOLOCINDES System Option

Specifies whether the macro processor prepends the full pathname of the autocall source file to the description field of the catalog entry of compiled autocall macro definition in the Work.SASMACR catalog.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMAUTOLOCINDES

**See:** Log

## Syntax

**MAUTOLOCINDES | NOMAUTOLOCINDES**

### *Required Arguments*

**MAUTOLOCINDES**
causes the macro processor to prepend the full pathname of the autocall macro source file to the description field of the catalog entry of the compiled autocall macro definition in the Work.SASMACR catalog.

**NOMAUTOLOCINDES**
no changes to the description field autocall macro definitions in the Work.SASMACR catalog.

## Details

Use MAUTOLOCINDES to help determine where autocall macro definition source code is located. The following is an example that shows the output that contains the full pathname:

```
  options mautolocindes;
  %put %lowcase(THIS);

this

  proc catalog cat=work.sasmacr;contents;run;

                     Contents of Catalog Work.SASMACR
```

```
# Name    Type          Create Date       Modified Date Description

1 LOWCASE MACRO 12Sep10:10:36:57    12Sep10:10:36:57    C:\SASv9\sas\dev\
                                                        mva-v930\shell\auto\
```

## MAUTOSOURCE System Option

Specifies whether the autocall feature is available.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** MAUTOSOURCE

### Syntax

**MAUTOSOURCE | NOMAUTOSOURCE**

#### *Required Arguments*

**MAUTOSOURCE**
causes the macro processor to search the autocall libraries for a member with the requested name when a macro name is not found in the Work library.

**NOMAUTOSOURCE**
prevents the macro processor from searching the autocall libraries when a macro name is not found in the Work library.

### Details

When the macro facility searches for macros, it searches first for macros compiled in the current SAS session. If the MSTORED option is in effect, the macro facility next searches the libraries containing compiled stored macros. If the MAUTOSOURCE option is in effect, the macro facility next searches the autocall libraries.

## MCOMPILE System Option

Specifies whether to allow new definitions of macros.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** MCOMPILE

## Syntax

**MCOMPILE | NOMCOMPILE**

### *Required Arguments*

**MCOMPILE**
allows new macro definitions.

**NOMCOMPILE**
disallows new macro definitions.

## Details

The MCOMPILE system option allows new definitions of macros.

The NOMCOMPILE system option prevents new definitions of macros. It does not prevent the use of existing stored compiled or autocall macros.

# MCOMPILENOTE System Option

Issues a NOTE to the log. The note contains the size and number of instructions upon the completion of the compilation of a macro.

| | |
|---|---|
| **Valid in:** | Configuration file, OPTIONS statement, SAS invocation |
| **Category:** | Macro |
| **PROC OPTIONS GROUP=** | MACRO |
| **Type:** | System option |
| **Default:** | NONE |

## Syntax

**MCOMPILENOTE=**NONE | NOAUTOCALL | ALL

### *Required Arguments*

***NONE***
prevents any NOTE from being written to the log.

***NOAUTOCALL***
prevents any NOTE from being written to the log for AUTOCALL macros, but does issue a NOTE to the log upon the completion of the compilation of any other macro.

***ALL***
issues a NOTE to the log. The note contains the size and number of instructions upon the completion of the compilation of any macro.

## Details

The NOTE confirms that the compilation of the macro was completed. When the option is on and the NOTE is issued, the compiled version of the macro is available for execution. A macro can successfully compile, but still contain errors or warnings that will cause the macro to not execute as you intended.

### Example: Using MCOMPILENOTE System Option

A macro can actually compile and still contain errors. Here is an example of the NOTE without errors:

```
option mcompilenote=noautocall;
%macro mymacro;
%mend mymacro;
```

Output to the log:

```
NOTE: The macro MYMACRO completed compilation without errors.
```

Here is an example of the NOTE with errors:

```
%macro yourmacro;
%end;
%mend yourmacro;
```

Output to the log:

```
ERROR: There is no matching %DO statement for the %END statement.
       This statement will be ignored.
NOTE: The macro YOURMACRO completed compilation with errors.
```

## MCOVERAGE System Options

Enables the generation of coverage analysis data.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** Macro

**Type:** System option

**Default:** NOMCOVERAGE

**Requirement:** Must use MCOVERAGELOC= system option

### Syntax

**MCOVERAGE | NOMCOVERAGE**

#### *Required Arguments*

**MCOVERAGE**
enables the generation of coverage analysis data.

**NOMCOVERAGE**
prevents the generation of coverage analysis data.

### Details

MCOVERAGE system option controls the generation of *coverage analysis data*, which is information needed to ensure proper testing of SAS Solutions products before their release.

The format of the coverage analysis data is a space delimited flat text file that contains three types of records. Each record begins with a numeric record type. The line numbers in the data are relative line numbers based on the %MACRO keyword used to define the macro. You must use the MCOVERAGELOC= system option to specify the location of the coverage analysis data file. See "MCOVERAGELOC= System Option" on page 342.

*Note:* Because nested macro definitions are stored as model text with line breaks collapsed, it is recommended that nested macro definitions not be used in macro definitions that will later be analyzed for execution coverage.

Below are explanations for each of the three record types.

Record type 1:

**1 n n macroname**

1
: record type

**n**
: first line number

**n**
: last line number

**macroname**
: macro name

Record type 1 indicates the beginning of the execution of a macro. Record type 1 appears once for each invocation of a macro.

Record type 2:

**2 n n macroname**

2
: record type

**n**
: first line number

**n**
: last line number

**macroname**
: macro name

Record type 2 indicates the lines of a macro that have executed. A single line of a macro might cause more than one record to be generated.

Record type 3:

**3 n n macroname**

3
: record type

**n**
: first line number

**n**
: last line number

**macroname**
: macro name

Record type 3 indicates which lines of the macro cannot be executed because no code was generated from them. These lines might be either commentary lines or lines that cause no macro code to be generated.

The following is a sample program log:

```
Sample Program Log:
NOTE: Copyright (c) 2002-2012 by SAS Institute Inc., Cary, NC, USA.
NOTE: SAS (r) Proprietary Software 9.4 (TS1B0)
      Licensed to SAS Institute Inc., Site 1.
NOTE: This session is executing on the W32_7PRO  platform.



NOTE: SAS initialization used:
      real time           0.45 seconds
      cpu time            0.20 seconds

1          options source source2;
2
3          options mcoverage mcoverageloc='./foo.dat';
4
5          /*  1 */ %macro
6          /*  2 */ foo (
7          /*  3 */ arg,
8          /*  4 */
9          /*  5 */
10         /*  6 */ arg2
11         /*  7 */
12         /*  8 */
13         /*  9 */ =
14         /* 10 */
15         /* 11 */ This is the default value of arg2)
16         /* 12 */ ;
17         /* 13 */ /*  This is a number of lines of comments     */
18         /* 14 */ /*  which presumably will help the maintainer */
19         /* 15 */ /*  of this macro to know what to do to keep  */
20         /* 16 */ /*  this silly piece of code current          */
21         /* 17 */   %if &arg %then %do;
22         /* 18 */      data _null_;
23         /* 19 */      x=1;
24         /* 20 */   %end;
25         /* 21 */ %* this is a macro comment statement
26         /* 22 */    that also can be used to document features
27         /* 23 */    and other stuff about the macro;
28         /* 24 */   %else
29         /* 25 */   %do;
30         /* 26 */      DATA _NULL_;
31         /* 27 */      y=1;
32         /* 28 */   %end;
33         /* 29 */      run;
34         /* 30 */
35         /* 31 */
36         /* 32 */
37         /* 33 */
38         /* 34 */
39         /* 35 */ %mend
40         /* 36 */
41         /* 37 */
42         /* 38 */
43         /* 39 */
44         /* 40 */
45         /* 41 */
46         /* 42 */
47         /* 43 */ foo This is text which should generate a warning!  ;
WARNING: Extraneous information on %MEND statement ignored for macro
definition FOO.
```

## MCOVERAGELOC= System Option

Specifies the location of the coverage analysis data file.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** Macro

**Type:** System option

**Requirement:** Use with MCOVERAGE system option

**See:** "MCOVERAGE System Options" on page 338

### Syntax

**MCOVERAGELOC**=*fileref* | *file-specification*

#### *Required Argument*

***fileref* | *file-specification***
a SAS fileref or an external file specification enclosed in quotation marks.

### Details

This MCOVERAGELOC = system option specifies where the coverage analysis is to be written. The option takes either an external file specification enclosed in quotation marks or a SAS fileref.

## MERROR System Option

Specifies whether the macro processor issues a warning message when a macro reference cannot be resolved.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** MERROR

### Syntax

**MERROR | NOMERROR**

### *Required Arguments*

**MERROR**
issues the following warning message when the macro processor cannot match a macro reference to a compiled macro:

```
WARNING: Apparent invocation of macro %text not resolved.
```

**NOMERROR**
issues no warning messages when the macro processor cannot match a macro reference to a compiled macro.

## Details

Several conditions can prevent a macro reference from resolving. These conditions appear when

- a macro name is misspelled
- a macro is called before being defined
- strings containing percent signs are encountered. For example:

```
TITLE Cost Expressed as %Sales;
```

If your program contains a percent sign in a string that could be mistaken for a macro keyword, specify NOMERROR.

# MEXECNOTE System Option

Specifies whether to display macro execution information in the log at macro invocation.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMEXECNOTE

**See:** MEXECSIZE on page 344

## Syntax

**MEXECNOTE | NOMEXECNOTE**

### *Required Arguments*

**MEXECNOTE**
displays the macro execution information in the log when the macro is invoked.

**NOMEXECNOTE**
does not display the macro execution information in the log when the macro is invoked.

## Details

The MEXECNOTE option controls the generation of a NOTE in the log that indicates the macro execution mode.

# MEXECSIZE System Option

Specifies the maximum macro size that can be executed in memory.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** 65536

**See:** MEXECNOTE on page 343 and MCOMPILENOTE on page 337

## Syntax

**MEXECSIZE=***n* | *n*K | *n*M | *n*G | *n*T | *hex*X | MIN | MAX

### *Required Arguments*

***n***
specifies the maximum size macro to be executed in memory available in bytes.

***n*K**
specifies the maximum size macro to be executed in memory available in kilobytes.

***n*M**
specifies the maximum size macro to be executed in memory available in megabytes.

***n*G**
specifies the maximum size macro to be executed in memory available in gigabytes.

***n*T**
specifies the maximum size macro to be executed in memory available in terabytes.

**MIN**
specifies the minimum size macro to be executed in memory. Minimum value is 0.

**MAX**
specifies the maximum size macro to be executed in memory. Maximum value is 2,147,483,647.

***hex*X**
specifies the maximum size macro to be executed in memory by a hexadecimal number followed by an X.

## Details

Use the MEXECSIZE option to control the maximum size macro that will be executed in memory as opposed to being executed from a file. The MEXECSIZE option value is the compiled size of the macro. Memory is allocated only when the macro is executed. After the macro completes, the memory is released. If memory is not available to

execute the macro, an out-of-memory message is written to the log. Use the MCOMPILENOTE option to write to the log the size of the compiled macro. The MEMSIZE option does not affect the MEXECSIZE option.

## MFILE System Option

Specifies whether MPRINT output is routed to an external file.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMFILE

**Requirement:** MPRINT option

**See:** "MPRINT System Option" on page 351

### Syntax

**MFILE | NOMFILE**

#### *Required Arguments*

**MFILE**
routes output produced by the MPRINT option to an external file. This option is useful for debugging.

**NOMFILE**
does not route MPRINT output to an external file.

### Details

The MPRINT option must also be in effect to use MFILE, and an external file must be assigned the fileref MPrint. Macro-generated code that is displayed by the MPRINT option in the log during macro execution is written to the external file referenced by the fileref MPrint.

If MPrint is not assigned as a fileref or if the file cannot be accessed, warnings are written to the log and MFILE is set to off. To use the feature again, you must specify MFILE again and assign the fileref MPrint to a file that can be accessed.

## MINDELIMITER= System Option

Specifies the character to be used as the delimiter for the macro IN operator.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** a blank

**Restriction:** The following characters cannot be used as a delimiter

```
%  &  '  "  (  ) ;
```

**See:** “MINOPERATOR System Option” on page 347 and “%MACRO Statement” on page 314

## Syntax

**MINDELIMITER=**"*option*"

### *Required Argument*

***option***
is a character enclosed in double or single quotation marks. The character will be used as the delimiter for the macro IN operator. Here is an example:

double quotation marks

```
mindelimiter=”,”;
```

or single quotation marks

```
mindelimiter=',';
```

**Restriction** The following characters cannot be used as a delimiter

```
%  &  '  "  (  )  ;
```

## Details

The option value is retained in original case and can have a maximum length of one character. The default value of the MINDELIMITER option is a blank.

You can use the **#** character instead of IN.

*Note:* When the IN or **#** operator is used in a macro, the delimiter that is used at the execution time of the macro is the value of the MINDELIMITER option at the time of the compilation of the macro. A specific delimiter value for use during the execution of the macro other than the current value of the MINDELIMITER system option might be specified on the macro definition statement:

```
%macro macroname / mindelimiter=',';
```

## Comparisons

The following is an example using a specified delimiter in an IN operator:

```
%put %eval(a in d,e,f,a,b,c); /* should print 0 */
%put %eval(a in d e f a b c); /* should print 1 */
option mindelimiter=',';
%put %eval(a in d,e,f,a,b,c); /* should print 1 */
%put %eval(a in d e f a b c); /* should print 0 */
```

The following is the output to the log:

```
NOTE: Copyright (c) 2002-2012 by SAS Institute Inc., Cary, NC, USA.
NOTE: SAS (r) Proprietary Software 9.4 (TS1B0)
      Licensed to SAS Institute Inc., Site 1.
```

```
NOTE: This session is executing on the W32_7PRO  platform.
NOTE: SAS initialization used:
      real time           1.02 seconds
      cpu time            0.63 seconds
  %put %eval(a in d,e,f,a,b,c); /* should print 0 */
0
  %put %eval(a in d e f a b c); /* should print 1 */
1
  option mindelimiter=',';
  %put %eval(a in d,e,f,a,b,c); /* should print 1 */
1
  %put %eval(a in d e f a b c); /* should print 0 */
0
```

# MINOPERATOR System Option

Controls whether the macro processor recognizes and evaluates the IN (#) logical operator.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMINOPERATOR

**Note:** In order to use the macro IN operator in an expression, you must ensure that the MINOPERATOR system option has been changed from its default value of NOMINOPERATOR to MINOPERATOR. For more information, see MINOPERATOR system option on page 347 and "%MACRO Statement" on page 314.

## Syntax

**MINOPERATOR | NOMINOPERATOR**

### *Required Arguments*

**MINOPERATOR**
causes the macro processor to recognize and evaluate both the mnemonic operator **IN** or the special character **#** as a logical operator in expressions.

**NOMINOPERATOR**
causes the macro processor to recognize both the mnemonic operator **IN** and the special character **#** as regular characters.

## Details

Use the MINOPERATOR system option or in the %MACRO statement if you want to use the **IN** (**#**) as operators in expressions:

```
options minoperator;
```

To use IN or # as operators in expressions evaluated during the execution of a specific macro, use the MINOPERATOR keyword on the definition of the macro:

```
%macro macroname / minoperator;
```

The macro IN operator is similar to the DATA step IN operator, but not identical. The following is a list of differences:

- The macro IN operator cannot search a numeric array.
- The macro IN operator cannot search a character array.
- A colon (**:**) is not recognized as a shorthand notation to specify a range, such as **1:10** means 1 through 10. Instead, you use the following in a macro:

  ```
  %eval(3 in 1 2 3 4 5 6 7 8 9 10);
  ```

- The default delimiter for list elements is a blank.
- Both operands must contain a value.

  ```
  %put %eval(a IN a b c d); /*Both operands are present. */
  ```

  If an operand contains a null value, an error is generated.

  ```
  %put %eval(  IN a b c d); /*Missing first operand. */
  ```

  or

  ```
  %put %eval(a IN); /*Missing second operand. */
  ```

  Whether the first or second operand contains a null value, the same error is written to the log:

  ```
  ERROR: Operand missing for IN operator in argument to %EVAL function.
  ```

The following example uses the macro IN operator to search a character string:

```
%if &state in (NY NJ PA) %then %let &region = %eval(&region + 1);
```

For more information, see "Defining Arithmetic and Logical Expressions" on page 72.

## MLOGIC System Option

Specifies whether the macro processor traces its execution for debugging.

| | |
|---|---|
| **Valid in:** | Configuration file, OPTIONS statement, SAS invocation |
| **Category:** | Macro |
| **PROC OPTIONS GROUP=** | MACRO<br>LOGCONTROL |
| **Type:** | System option |
| **Default:** | NOMLOGIC |

### Syntax

**MLOGIC | NOMLOGIC**

#### *Required Arguments*

**MLOGIC**
causes the macro processor to trace its execution and to write the trace information to the log. This option is a useful debugging tool.

**NOMLOGIC**
does not trace execution. Use this option unless you are debugging macros.

## Details

Use MLOGIC to debug macros. Each line generated by the MLOGIC option is identified with the prefix MLOGIC(*macro-name*):. If MLOGIC is in effect and the macro processor encounters a macro invocation, the macro processor displays messages that identify the following:

- the beginning of macro execution
- values of macro parameters at invocation
- execution of each macro program statement
- whether each %IF condition is true or false
- the ending of macro execution

*Note:* Using MLOGIC can produce a great deal of output.

For more information about macro debugging, see Chapter 10, "Macro Facility Error Messages and Debugging," on page 117.

# MLOGICNEST System Option

Specifies whether to display the macro nesting information in the MLOGIC output in the log.

| | |
|---|---|
| **Valid in:** | Configuration file, OPTIONS statement, SAS invocation |
| **Category:** | Macro |
| **PROC OPTIONS GROUP=** | MACRO<br>LOGCONTROL |
| **Type:** | System option |
| **Default:** | NOMLOGICNEST |

## Syntax

**MLOGICNEST | NOMLOGICNEST**

### *Required Arguments*

**MLOGICNEST**
enables the macro nesting information to be displayed in the MLOGIC output in the log.

**NOMLOGICNEST**
prevents the macro nesting information from being displayed in the MLOGIC output in the log.

## Details

MLOGICNEST enables the macro nesting information to be written to the log in the MLOGIC output.

The setting of MLOGICNEST does not affect the output of any currently executing macro.

The setting of MLOGICNEST does not imply the setting of MLOGIC. You must set both MLOGIC and MLOGICNEST in order for output (with nesting information) to be written to the log.

## Example: Using MLOGICNEST System Option

The first example shows both the MLOGIC and MLOGICNEST options being set:

```
%macro outer;
    %put THIS IS OUTER;
    %inner;
%mend outer;
%macro inner;
    %put THIS IS INNER;
    %inrmost;
%mend inner;
%macro inrmost;
    %put THIS IS INRMOST;
%mend;
    options mlogic mlogicnest;
    %outer
```

Here is the MLOGIC output in the log using the MLOGICNEST option:

```
MLOGIC(OUTER):  Beginning execution.
MLOGIC(OUTER):  %PUT THIS IS OUTER
THIS IS OUTER
MLOGIC(OUTER.INNER):  Beginning execution.
MLOGIC(OUTER.INNER): %PUT THIS IS INNER
THIS IS INNER
MLOGIC(OUTER.INNER.INRMOST):  Beginning execution.
MLOGIC(OUTER.INNER.INRMOST):  %PUT THIS IS INRMOST
THIS IS INRMOST
MLOGIC(OUTER.INNER.INRMOST): Ending execution.
MLOGIC(OUTER.INNER):  Ending execution.
MLOGIC(OUTER):  Ending execution.
```

The second example uses only the NOMLOGICNEST option:

```
%macro outer;
    %put THIS IS OUTER;
    %inner;
%mend outer;
%macro inner;
    %put THIS IS INNER;
    %inrmost;
%mend inner;
%macro inrmost;
    %put THIS IS INRMOST;
%mend;
    options nomlogicnest;
    %outer
```

Here is the output in the log when you use only the NOMLOGICNEST option:

```
MLOGIC(OUTER):  Beginning execution.
MLOGIC(OUTER):  %PUT THIS IS OUTER
THIS IS OUTER
MLOGIC(INNER):  Beginning execution.
```

```
MLOGIC(INNER):  %PUT THIS IS INNER
THIS IS INNER
MLOGIC(INRMOST):  Beginning execution.
MLOGIC(INRMOST):  %PUT THIS IS INRMOST
THIS IS INRMOST
MLOGIC(INRMOST):  Ending execution.
MLOGIC(INNER):  Ending execution.
MLOGIC(OUTER):  Ending execution.
```

# MPRINT System Option

Specifies whether SAS statements generated by macro execution are traced for debugging.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO
LOGCONTROL

**Type:** System option

**Default:** NOMPRINT

## Syntax

**MPRINT | NOMPRINT**

### *Required Arguments*

**MPRINT**
displays the SAS statements that are generated by macro execution. The SAS statements are useful for debugging macros.

**NOMPRINT**
does not display SAS statements that are generated by macro execution.

## Details

The MPRINT option displays the text generated by macro execution. Each SAS statement begins a new line. Each line of MPRINT output is identified with the prefix MPRINT(*macro-name*):, to identify the macro that generates the statement. Tokens that are separated by multiple spaces are printed with one intervening space.

You can direct MPRINT output to an external file by also using the MFILE option and assigning the fileref MPrint to that file. For more information, see "MFILE System Option" on page 345.

## Example: Directing MPRINT Output to an External File

Adding these statements before the macro call in the previous program sends the MPRINT output to the file DebugMac when the SAS session ends.

```
options mfile mprint;
filename mprint 'debugmac';
```

## MPRINTNEST System Option

Specifies whether to display the macro nesting information in the MPRINT output in the log.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMPRINTNEST

### Syntax

**MPRINTNEST | NOMPRINTNEST**

#### *Required Arguments*

**MPRINTNEST**
enables the macro nesting information to be displayed in the MPRINT output in the log.

**NOMPRINTNEST**
prevents the macro nesting information from being displayed in the MPRINT output in the log.

### Details

MPRINTNEST enables the macro nesting information to be written to the log in the MPRINT output. The MPRINTNEST output has no effect on the MPRINT output that is sent to an external file. For more information, see MFILE System Option.

The setting of MPRINTNEST does not imply the setting of MPRINT. You must set both MPRINT and MPRINTNEST in order for output (with the nesting information) to be written to the log.

### Example: Using MPRINTNEST System Option

The following example uses the MPRINT and MPRINTNEST options:

```
%macro outer;
data _null_;
     %inner
run;
%mend outer;
%macro inner;
    put %inrmost;
%mend inner;
%macro inrmost;
    'This is the text of the PUT statement'
%mend inrmost;
    options mprint mprintnest;
    %outer
```

Here is the output written to the log using both the MPRINT option and the MPRINTNEST option:

```
MPRINT(OUTER):   data _null_;
MPRINT(OUTER.INNER):   put
MPRINT(OUTER.INNER.INRMOST):   'This is the text of the PUT statement'
MPRINT(OUTER.INNER):  ;
MPRINT(OUTER):   run;
This is the text of the PUT statement
NOTE: DATA statement used (Total process time):
      real time           0.10 seconds
      cpu time            0.06 seconds
```

Here is an example that uses the NOMPRINTNEST option:

```
%macro outer;
    data _null_;
    %inner
run;
%mend outer;
%macro inner;
    put %inrmost;
%mend inner;
%macro inrmost;
    'This is the text of the PUT statement'
%mend inrmost;
    options nomprintnest;
    %outer
```

Here is the output written to the log using the NOMPRINTNEST option:

```
MPRINT(OUTER):   data _null_;
MPRINT(INNER):   put
MPRINT(INRMOST):   'This is the text of the PUT statement'
MPRINT(INNER):  ;
MPRINT(OUTER):   run;
This is the text of the PUT statement
NOTE: DATA statement used (Total process time):
      real time           0.00 seconds
      cpu time            0.01 seconds
```

## MRECALL System Option

Specifies whether autocall libraries are searched for a member that was not found during an earlier search.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMRECALL

## Syntax

**MRECALL | NOMRECALL**

### *Required Arguments*

**MRECALL**
searches the autocall libraries for an undefined macro name each time an attempt is made to invoke the macro. It is inefficient to search the autocall libraries repeatedly for an undefined macro. Generally, use this option when you are developing or debugging programs that call autocall macros.

**NOMRECALL**
searches the autocall libraries only once for a requested macro name.

## Details

Use the MRECALL option primarily for

- developing systems that require macros in autocall libraries.
- recovering from errors caused by an autocall to a macro that is in an unavailable library. Use MRECALL to call the macro again after making the library available. In general, do not use MRECALL unless you are developing or debugging autocall macros.

# MREPLACE System Option

Specifies whether to enable existing macros to be redefined.

| | |
|---|---|
| **Valid in:** | Configuration file, OPTIONS statement, SAS invocation |
| **Category:** | Macro |
| **PROC OPTIONS GROUP=** | MACRO |
| **Type:** | System option |
| **Default:** | MREPLACE |

## Syntax

**MREPLACE | NOMREPLACE**

### *Required Arguments*

**MREPLACE**
enables you to redefine existing macro definitions that are stored in a catalog in the Work library.

**NOMREPLACE**
prevents you from redefining existing macro definitions that are stored in a catalog in the Work library.

## Details

The MREPLACE system option enables you to overwrite existing macros if the names are the same.

The NOMREPLACE system option prevents you from overwriting a macro even if a macro with the same name has already been compiled.

# MSTORED System Option

Specifies whether the macro facility searches a specific catalog for a stored compiled macro.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Default:** NOMSTORED

## Syntax

**MSTORED | NOMSTORED**

### *Required Arguments*

**MSTORED**
searches for stored compiled macros in a catalog in the SAS library referenced by the SASMSTORE= option.

**NOMSTORED**
does not search for compiled macros.

## Details

Regardless of the setting of MSTORED, the macro facility first searches for macros compiled in the current SAS session. If the MSTORED option is in effect, the macro facility next searches the libraries containing compiled stored macros. If the MAUTOSOURCE option is in effect, the macro facility next searches the autocall libraries. Then, the macro facility searches the SASMACR catalog in the SASHelp library.

# MSYMTABMAX= System Option

Specifies the maximum amount of memory available to the macro variable symbol table or tables.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

## Syntax

**MSYMTABMAX=** *n* | *n*K | *n*M | *n*G | MAX

### *Required Arguments*

***n***
specifies the maximum memory available in bytes.

***n*K**
specifies the maximum memory available in kilobytes.

***n*M**
specifies the maximum memory available in megabytes.

***n*G**
specifies the maximum memory available in gigabytes.

**MAX**
specifies the maximum memory of 65534.

## Details

Once the maximum value is reached, additional macro variables are written out to disk.

The value that you specify with the MSYMTABMAX= system option can range from 0 to the largest nonnegative integer representable on your operating environment. The default values are host dependent. A value of 0 causes all macro symbol tables to be written to disk.

The value of MSYMTABMAX= can affect system performance. If this option is set too low and the application frequently reaches the specified memory limit, then disk I/O increases. If this option is set too high (on some operating environments) and the application frequently reaches the specified memory limit, then less memory is available for the application, and CPU usage increases. Before you specify the value for production jobs, run tests to determine the optimum value.

# MVARSIZE= System Option

Specifies the maximum size for macro variable values that are stored in memory.

| | |
|---|---|
| **Valid in:** | Configuration file, OPTIONS statement, SAS invocation |
| **Category:** | Macro |
| **PROC OPTIONS GROUP=** | MACRO |
| **Type:** | System option |
| **Default:** | 65534 |

## Syntax

**MVARSIZE=***n* | *n*K | *n*M | *n*G | MAX

### *Required Arguments*

***n***
specifies the maximum memory available in bytes.

***n*K**
specifies the maximum memory available in kilobytes.

***n*M**
specifies the maximum memory available in megabytes.

***n*G**
specifies the maximum memory available in gigabytes.

**MAX**
specifies the maximum memory of 65534.

## Details

If the memory required for a macro variable value is larger than the MVARSIZE= value, the variable is written to a temporary catalog on disk. The macro variable name is used as the member name, and all members have the type MSYMTAB.

The value that you specify with the MVARSIZE= system option can range from 0 to 65534. A value of 0 causes all macro variable values to be written to disk.

The value of MVARSIZE= can affect system performance. If this option is set too low and the application frequently creates macro variables larger than the limit, then disk I/O increases. Before you specify the value for production jobs, run tests to determine the optimum value.

*Note:* The MVARSIZE= option has no affect on the maximum length of the value of the macro variable. For more information, see "Macro Variables" on page 21.

# SASAUTOS= System Option

Specifies the location of one or more autocall libraries.

| | |
|---|---|
| **Valid in:** | Configuration file, OPTIONS statement, SAS invocation |
| **Category:** | Macro |
| **PROC OPTIONS GROUP=** | ENVFILES<br>MACRO |
| **Type:** | System option |
| **Default:** | SASAUTOS |

## Syntax

**SASAUTOS=** *library-specification* |
(*library-specification-1*, *library-specification-2*, …)

### Required Arguments

***library-specification***
identifies a location that contains library members that contain a SAS macro definition. A location can be a SAS fileref or a host-specific location name enclosed in quotation marks. Each member contains a SAS macro definition.

**(*library-specification-1*, *library-specification-2*, ...)**
identifies two or more locations that contain library members that contain a SAS macro definition. A location can be a SAS fileref or a host-specific location name enclosed in quotation marks. When you specify two or more autocall libraries, enclose the specifications in parentheses and separate them with either a comma or a blank space.

## Details

SAS automatically generates a fileref named SASAUTOS. This is the default value of the SASAUTOS= option and points to all the SAS autocall macros. If the value of SASAUTOS= is overwritten, then SAS no longer knows where to locate its own autocall macros. When you specify the value of the SASAUTOS= system option, list the fileref SASAUTOS first, followed by the location of other autocall libraries. This enables SAS to locate the SAS autocall macros as well as any autocall macros that you have defined.

When SAS searches for an autocall macro definition, it opens and searches each location in the same order that it is specified in the SASAUTOS option. If SAS cannot open any specified location, it generates a warning message and sets the NOMAUTOSOURCE system option on. To use the autocall facility again in the same SAS session, you must specify the MAUTOSOURCE option again. Also see "MRECALL System Option" on page 353, which searches the autocall libraries for an undefined macro name each time an attempt is made to invoke the macro.

*Note:* When searching the list of library specifications for an autocall macro definition, SAS silently ignores library access failures due to insufficient access privileges and continues to search through the list of library specifications.

*Operating Environment Information*
You specify a source library by using a fileref or by enclosing the host-specific location name in quotation marks. A valid library specification and its syntax are host specific. Although the syntax is generally consistent with the command-line syntax of your operating environment, it might include additional or alternate punctuation. For more information, see the SAS documentation for your operating environment.

# SASMSTORE= System Option

Identifies the libref of a SAS library with a catalog that contains, or will contain, stored compiled SAS macros.

| | |
|---|---|
| **Valid in:** | Configuration file, OPTIONS statement, SAS invocation |
| **Category:** | Macro |
| **PROC OPTIONS GROUP=** | MACRO |
| **Type:** | System option |

## Syntax

**SASMSTORE**=*libref*

### *Required Argument*

***libref***
specifies the libref of a SAS library that contains, or will contain, a catalog of stored compiled SAS macros. This libref cannot be Work.

# SERROR System Option

Specifies whether the macro processor issues a warning message when a macro variable reference does not match a macro variable.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO

**Type:** System option

**Alias:** SERR | NOSERR

**Default:** SERROR

## Syntax

**SERROR | NOSERROR**

### *Required Arguments*

**SERROR**
issues a warning message when the macro processor cannot match a macro variable reference to an existing macro variable.

**NOSERROR**
issues no warning messages when the macro processor cannot match a macro variable reference to an existing macro variable.

## Details

Several conditions can occur that prevent a macro variable reference from resolving. These conditions appear when one or more of the following is true:

- the name in a macro variable reference is misspelled.
- the variable is referenced before being defined.
- the program contains an ampersand ( **&**) followed by a string, without intervening blanks between the ampersand and the string. For example:

```
if x&y then do;
if buyer="Smith&Jones, Inc." then do;
```

If your program uses a text string containing ampersands and you want to suppress the warnings, specify NOSERROR.

## SYMBOLGEN System Option

Specifies whether the results of resolving macro variable references are written to the log for debugging.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**PROC OPTIONS GROUP=** MACRO
LOGCONTROL

**Type:** System option

**Alias:** SGEN | NOSGEN

**Default:** NOSYMBOLGEN

### Syntax

**SYMBOLGEN | NOSYMBOLGEN**

#### *Required Arguments*

**SYMBOLGEN**
displays the results of resolving macro variable references. This option is useful for debugging.

**NOSYMBOLGEN**
does not display results of resolving macro variable references.

### Details

SYMBOLGEN displays the results in this form:

```
SYMBOLGEN: Macro variable name resolves to value
```

SYMBOLGEN also indicates when a double ampersand (**&&**) resolves to a single ampersand (**&**).

## SYSPARM= System Option

Specifies a character string that can be passed to SAS programs.

**Valid in:** Configuration file, OPTIONS statement, SAS invocation

**Category:** Macro

**Type:** System option

### Syntax

**SYSPARM=**'*character-string*'

### Required Argument

***character-string***
is a character string, enclosed in quotation marks, with a maximum length of 200.

## Details

The character string specified can be accessed in a SAS DATA step by the SYSPARM() function or anywhere in a SAS program by using the automatic macro variable reference &SYSPARM.

*Operating Environment Information*
The syntax shown here applies to the OPTIONS statement. At invocation or in a configuration file, the syntax is host specific. For more information, see the SAS documentation for your operating environment.

## Example: Passing a User Identification to a Program

This example uses the SYSPARM option to pass a user identification to a program.

```
options sysparm='usr1';
data a;
   length z $100;
   if sysparm()='usr1' then z="&sysparm";
run;
```

# Part 3

# Appendixes

*Appendix 1*
***Reserved Words in the Macro Facility*** . . . . . *365*

*Appendix 2*
***SAS Macro Facility Error and Warning Messages*** . . . . . *367*

*Appendix 3*
***SAS Tokens*** . . . . . *407*

*Appendix 4*
***Syntax for Selected Functions Used with the %SYSFUNC Function*** . . . . . *409*

*Appendix 5*
***Using the Macro Facility with the Linux Operating Environment*** . . *415*

*Appendix 1*

# Reserved Words in the Macro Facility

**Macro Facility Word Rules** . . . . . 365
**Reserved Words** . . . . . 365

## Macro Facility Word Rules

The following rules apply to the macro facility.

- Do not use a reserved word as the name of a macro, a macro variable, or a macro label. Reserved words include words reserved by both the macro facility and the operating environment. When a macro name is a macro facility reserved word, the macro processor issues a warning, and the macro is neither compiled nor available for execution. The macro facility reserves the words listed under "Reserved Words" on page 365 for internal use.
- Do not prefix the name of a macro language element with SYS because SAS reserves the SYS prefix for the names of macro language elements supplied with SAS software.
- Do not prefix macro variables names with SYS, AF, or DMS in order to avoid macro name conflicts.

## Reserved Words

The following is a list of reserved words for the macro facility.

| | | | |
|---|---|---|---|
| ABEND | GO | NRBQUOTE | STR |
| ABORT | GOTO | NRQUOTE | SUBSTR |
| ACT | IF | NRSTR | SUPERQ |
| ACTIVATE | INC | ON | SYMDEL |
| BQUOTE | INCLUDE | OPEN | SYMGLOBL |
| BY | INDEX | PAUSE | SYMLOCAL |
| CLEAR | INFILE | PUT | SYMEXIST |
| CLOSE | INPUT | QKCMPRES | SYSCALL |
| CMS | KCMPRES | QKLEFT | SYSEVALF |

| | | | |
|---|---|---|---|
| COMANDR | KINDEX | QKSCAN | SYSFUNC |
| COPY | KLEFT | QKSUBSTR | SYSGET |
| DEACT | KLENGTH | QKTRIM | SYSRPUT |
| DEL | KSCAN | QKUPCASE | THEN |
| DELETE | KSUBSTR | QSCAN | TO |
| DISPLAY | KTRIM | QSUBSTR | TSO |
| DMIDSPLY | KUPCASE | QSYSFUNC | UNQUOTE |
| DMISPLIT | LENGTH | QUOTE | UNSTR |
| DO | LET | QUPCASE | UNTIL |
| EDIT | LIST | RESOLVE | UPCASE |
| ELSE | LISTM | RETURN | WHILE |
| END | LOCAL | RUN | WINDOW |
| EVAL | MACRO | SAVE | |
| FILE | MEND | SCAN | |
| GLOBAL | METASYM | STOP | |

*Appendix 2*

# SAS Macro Facility Error and Warning Messages

**SAS Macro Error Messages** . . . . . 367
**SAS Macro Warning Messages** . . . . . 399

## SAS Macro Error Messages

This section contains error messages that might be reported when using macros and the solutions to correct them. If you are unable to resolve the error, then contact SAS Technical Support.

**Error: %EVAL must be followed by an expression enclosed in parentheses.**

| Cause | Solution |
|---|---|
| There is no expression following the %EVAL function. | The %EVAL function must be followed by an expression that is enclosed in parentheses . |
| An expression follows the %EVAL function but the parentheses are missing. | The %EVAL function must contain an expression that is enclosed in parentheses. |

**Error: Expecting a variable name after *value*.**

| Cause | Solution |
|---|---|
| The first letter of the variable name begins with a number or special character. | The first character must begin with an English letter or an underscore. Subsequent characters can be English letters, digits, or underscores. |
| The variable name is missing. | Verify that the variable name exists. |

**Error: Symbolic variable name *value* must be 32 or fewer characters long.**

| Cause | Solution |
|---|---|
| The macro variable name is longer than 32 characters. | A macro variable name can be only 32 characters or less. |

**Error: Symbolic variable name *value* must begin with a letter or underscore.**

| Cause | Solution |
|---|---|
| The macro variable name contained within quotation marks in the first argument to the SYMPUT routine or the SYMPUTX routine begins with a number or special character. | The macro variable name must begin with a letter or an underscore. |
| The value of the SAS data set variable that is used to create the macro variable name begins with a number or special character. | The value within the data set variable must begin with a letter or underscore. |

**Error: Symbolic variable name *value* must contain only letters, digits, and underscores.**

| Cause | Solution |
|---|---|
| The macro variable name contained within quotation marks in the first argument to the SYMPUT routine or the SYMPUTX routine contains a special character. | The macro variable name must contain only letters, digits, or underscores. |
| The value of the SAS data set variable that is used to create the macro variable name within the SYMPUT routine or the SYMPUTX routine contains a special character. | The value within the data set variable must contain only letters, digits, or underscores. |

**Error: Expected open parenthesis after macro function name not found.**

| Cause | Solution |
|---|---|
| The macro function being used is missing the open parenthesis to begin the argument. | Each macro function used must contain an open and close parenthesis. |

**Error: Maximum level of nesting of macro functions exceeded.**

| Cause | Solution |
|---|---|
| The macro functions are nested more than ten times. | You cannot nest macro functions more than ten times. |

| Cause | Solution |
|---|---|
| An attempt was made to assign a macro variable to itself. A macro quoting function was used inside a %DO loop that is going beyond ten iterations. | Many times a macro quoting function is used when it is not needed. If this is the case, then remove the quoting function. |

**Error: Invalid macro name *value*. It should be a valid SAS identifier no longer than 32 characters.**

| Cause | Solution |
|---|---|
| The macro name begins with a character other than an underscore or letter. | Remove the special character at the beginning of the macro name so that it begins with an underscore or letter. |
| There is a period within the macro name. | Remove the period contained within the macro name. |
| The macro name is longer than 32 characters. | Reduce the length of the macro name to 32 characters or less. |

**Error: A character operand was found in the %EVAL function or %IF condition where a numeric operand is required. The condition was: *value***

| Cause | Solution |
|---|---|
| A %EVAL function or a %IF statement contains an expression that has a negative floating-point number, for example,<br>`%eval(-1.2 le 2)` | A %IF statement uses an implied %EVAL function that can handle only whole numbers. Use the %SYSEVALF function around the expression instead, for example,<br>`%sysevalf(-1.2 le 2)` |
| The start or stop value contained within a %DO loop contains a character other than an integer. | The start and stop values within a %DO loop must be integers or macro expressions that generate integers. |
| There is a non-integer value within an arithmetic expression, for example,<br>`%eval(3.2+2)` | The %EVAL function evaluates arithmetic and logical expressions. If arithmetic is taking place, then all values must be whole numbers. If you are using floating-point values, then use %SYSEVALF, for example,<br>`%sysevalf(3.2+2)` |
| There is a letter or special character within the %EVAL function where an integer was expected, for example,<br>`%if a+2 = 4 %then %put test;` | Remove the non-integer value. If you are trying to reference a SAS data set variable, then change the code to a DATA step IF condition. |

| Cause | Solution |
|---|---|
| A non-existent macro variable is referenced on a %IF or %DO statement. | Make sure the macro variable that is referenced exists and contains a valid value for the expression. |

**ERROR: More positional parameters found than defined.**

| Cause | Solution |
|---|---|
| The macro was defined with **n** number of parameters but the invocation went beyond that number. | If the definition contains two positional parameters, then the invocation must contain two positional parameters. |
| A macro variable on the invocation contains a comma within the value. | The macro variable that contains the comma as text must be surrounded with a macro quoting function, such as the %BQUOTE function, for example, **%test(%bquote(&var),b,c)**. The example code contains 3 parameters values: **&var**, **b**, and **c**. |
| The string being passed as a parameter contains a comma. | The string that contains the comma needs a quoting function to hide the comma, such as the %STR function, for example, **%test(%str(a,b),c)**. The example code contains three parameters: **a,b** and **c**. |
| The %STR function was used to mask the comma. | The %BQUOTE function or the %SUPERQ function should be used instead. |

**Error: Expecting comma (to separate macro parameters) or close parenthesis (to end parameter list) but found: *value***

| Cause | Solution |
|---|---|
| A positional parameter precedes a keyword parameter. There is a missing comma between the two parameters, for example,<br>`%macro test(c a=);` | Insert the comma between the two parameters, for example,<br>`%macro test(c,a=);` |
| A close parenthesis is missing from the parameter list when specifying positional parameters. | Add the missing parenthesis to the parameter list. |
| A positional parameter within the definition contains a special character, for example,<br>`%macro test(a-b,c);` | A parameter name must be a valid SAS name that contains no special characters. |

**Error: Invalid symbolic variable name *value*.**

| Cause | Solution |
|---|---|
| The macro variable name contained within a %LOCAL statement or a %GLOBAL statement contains a special character, for example,<br>`%GLOBAL a = b;` | Remove the special character. %LOCAL statements and %GLOBAL statements do not require the macro variable name to have an ampersand. Macro variable names must start with a letter or an underscore and can be followed by letters or digits. |

**Error: No matching %MACRO statement for this %MEND statement.**

| Cause | Solution |
|---|---|
| The matching %MACRO statement for the %MEND statement is missing. | Add the %MACRO statement. Each %MEND statement must have a matching %MACRO statement. |
| There is an unclosed comment, missing semicolon, or unmatched parenthesis that is causing the %MACRO statement to not be read. | Close the comment, add the semicolon, or close the parenthesis that appears before the %MACRO statement. After making the correction, you might need to restart your SAS session. |

**Error: Operand missing for *value* operator in argument to %EVAL function.**

| Cause | Solution |
|---|---|
| The IN operator is being used but there are no values specified within the IN operator, or the operand to the left of the IN operator contains a null value. | When you use the IN operator, both operands must contain a value. If the operand contains a null value, then an error is generated. |

**Error: No file referenced by SASAUTOS OPTION can be opened.**

| Cause | Solution |
|---|---|
| The SASAUTOS= system option is being used in an OPTIONS statement but the SASAUTOS= system option fileref from the SAS configuration file is missing or commented out. | Ensure that the SASAUTOS= system option fileref is present within the SAS configuration file and that it points to the SAS supplied autocall macro location. |

**Error: The text expression *value* contains a recursive reference to the macro variable *value*. The macro variable will be assigned the null value.**

| Cause | Solution |
|---|---|
| A macro variable is being assigned to itself. The macro variable did not exist prior to the assignment, for example,<br>`%let a=&a` | Ensure that the macro exists prior to the assignment statement, for example,<br>`%global a; %let a=&a` |

**Error: Attempt to %GLOBAL a name *(value)* which exists in a local environment.**

| Cause | Solution |
|---|---|
| A %GLOBAL statement is being used on a macro variable that has already been declared as local, for example,<br>`%macro test(a);`<br>`%global a;`<br>`%mend;`<br><br>`%test(100)` | If a local macro variable needs to be made global, a new global macro variable needs to be created. The new global macro must be equal to the local macro variable, for example,<br>`%macro test(a);`<br>`%global newa;`<br>`%let newa=&a`<br>`%mend;`<br><br>`%test(100)` |

**Error: Attempt to assign a value to a read-only symbolic variable *(value)*.**

| Cause | Solution |
|---|---|
| A macro variable is being assigned a value but the macro variable is a read-only SAS automatic macro variable, for example,<br>`%let syserr=0;` | A read-only SAS automatic macro variable cannot be assigned a value. If you are trying to create a new macro variable, then change the name to something that does not match the SAS supplied variables. |

**Error: There is no matching %DO statement for the %END. This statement will be ignored.**

| Cause | Solution |
|---|---|
| There is a missing %DO statement. | Each %END statement must have a matching %DO statement. If all %END statements have a matching %DO statement, ensure that there is not an unclosed comment or missing semicolon prior to the %DO statement. |

**Error: The %GOTO statement has no target. The statement will be ignored.**

| Cause | Solution |
|---|---|
| A macro variable was used as the label in a %GOTO statement but has a null value. | The label for the %GOTO statement must be a valid SAS name. |

**Error: The macro *value* contains a %GOTO statement with an invalid statement label name. The macro will not be compiled.**

| Cause | Solution |
|---|---|
| A %GOTO statement points to a label that does not exist. | Each %GOTO statement must have a valid label statement that begins with a percent sign and is followed by a colon. |
| There is an unclosed comment, unmatched quotation mark, or missing semicolon prior to the %LABEL statement. | Close all comments, match all quotation marks, and ensure that all statements have a semicolon. After making the correction, you might need to restart your SAS session. |
| The label is not a valid SAS name, for example,<br>`%a-1:` | The label must be a valid SAS name that contains no special characters. |

**Error: In macro *value*, the target of the statement %GOTO *value*, resolved into the label *value*, which was not found.**

| Cause | Solution |
|---|---|
| A percent sign precedes the label name of the %GOTO statement, for example,<br>`%goto %a;` | Remove the percent sign. If you want to invoke a macro and return a label name, then ensure that the macro contains only a valid label name with no semicolon. |
| An ampersand precedes the label name of the %GOTO statement, for example,<br>`%goto &a;` | Ensure that the macro variable exists and that it returns a valid label name value. |

**Error: In macro *value*, the target of the statement %GOTO *value*, resolved into the label *value*, which is not a valid statement label.**

| Cause | Solution |
|---|---|
| The label is a macro or macro variable that contains a character that is not valid in a label name. | Ensure that the macro invocation or macro variable returns a valid SAS name as a label. If the label name is from a macro invocation, then ensure that there is no semicolon following the label name. |

| Cause | Solution |
|---|---|
| The %GOTO statement contains a label that is not a valid SAS name, for example,<br>`%goto a-1;` | Ensure that the %GOTO statement contains a valid SAS name for the label and that it does not contain special characters. |

**Error: *value* is an invalid macro variable name for the index variable of the %DO loop.**

| Cause | Solution |
|---|---|
| The index variable is not a valid SAS name, for example,<br>`%do 1a=1 %to 3;` | The index variable must be a valid SAS name, which starts with a letter or an underscore and can be followed by letters or digits, for example,<br>`%do a1=1 %to 3;` |
| The index variable contains an ampersand but there is no macro variable with that name. | Remove the ampersand, or create the macro variable first that contains a valid SAS name. |
| The index variable contains an ampersand but the macro variable resolves to a null value or invalid SAS name. | Ensure that the macro variable that resolves as the index variable resolves to a valid SAS name. |

**Error: The *value* value of the %DO *value* loop is invalid.**

| Cause | Solution |
|---|---|
| Either the FROM or TO value is not an integer value. | The FROM and TO values must be an integer or a macro expression that generates integers. |

**Error: The %BY value of the %DO *value* loop is zero.**

| Cause | Solution |
|---|---|
| The value of the %BY statement is zero, or a macro variable is used and resolves to zero. | The value of the %BY statement must be an integer (other than zero) or a macro expression that resolves to an integer. |

**Error: Expected %TO not found in %DO statement.**

| Cause | Solution |
|---|---|
| The %TO statement is missing from an iterative %DO loop, for example,<br>`%do i=1 3;` | An iterative %DO loop must contain a %TO statement, for example,<br>`%do i=1 %to 3;` |

**Error: Invalid macro parameter name *value*. It should be a valid SAS identifier no longer than 32 characters.**

| Cause | Solution |
|---|---|
| The parameter name within a macro definition contains an ampersand. | Remove the ampersand. Parameter names that are specified within a macro definition cannot contain an ampersand. |
| The parameter name that is within a macro definition contains a percent sign. | Remove the percent sign. Parameter names that are specified within a macro definition cannot contain a percent sign. |
| The parameter name is longer than 32 characters. | A macro variable name must be 32 characters or less. |

**Error: Expected equal sign not found in *value* statement.**

| Cause | Solution |
|---|---|
| A %LET statement within a macro definition is missing the equal sign. | The %LET statement must contain an equal sign that follows the macro variable name. |
| A %SYSLPUT statement or a %SYSRPUT statement is within a macro definition and is missing an equal sign. | The %SYSLPUT statement and the %SYSRPUT statement must contain an equal sign that is between the macro variable name and the value. |
| There is a missing equal sign on a %GLOBAL or %LOCAL statement while trying to create a read-only macro variable, for example,<br>`%global / readonly newtest;` | Include the equal sign when creating a read-only macro variable, for example,<br>`%global / readonly newtest=100;` |

**Error: An unexpected semicolon occurred in the %DO statement.**

| Cause | Solution |
|---|---|
| There is a missing equal sign that follows the index variable in the %DO statement. | Place an equal sign after the index variable name, for example,<br>`%do i=1 %to 3;` |

**Error: %EVAL function has no expression to evaluate, or %IF statement has no condition.**

| Cause | Solution |
|---|---|
| An %IF statement does not contain an expression to evaluate before the %THEN statement. | Add an expression to evaluate between the %IF statement and the %THEN statement. |

| Cause | Solution |
|---|---|
| A %DO %UNTIL statement or a %DO %WHILE statement does not contain any text between the parentheses. | A %DO statement requires an expression to evaluate. |
| The %EVAL function does not contain any text between the parentheses. | A %EVAL function requires an expression to evaluate. |
| A function that is being used to generate an expression returns a null value, for example,<br>`%if %eval(a) %then` | Ensure that the function returns a valid expression. |

**Error: Required operator not found in expression: *value***

| Cause | Solution |
|---|---|
| There is an extra close parenthesis within the macro function that is being used. | Remove the extra close parenthesis. |
| There is a colon following a parenthesis within a %IF statement. | If a macro variable contains a colon, then use the %SUPERQ function around the macro variable, or use the %STR function around the text. |
| A SAS function is being used on a macro statement, such as the %IF statement. | Use the %SYSFUNC function around the SAS function. |
| The IN operator is being used within the macro facility. | The MINOPERATOR system option must be set before using the IN operator. |
| A macro is being invoked from a statement, such as a %IF statement, but the macro does not exist. | Ensure that the macro that is invoked has been compiled. If it is an autocall macro, then ensure that the SASAUTOS= system option is pointing to the location of the macro. |

**Error: Macro function *value* has too many arguments.**

| Cause | Solution |
|---|---|
| The function being used requires a certain number of arguments and that number has been exceeded, for example, **`%substr(abcd,1,2,3)`**.The %SUBSTR function can handle only three arguments. | Ensure that the required number of arguments are met and not exceeded. If the text string contains a comma, then use the %STR function around the text. |
| A macro variable is being referenced as an argument and it contains a comma. | Use a quoting function around the macro variable, such as the %BQUOTE function, to mask the comma. |

**Error: Macro function *value* has too few arguments.**

| Cause | Solution |
|---|---|
| The function being used requires a certain number of arguments and that number has not been reached, for example, **%substr(abcd)**.The %SUBSTR function requires at least two arguments. | Ensure that the required number of arguments are met. |

**Error: There were *value* unclosed %DO statements. The macro *value* will not be compiled.**

| Cause | Solution |
|---|---|
| There is a missing %END statement for a %DO statement. | Every %DO statement requires a corresponding %END statement. |
| There is a missing semicolon, unclosed comment, or unmatched quotation mark prior to a %END statement. | Ensure that all comments are closed, each statement has a semicolon, and each quotation mark has a matching quotation mark prior to the %END statement. After making the correction, you might need to restart the SAS session. |

**Error: Argument *value* to macro function *value* is not a number.**

| Cause | Solution |
|---|---|
| The second argument of the %SCAN function or the %QSCAN function is not an integer, instead it is a character value. | The second argument of the %SCAN function or the %QSCAN function must be a number or an expression that resolves to an integer. |
| The second or third argument of the %SUBSTR function or the %QSUBSTR function is not an integer, instead it is a character value. | The second and third arguments to the %SUBSTR function or the %QSUBSTR function must be a number or an expression that resolves to an integer. |

**Error: The condition in the %DO *value* loop, *value*, yielded an invalid or missing value, *value*. The macro will stop executing.**

| Cause | Solution |
|---|---|
| A condition within the %DO %UNTIL statement or the %DO %WHILE statement resolves to a null value or nonnumeric characters. | The macro expression within the %DO %UNTIL statement or the %DO %WHILE statement must resolve to a logical value. The expression is true if it is an integer other than zero. The expression is false if it has a value of zero. |

**Error: Invalid branch into iterative %DO.**

| Cause | Solution |
|---|---|
| The label for a %GOTO statement is contained within a %DO and %END statement. | Move the label outside of the iterative %DO loop. |

**Error: Division by zero in %EVAL is invalid.**

| Cause | Solution |
|---|---|
| The denominator of a calculation within a %EVAL function is zero. | Change the denominator to something other than 0. |
| An expression within a %IF or %DO loop contains a calculation with 0 as the denominator. | Ensure that the expression does not contain a calculation that is dividing by 0. |

**Error: The keyword parameter *value* was not defined with the macro.**

| Cause | Solution |
|---|---|
| The keyword parameter specified in the macro invocation does not exist in the definition. | Ensure that each parameter that is used in the invocation also exists in the definition. |
| The parameter value contains an equal sign. | Use the %STR function around the value in the macro invocation, for example,<br>`%test(%str(a=100))` |

**Error: The macro variable name is either all blank or missing.**

| Cause | Solution |
|---|---|
| There is no text between the quotation marks of the first argument within the CALL SYMPUTX routine or the CALL SYMPUT routine. | A valid SAS name must be specified in the first argument to create the macro variable name. |
| The DATA step variable being used as the macro variable name within the CALL SYMPUT routine or the CALL SYMPUTX routine has no value. | Ensure that the DATA step variable contains a valid SAS name. |

**Error: Expected %THEN statement not found.**

| Cause | Solution |
|---|---|
| A %IF statement does not contain a %THEN statement following the expression. | Add the %THEN statement following the expression within the %IF statement. |

**Error: Overflow has occurred; evaluation is terminated.**

| Cause | Solution |
|---|---|
| The value within the %SYSEVALF function or the %EVAL function has gone beyond 1.79e308. | Ensure that the value is less than 1.79e308 or add quotation marks around the value so that it is treated as a text value. |

**Error: %GO not followed by TO.**

| Cause | Solution |
|---|---|
| The TO portion of the %GOTO statement is missing. | Ensure that the %GOTO statement is spelled correctly. |

**Error: The target of the %GOTO statement was a reserved macro keyword, *value*.**

| Cause | Solution |
|---|---|
| The label portion of the %GOTO statement is a macro reserved word. | Change the %GOTO label so that it does not match any reserved words. See Appendix 1, " Reserved Words in the Macro Facility," on page 365. |

**Error: All positional parameters must precede keyword parameters.**

| Cause | Solution |
|---|---|
| The parameters followed by an equal sign precedes parameters without an equal sign in the definition. | If using keyword (with equal sign) parameters and positional (without equal sign) parameters together, then all positional parameters must come before the keyword parameters. |
| The parameter value contains a comma that is meant to be text to the parameter. | Mask the string being passed to the macro with the %STR function, for example,<br>`%test(1,a=%str(4,f))` |

**Error: The keyword parameter *value* passed to macro *value* was given a value twice.**

| Cause | Solution |
|---|---|
| The same parameter name is listed more than once within a macro invocation. | Each parameter name can appear only once within the parameter list. |

**Error: The index variable in the %DO *value* loop has taken on an invalid or missing value. The macro will stop executing.**

| Cause | Solution |
|---|---|
| The index variable of a macro %DO statement has been set to missing or given a non-numeric value within the loop. | If there is a nested macro invocation within the loop, then ensure that the %DO index variable is not getting reset in the nested macro. Either change the index variable name or change the matching name within the nested macro. |

**Error: Literal contains unmatched quote.**

| Cause | Solution |
|---|---|
| A value contains a missing or extra quotation mark or an apostrophe. | Match the missing quotation mark. If the unmatched quotation mark or apostrophe is part of the text, then a macro quoting function, such as %STR, is needed, for example,<br>`%str(joe%'s diner)`<br>Precede the apostrophe or unmatched quotation mark with a percent sign. |

**Error: The SAS System was unable to open the macro library.**

| Cause | Solution |
|---|---|
| A stored compiled macro was moved from one release to another or from one operating system to another. | A stored compiled macro cannot be moved to a different operating system or to a different release of SAS. The macro must be recompiled in the new location or release. |
| There is a leftover file within the Work directory that you might not have correct permissions for use. | Clean out the Work directory. The following SAS Note might help: http://support.sas.com/kb/8/786.html. |
| NOWORKINIT system option is set. | Run the job with the WORKINIT system option set. |

**Error: The SAS System is unable to write the macro *value* to the macro library.**

| Cause | Solution |
|---|---|
| An attempt was made to compile a macro to a permanent location that is specified by the SASMSTORE= system option. | The SASMACR catalog that is being written to is either corrupt or the catalog contains stored compiled macros from a different SAS release or different operating system. Write to a new location. |

**Error: Expected semicolon not found after *value* clause.**

| Cause | Solution |
|---|---|
| There is a macro variable reference on the macro name of a definition, for example,<br>`%macro test&i;` | A macro name must be a valid SAS name. You cannot use a text expression to generate a macro name in a %MACRO statement. |
| The word %MACRO is repeated before a macro invocation. | When calling or invoking a macro you do not include the word %MACRO before it. |
| A macro variable is being referenced on the macro definition line to declare options. | A macro variable cannot be used to generate options on a macro definition. Remove the macro variable and hardcode the options that you need. |

**Error: Open code statement recursion detected.**

| Cause | Solution |
|---|---|
| A statement within a macro is missing a semicolon. | Ensure that every statement that requires a semicolon has one. Ensure that there is not an unclosed comment that is causing a semicolon to not be seen. Run the following code after you make the correction:<br>`*'; *"; *); */; %mend;`<br>`run;` |
| A function is missing a parenthesis. | Ensure that all parenthesis match. Run the following code after you make the correction:<br>`*'; *"; *); */; %mend;`<br>`run;` |
| A macro variable is being referenced in a function that might contain unmatched quotation marks, parenthesis, or a comment. | Use a macro quoting function around the macro variable, such as the %SUPERQ function. If you are using a function, such as the %SUBSTR function, then switch to %QSUBSTR. |
| A comment, such as *****, is being used inside a macro. | Do not use ***** style comments inside a macro. The PL1 style comments **/* */** should be used inside a macro. |
| Quotation marks are being used around a macro variable in a function, such as %SUBSTR, for example,<br>`%let temp=%substr("abc",1,2);` | Remove the quotation marks from around the macro variable. |

**Error: A dummy macro will be compiled.**

| Cause | Solution |
|---|---|
| If the macro processor detects a syntax error while compiling the macro, then it checks the syntax in the rest of the macro. Messages are issued for any additional errors that are found. However, the macro processor does not store the macro for execution. A macro that is compiled by the macro processor but is not stored is called a *dummy macro*. | Correct the syntax and compile the macro again. |

**Error: Macro keyword *value* is not yet implemented.**

| Cause | Solution |
|---|---|
| The keyword referenced in the error message is a functionality of the macro facility but is not yet available for use. | Ensure that you are running the correct release of SAS that contains this functionality. |

**Error: Macro keyword *value* appears as text.**

| Cause | Solution |
|---|---|
| There is a missing semicolon in a line prior to the statement being flagged with the error message. | Add the missing semicolon. If you are running interactively, then SAS might need to be restarted. |
| There is an unmatched parenthesis before the statement that is being flagged with the error message. | Add the missing parenthesis. If you are running interactively, then SAS might need to be restarted. |
| A macro statement is being used incorrectly within a %LET statement within a macro definition, for example,<br>`%let x= %put test;` | Macro statements cannot be used inside a %LET statement. Change the example %LET statement to the following:<br>`%let x=%nrstr(%put test;);` |

**Error: The macro name *value* and the internal macro header name *value* in the SASMACR macro catalog differ. Recompile this macro and try again.**

| Cause | Solution |
|---|---|
| There is an extra or missing parenthesis on the macro invocation. | Ensure that the parentheses have matching pairs. You might need to restart the SAS session. |
| There is an unmatched parenthesis, quotation mark, or a comment within the macro. | Ensure that there is a matching pair of parentheses, quotation marks, or a comment. You might need to restart the SAS session. |

| Cause | Solution |
|---|---|
| There is a partial nested macro definition with the same name as the outer macro. | Remove the nested macro definition. If nesting is needed, then ensure that the macro names are different. The best practice is to nest the macro invocation, not the macro definition. |

**Error: Macro library damaged. Cannot compile macro *value*.**

| Cause | Solution |
|---|---|
| A compiled macro was copied to a different operating system or release of SAS than where it was compiled. | Compiled macro catalog entries can be executed only on the same release of SAS and on the same operating system where they were created. Moving compiled macros across operating systems or releases of SAS is not supported. The macros need to be recompiled on the new operating system or new release of SAS. |
| A compiled macro is being permanently stored in a SASMACR catalog that contains macros from a different operating system or release of SAS. | Compile the macro to a new location to create a new SASMACR catalog. |

**Error: %SYSRPUT statement is valid only when OPTION DMR is in effect.**

| Cause | Solution |
|---|---|
| The NODMR system option is set when SAS starts up and an attempt was made to use the %SYSRPUT function. | The DMR system option must be set in order to be able to use %SYSRPUT. |

**Error: Macro *value* has been given a reserved name.**

| Cause | Solution |
|---|---|
| An attempt was made to define a macro that has the same name as a macro function or macro statement. (This does not include the SAS supplied autocall macros.) | When you name a user-defined macro, follow the rules for naming macros.See Appendix 1, " Reserved Words in the Macro Facility," on page 365. |

**Error: Invalid branch into %DO %WHILE.**

| Cause | Solution |
|---|---|
| An attempt was made to use %GOTO logic within a %DO %WHILE loop. | %GOTO syntax cannot be used within a %DO %WHILE loop. Remove it from the loop. |

**Error: Invalid branch into %DO %UNTIL.**

| Cause | Solution |
|---|---|
| An attempt was made to use %GOTO logic within a %DO %UNTIL loop. | %GOTO syntax cannot be used within a %DO %UNTIL loop. Remove it from the loop. |

**Error: Extraneous text on %MACRO statement ignored.**

| Cause | Solution |
|---|---|
| The macro statement contains a slash (/) that is followed by an invalid option. | Only valid options can be used in the %MACRO statement. The following is a list of valid options:<br>CMD<br>DES=<br>MINDELIMITER=<br>MINOPERATOR<br>PARMBUF<br>SECURE \| NOSECURE<br>STMT<br>SOURCE \| SRC<br>STORE |

**Error: The MSTORED option must be set to use the /STORE macro statement option.**

| Cause | Solution |
|---|---|
| The /STORE option is used in the %MACRO statement and the MSTORED system option is not set. | List the MSTORED system option in an OPTIONS statement before using the STORE option in the %MACRO statement. |

**Error: The syntax for this %MACRO statement option is /DES = "*description*".**

| Cause | Solution |
|---|---|
| The description used with the DES= option is not within quotation marks. | The value of the DES= option in the %MACRO statement must be within quotation marks. |

**Error: The WORK.SASMACR catalog is temporary and can not be used for compiled stored macros. Change OPTION SASMSTORE to a different libref.**

| Cause | Solution |
|---|---|
| The SASMSTORE= option is set to the Work library. | Set the SASMSTORE= option to a valid library other than the Work library. |

**Error: The option SASMSTORE = libref is not set.**

| Cause | Solution |
|---|---|
| The MSTORED system option is set and the macro is defined with the /STORE option without setting the SASMSTORE= system option. | Set the SASMSTORE= system option to a valid library when using the STORE option in the %MACRO statement. |

**Error: Expected close parenthesis after macro function invocation not found.**

| Cause | Solution |
|---|---|
| The close parenthesis is omitted when using a macro function. | The syntax for every macro function requires an open and close parenthesis. |

**Error: Macro parameter contains syntax error.**

| Cause | Solution |
|---|---|
| An attempt was made to invoke a macro with CALL EXECUTE when a parameter value has an open parenthesis and not a close parenthesis. | The unmatched parenthesis in the parameter must be masked with the %STR function and preceded by a percent sign. The following is an example:<br>`call=cats('%test(%str (',tranwrd(tranwrd(x, '(','%('),')','%)'),'))');`<br>`call execute(call);` |

**Error: The *value* function referenced in the %SYSFUNC or %QSYSFUNC macro function is not found.**

| Cause | Solution |
|---|---|
| Listing a function within %SYSFUNC that does not exist. | Check the function documentation to make sure that the first argument to the %SYSFUNC function is valid. |
| An attempt was made to use the PUT or INPUT function with the %SYSFUNC function. | Use the INPUTC, INPUTN, PUTC, or PUTN function instead of the PUT or INPUT function. |

**Error: The function *value* referenced by the %SYSFUNC or %QSYSFUNC macro function has too many arguments.**

| Cause | Solution |
|---|---|
| More commas are found in the syntax of the function than there are arguments to that function. The most likely cause is that an argument to the function is a macro variable and the resolved value of the macro variable contains commas. | Ensure that the correct syntax is used for the function.<br>If the comma or commas causing the error are within the resolved value of the macro variable that is used with the function, then that variable must be masked using the %BQUOTE function. |

**Error: The function *value* referenced by the %SYSFUNC or %QSYSFUNC macro function has too few arguments.**

| Cause | Solution |
|---|---|
| Not all of the required arguments are listed in the function's syntax. | Refer to the documentation for the function mentioned in the error and ensure that all required arguments are listed. |

**Error: Argument *value* to function *value* referenced by the %SYSFUNC or %QSYSFUNC macro function is not a number.**

| Cause | Solution |
|---|---|
| A nonnumeric argument value is used instead of the expected numeric value. | Refer to the documentation for the function mentioned in the error. Ensure that numeric values are used for the arguments that require numeric values. |

**Error: %SYSEVALF must be followed by an expression enclosed in parentheses.**

| Cause | Solution |
|---|---|
| The expression to be evaluated is not within parentheses. | Enclose the expression to be evaluated in parentheses. |

**Error: The function *value* referenced by %SYSFUNC, %QSYSFUNC, or %SYSCALL cannot be used within the MACRO function/call-routine interfaces.**

| Cause | Solution |
|---|---|
| An unapproved function is used as the first argument to the %SYSFUNC function. | The following variable information functions are not available for use with the %SYSFUNC function: .<br>ALLCOMB LEXCOMBI<br>ALLPERM LEXPERK<br>DIF LEXPERM<br>DIM LEXCOMB<br>HBOUND MISSING<br>IORCMSG PUT<br>INPUT RESOLVE<br>LAG SYMGET<br>LBOUND |

**Error: Unknown %SYSEVALF conversion operand *value* specified; conversion is terminated.**

| Cause | Solution |
|---|---|
| The conversion type specified in the %SYSEVALF syntax is invalid. | The following valid values are for the second argument to the %SYSEVALF function:<br>BOOLEAN FLOOR<br>CEIL INTEGER |

**Error: The %SYSEVALF ROUND conversion operation is not supported.**

| Cause | Solution |
|---|---|
| An attempt was made to use 'ROUND' as the conversion type in the %SYSEVALF syntax. | The following valid values are for the second argument to the %SYSEVALF function:<br>BOOLEAN FLOOR<br>CEIL INTEGER |

**Error: %SYSEVALF detected a missing value during the conversion operation requested; conversion is terminated.**

| Cause | Solution |
|---|---|
| There is a missing value within the expression being evaluated by the %SYSEVALF function and a conversion type is being used. | Use only nonmissing values within the first argument to the %SYSEVAL function. |

**Error: %SYSEVALF function has no expression to evaluate.**

| Cause | Solution |
|---|---|
| The first argument to the %SYSEVALF function is omitted. | Use only nonmissing values within the first argument to the %SYSEVALF function. |

**Error: The %SYSFUNC or %QSYSFUNC macro function has too many arguments. The excess arguments will be ignored.**

| Cause | Solution |
|---|---|
| More commas are found in the syntax than expected. The most common cause of this error is an argument to the %SYSFUNC function that contains unmasked commas. | Ensure that the correct number of commas is used within the syntax. If an argument to a function within the %SYSFUNC function contains commas, then the commas must be masked using the %BQUOTE function. |

**Error: Invalid arguments detected in %SYSCALL, %SYSFUNC, or %QSYSFUNC argument list. Execution of %SYSCALL statement or %SYSFUNC or %QSYSFUNC function reference is terminated.**

| Cause | Solution |
|---|---|
| There is an invalid argument to the function being used within the %SYSFUNC function. | Check the syntax for the function that is being used with the %SYSFUNC function to make sure that valid arguments are being used. |

**Error: Format name *value* not found or the width and/or decimal specified for the format used are out of range.**

| Cause | Solution |
|---|---|
| This occurs when you specify the format as the second argument to the %SYSFUNC function.<br>This occurs when you use an unknown format, an invalid width, or both, for a format within the %SYSFUNC function. | Ensure that the format used as the optional second argument to the %SYSFUNC function is valid. |

**Error: Expecting a variable name after %LET.**

| Cause | Solution |
|---|---|
| A null value is between the %LET statement and the equal sign (=). | A valid macro variable name must immediately follow the %LET statement. |

**Error: Expecting a variable name after %SYSRPUT.**

| Cause | Solution |
|---|---|
| A null value is between the %SYSRPUT statement and the equal sign (=). | A valid macro variable name must immediately follow the %SYSRPUT statement. |

**Error: Expected equal sign not found in %LET statement.**

| Cause | Solution |
|---|---|
| The equal sign (=) in the %LET statement syntax was omitted. This error occurs only within a macro definition. | Ensure that the syntax for the %LET statement is correct.<br>`%LET variable-name=value;` |

**Error: Expected equal sign not found in %SYSRPUT statement.**

| Cause | Solution |
|---|---|
| A valid macro variable name does not follow %SYSRPUT statement. | A macro variable name must follow these rules:<br>• SAS macro variable names can be up to 32 characters in length.<br>• The first character must begin with a letter or an underscore. Subsequent characters can be letters, numeric digits, or underscores.<br>• A macro variable name cannot contain blanks.<br>• A macro variable name cannot contain double-byte character set (DBCS) characters.<br>• A macro variable name cannot contain any special characters other than the underscore.<br>• Macro variable names are case insensitive. For example, cat, Cat, and CAT all represent the same variable.<br>• You can assign any name to a macro variable as long as the name is not a reserved word. The prefixes AF, DMS, SQL, and SYS are not recommended because they are frequently used in SAS software for automatic macro variables. Thus, using one of these prefixes can cause a name conflict with an automatic macro variable. For a complete list of reserved words in the macro language, see Appendix 1, “ Reserved Words in the Macro Facility,” on page 365. If you assign a macro variable name that is not valid, an error message is printed in the log. |

| Cause | Solution |
|---|---|
| A macro variable that does not exist has been listed after the %SYSRPUT statement. | Review the possible reasons for a macro variable not resolving. |

**Error: The %SYSEVALF macro function has too many arguments. The excess arguments will be ignored.**

| Cause | Solution |
|---|---|
| The %SYSEVALF function has only two possible arguments. The presence of more than one comma produces this error. An extra comma is often found in the resolved value of a macro variable. | Omit any commas when listing the arguments to the %SYSEVALF function. If the argument to %SYSEVALF is a macro variable that contains a comma, then the comma can be removed using the COMPRESS function.<br>`%sysevalf( %sysfunc(compress(%bquote(&x), %str(,)))*&y)` |

**Error: Function name missing in %SYSFUNC or %QSYSFUNC macro function reference.**

| Cause | Solution |
|---|---|
| No function is listed in the %SYSFUNC syntax. | The first argument to the %SYSFUNC function must be a valid SAS function. |

**Error: CALL routine name missing in %SYSCALL macro statement.**

| Cause | Solution |
|---|---|
| The call routine name after the %SYSCALL statement was omitted. | A valid call routine name must immediately follow %SYSCALL. |

**Error: Macro variable name *value* must start with a letter or underscore.**

| Cause | Solution |
|---|---|
| An attempt was made to reference an invalid macro variable name in the %SYMDEL statement. | A macro variable name must follow these naming conventions:<br>• SAS macro variable names can be up to 32 characters in length.<br>• The first character must begin with a letter or an underscore. Subsequent characters can be letters, numeric digits, or underscores.<br>• A macro variable name cannot contain blanks.<br>• A macro variable name cannot contain double-byte character set (DBCS) characters.<br>• A macro variable name cannot contain any special characters other than the underscore.<br>• Macro variable names are case insensitive. For example, cat, Cat, and CAT all represent the same variable.<br>• You can assign any name to a macro variable as long as the name is not a reserved word. The prefixes AF, DMS, SQL, and SYS are not recommended because they are frequently used in SAS software for automatic macro variables. Thus, using one of these prefixes can cause a name conflict with an automatic macro variable. For a complete list of reserved words in the macro language, see Appendix 1, " Reserved Words in the Macro Facility," on page 365. If you assign a macro variable name that is not valid, an error message is printed in the log. |

**Error: Compiled stored macro *value* has was invoked using statement-style invocation. This compiled stored macro was not compiled as a statement-style macro. Execution of this compiled stored macro ends. Use name-style invocation for this compiled stored macro.**

| Cause | Solution |
|---|---|
| An attempt was made to invoke a macro as a statement-style macro when the macro was not defined as a statement-style macro. This error message is usually issued when the IMPLMAC system option is set and the percent sign (%) that should precede the macro invocation is omitted. | Ensure that the macro invocation begins with a percent sign (%). When you use the IMPLMAC system option, the processing time is increased because SAS searches the macros that are compiled during the current session for a name corresponding to the first word of each SAS statement. If you are not using statement-style macros, then make sure that the NOIMPLMAC system option is set. |

**Error: Compiled stored macro *value* has was invoked using command-style invocation. This compiled stored macro was not compiled as a command-style macro. Execution of this compiled stored macro ends. Use name-style invocation for this compiled stored macro.**

| Cause | Solution |
|---|---|
| An attempt was made to invoke a macro as a command-style macro when the macro was not defined as a command-style macro. | Invoke the macro within the body of the code editor. |

**Error: WORK is at level 1 of the concatenated libref *value* for compiled stored macros *value*. Change OPTION SASMSTORE to a different libref without WORK at level 1. WORK is temporary.**

| Cause | Solution |
|---|---|
| An attempt was made to use a libref that is the concatenation of a library and the Work library as the value of the SASMSTORE= system option. The Work library is listed first in the LIBNAME statement. | Do not point to the Work library when assigning the value of the SASMSTORE= system option. Work is a temporary library and is not a possible location for a permanent macro catalog. |

**Error: Expecting a variable name after %SYSLPUT.**

| Cause | Solution |
|---|---|
| A valid macro variable name does not follow the %SYSLPUT statement. | Ensure the text that immediately follows the %SYSLPUT statement is a valid macro variable name. If the %SYSLPUT statement is followed by a macro variable reference, ensure that the resolved value of that macro variable is a valid macro variable name. |

**Error: Expected equal sign not found in %SYSLPUT statement.**

| Cause | Solution |
|---|---|
| An equal sign (=) that should appear between the macro variable that is being created and its value has been omitted. This error message occurs only within a macro. | An equal sign (=) must separate the macro variable that is being created and its value. |

**Error: The *value* call routine referenced in the %SYSCALL macro statement is not found.**

| Cause | Solution |
|---|---|
| A non-existent call routine was listed. | A valid call routine must be listed. All SAS call routines are accessible with the %SYSCALL statement except LABEL, VNAME, SYMPUT, and EXECUTE. |

**Error: Improper use of macro reserved word *value*.**

| Cause | Solution |
|---|---|
| An attempt was made to use a reserved macro word incorrectly. | The correct syntax must be used when using macro syntax such as the %TO, %BY, and %THEN statements. |

**Error: Attempt to delete automatic macro variable *value*.**

| Cause | Solution |
|---|---|
| An attempt was made to delete a macro variable defined by SAS. | Only user-defined global macro variables can be deleted using the %SYMDEL statement. |

**Error: Unrecognized option to the %SYSLPUT statement.**

| Cause | Solution |
|---|---|
| An invalid option is listed in the %SYSLPUT statement. | REMOTE= is the only valid option in the %SYSLPUT statement. |

**Error: The text expression length (*value*) exceeds maximum length (*value*). The text expression has been truncated to *value* characters.**

| Cause | Solution |
|---|---|
| A text expression within the macro language exceeds 65534 bytes. For example, this error message is generated if the argument to a macro function exceeds 65534 bytes. | A macro variable value cannot exceed 65534 bytes. |

**Error: Unrecognized option on %ABORT statement: *value***

| Cause | Solution |
|---|---|
| An unknown option is used in the %ABORT statement. | Valid options in the %ABORT statement are: ABEND, CANCEL, and RETURN. |

**Error: Execution terminated by an %ABORT statement.**

| Cause | Solution |
|---|---|
| This error is generated when the %ABORT statement executes successfully. | This error is expected when the %ABORT statement is executed. |

**Error: The MSTORED option must be set to use the /SOURCE macro statement option.**

| Cause | Solution |
|---|---|
| The /SOURCE option is used in the %MACRO statement and the MSTORED system option has not been used. | The MSTORED and SASMSTORE= system options must be used in order to use the stored compiled macro facility. |

**Error: Extraneous text on %COPY statement ignored.**

| Cause | Solution |
|---|---|
| Text that comes after the slash (/) in the %COPY statement is not a valid option. | Valid options for the %COPY statement are:<br>`LIBRARY= \| LIB=`<br>`OUTFILE= \| OUT=` |

**Error: The syntax for this %COPY statement option is /LIBRARY = libref.**

| Cause | Solution |
|---|---|
| The equal sign (=) that should follow the LIBRARY option is omitted. | The following is the correct syntax for the LIBRARY= option:<br>/library=*valid-libref* |

**Error: The syntax for this %COPY statement option is /OUTFILE = <fileref> \| "filename".**

| Cause | Solution |
|---|---|
| The equal sign (=) that should follow OUTFILE is omitted. | The following is the correct syntax for the OUTFILE= option:<br>`/outfile=`*`fileref`*`\|`*`'external file name'`* |

**Error: This combination of default and specified %COPY statement options is not supported.**

| Cause | Solution |
|---|---|
| At least one option is listed in the %COPY statement, but the SOURCE option is omitted. | The SOURCE option must be listed if using the %COPY statement. |

**Error: Macro *value* not found in libref *value*.**

| Cause | Solution |
|---|---|
| The macro listed in the %COPY statement is not found in the libref listed on the LIBRARY= option. | Ensure that the macro listed in the %COPY statement is stored in the Sasmacr.sas7bcat catalog located in the library referenced by the SASMSTORE= system option. |

**Error: The /SOURCE option was not specified when the macro *value* was compiled.**

| Cause | Solution |
|---|---|
| The macro listed in the %COPY statement was not compiled with the SOURCE option set. | Only stored compiled macros that were compiled with the SOURCE option can be listed in the %COPY statement. |

**Error: An error occurred during the execution of the %COPY statement.**

| Cause | Solution |
|---|---|
| This error message follows any syntax error that is generated by the %COPY statement. | The following is the correct syntax for the %COPY statement:<br>`%copy macro-name /<option-1 <option-2> ...> source` |

**Error: Invalid or missing macro name specified in the %COPY statement, *value*.**

| Cause | Solution |
|---|---|
| The macro name is omitted or the macro name is not a valid macro name. | Ensure that the macro name listed in the %COPY statement exists in the Sasmacr.sas7bcat catalog located in the library referenced by the SASMSTORE= option. |

**Error: The /SOURCE option cannot be used on a macro definition enclosed within another macro.**

| Cause | Solution |
|---|---|
| A macro definition nested within another macro definition has the SOURCE option listed in addition to the STORE option. | A nested macro definition cannot be defined as a stored compiled macro. Nested macro definitions are not recommended because of the decrease in efficiency. |

**Error: The /SOURCE option cannot be used without the /STORE option.**

| Cause | Solution |
|---|---|
| The SOURCE option is listed without listing the STORE option. | The SOURCE option is valid only with the STORE option. |

**Error: Conflicting use of /SECURE and /NOSECURE options.**

| Cause | Solution |
|---|---|
| The SECURE and NOSECURE options are listed simultaneously in the %MACRO statement. | Specify only the SECURE option or the NOSECURE option in the %MACRO statement. |

**Error: The /MINDELIMITER= option must be a single character enclosed in single quotation marks.**

| Cause | Solution |
|---|---|
| More than one character is listed as the delimiter. | Only one character can be listed as the delimiter. |
| The value for the MINDELIMITER= option is listed within double quotation marks. | The character must be within single quotation marks. |

**Error: The /MINDELIMITER= option can only be specified once.**

| Cause | Solution |
|---|---|
| The MINDELIMITER= option is listed more than once in the %MACRO statement. | Only one delimiter can be used. The MINDELIMITER= option can be specified only once. |

**Error: Attempt to define more than one parameter with same name: *value*.**

| Cause | Solution |
|---|---|
| An attempt was made to list multiple parameters with the same name. | Each macro parameter must have a unique name. |

**Error: Execution canceled by an %ABORT CANCEL statement.**

| Cause | Solution |
|---|---|
| This error message is generated when the %ABORT statement is executed. | This error message simply indicates that the %ABORT statement executed. |

**Error: Execution canceled by an %ABORT CANCEL FILE statement.**

| Cause | Solution |
|---|---|
| The %ABORT CANCEL statement is executed and the FILE option is specified. | This error message simply indicates that the %ABORT CANCEL statement executed and that the FILE option has been specified. |

**Error: Attempt to %LOCAL automatic macro variable *value*.**

| Cause | Solution |
|---|---|
| A macro variable defined by SAS is listed in the %LOCAL statement. | List only user-defined macro variables in the %LOCAL statement. |

**Error: Attempt to %GLOBAL automatic macro variable *value*.**

| Cause | Solution |
|---|---|
| A macro variable defined by SAS is listed in the %GLOBAL statement. | List only user-defined macro variables in the %GLOBAL statement. |

**Error: Conflicting use of /MINOPERATOR and /NOMINOPERATOR options.**

| Cause | Solution |
|---|---|
| The MINOPERATOR and NOMINOPERATOR options are listed on the same %MACRO statement. | List only the MINOPERATOR option in the %MACRO statement if the macro IN operator is going to be used within the macro that is being defined. List only the NOMINOPERATOR option if the MINOPERATOR system option has been set. The macro IN operator should not be available in the macro that is being defined. |

**Error: Attempt to execute the /SECURE macro *value* within a %PUT statement.**

| Cause | Solution |
|---|---|
| A macro defined with the SECURE option is invoked in a %PUT statement. | A macro defined with the SECURE option cannot be executed in a %PUT statement. |

**Error: The macro *value* is still executing and cannot be redefined.**

| Cause | Solution |
|---|---|
| If a macro is invoked and a parameter has an open parenthesis with no closing parenthesis, then the macro processor looks for the closing parenthesis. If an attempt is made to invoke the same macro, this error is issued. | The macro parameter list must have an open and close parentheses. |

**Error: The value supplied for assignment to the numeric automatic macro variable SYSCC was out of range or could not be converted to a numeric value.**

| Cause | Solution |
|---|---|
| An attempt was made to use a value of 9999999999 or greater for the SYSCC automatic macro variable. | The value for the SYSCC automatic macro variable must be less than 9999999999. |

**Error: The variable *value* was previously declared and cannot be made READONLY.**

| Cause | Solution |
|---|---|
| An attempt was made to list an existing macro variable on a %GLOBAL or %LOCAL statement with the READONLY option specified. | An existing macro variable cannot be redefined as read-only. A new macro variable must be created. |

**Error: The variable *value* was declared READONLY and cannot be modified or re-declared.**

| Cause | Solution |
|---|---|
| An attempt was made to redefine a macro variable that was created with the READONLY option on a %GLOBAL or %LOCAL statement. | A read-only macro variable cannot be redefined. |

**Error: The variable *value* was declared READONLY and cannot be deleted.**

| Cause | Solution |
|---|---|
| A macro variable defined as read-only has been listed in the %SYMDEL statement. | Read-only macro variables cannot be deleted using the %SYMDEL statement. |

**Error: The variable *value* was previously declared as READONLY and cannot be re-declared.**

| Cause | Solution |
|---|---|
| An attempt was made to redefine a macro variable that was initialized with the READONLY option on a %GLOBAL or %LOCAL statement for a second time. | A macro variable can be defined only once on a %GLOBAL or %LOCAL statement when using the READONLY option. |

# SAS Macro Warning Messages

This section contains warning messages that might be reported when using macros and the solutions to correct them . If you are unable to resolve the warning, then contact SAS Technical Support.

**WARNING: Apparent symbolic reference *value* not resolved.**

| Cause | Solution |
|---|---|
| A macro variable is being referenced but cannot be found. | Define the macro variable before resolution. |
| A macro variable was spelled incorrectly. | Verify the spelling of the macro variable. |
| A local macro variable to a specific macro is being used globally outside the macro. | Add the macro variable to a %GLOBAL statement, or if you are using CALL SYMPUT, then use CALL SYMPUTX with the third argument as **'g'**, for example,<br>`call symputx('macro_variable', symbolic_reference_value,'g');` |
| A macro variable is being used in the same step as a CALL SYMPUT routine. | A step boundary such as a RUN statement must be reached before resolving the macro variable created with CALL SYMPUT. |

| Cause | Solution |
|---|---|
| The macro resolution occurred within a macro when the macro variable was created with a CALL SYMPUT routine or the INTO clause. The macro is being invoked with a CALL EXECUTE routine. | Place the %NRSTR function around the macro invocation, for example,<br>`call execute('%nrstr(%macro_name ('||variable1||'))');`<br>This delays the resolution. |
| You have omitted the period delimiter when adding text to the end of the macro variable. | When text follows a macro variable a period is needed after the macro variable name, for example,<br>`%let var=abc;`<br>`%put &var.def;`<br>This code resolves to **abcdef**. |

**WARNING: Apparent invocation of macro *value* not resolved.**

| Cause | Solution |
|---|---|
| You have misspelled the macro name. | Verify the spelling of the macro name. |
| The MAUTOSOURCE system option is turned off. | If invoking an autocall macro, then the MAUTOSOURCE system option must be turned on. |
| The MAUTOSOURCE system option is on, but you have specified an incorrect pathname in the SASAUTOS= system option. | The SASAUTOS= system option must contain the exact path for the location of the macro. |
| You are using the autocall facility but you do not have permission to the path on the SASAUTOS= system option. | Ensure that you have Read or Write access to the directory. |
| You are using the autocall facility but you have given different names for the macro name and the filename. | When using autocall macros, the macro name must match the filename exactly. |
| You are using the autocall facility but did not give the file a .sas extension. | When using autocall macros, the file that contains the macro must have the .sas extension. |
| You are using the autocall facility but the filename contains mixed case. | When using autocall macros, on Linux the filename must be all lowercase letters. |
| The macro has not been compiled. | The definition of a macro must be compiled before the invocation of a macro. |

**Warning: Extraneous text on %MEND statement ignored for macro definition *value*.**

| Cause | Solution |
|---|---|
| The name in the %MEND statement does not match the name in the %MACRO statement. | The name in the %MEND statement and the %MACRO statement must match. |
| There is a missing semicolon in the %MEND statement. | The %MEND statement requires a semicolon to end the statement. |

**Warning: Argument *value* to macro function *value* is out of range.**

| Cause | Solution |
|---|---|
| The first **value** represents the position of the argument that is causing the problem. The second **value** represents the function that is being used. This argument is either less than or greater than the range allowed. | Ensure that the argument is within the range needed, for example,<br>`%put %scan(a b c,0);`<br>The value **0** is less than the range allowed.<br>`%put %substr(abc,4,1);`<br>The value **4** is greater than the length of the first argument. |

**Warning: Missing %MEND statement for macro *value*.**

| Cause | Solution |
|---|---|
| There is an unclosed comment that is causing the %MEND statement not to be seen. | In the comments, ensure that every **/*** has a matching ***/** and that every **%*** and ***** have a matching semicolon. If running interactively, you might need to restart your SAS session after fixing the problem or you might try running the following code:<br>`;*%mend;*);*';*";**/;run;` |
| There is a missing semicolon prior to the %MEND statement. | Ensure that each statement prior to the %MEND statement that requires a semicolon has one. |
| There is an unmatched quotation mark prior to the %MEND statement. | Ensure that every double quotation mark and single quotation mark have a matching quotation mark. |
| There is no %MEND statement. | Every %MACRO statement requires a matching %MEND statement. |

**Warning: Source level autocall is not found or cannot be opened. Autocall has been suspended and OPTION NOMAUTOSOURCE has been set. To use the autocall facility again, set OPTION MAUTOSOURCE.**

| Cause | Solution |
|---|---|
| All library specifications on the SASAUTOS= system option are invalid or do not exist. | Ensure that the locations on the SASAUTOS= system option are valid and exist. Use the MAUTOSOURCE system option and the MRECALL system option. |

**Warning: The argument to macro function %SYSGET is not defined as a system variable.**

| Cause | Solution |
|---|---|
| The value used within the %SYSGET function is not recognized as a valid environment variable. | Check the spelling and ensure that the value is a valid environment variable on your operating system. |
| Quotation marks were used around the value being passed to the %SYSGET function. | Remove the quotation marks. They are not needed within a macro function. |

**Warning: The RESOLVE function is disabled by the NOMACRO option.**

| Cause | Solution |
|---|---|
| The NOMACRO option has been set at invocation time. | To use any part of the macro facility the MACRO option must be set at SAS invocation. |

**Warning: The *value*. SASMACR catalog is opened for read only.**

| Cause | Solution |
|---|---|
| **value** represents the libref that is associated with the SASMACR catalog. The SASMSTORE= system option is pointing to a libref where the SASMACR catalog has been set with read-only attributes. | In SAS 9.1.3 Service Pack 2 or higher, the stored compiled macro catalog is initially opened for Read-Only access. When a session first attempts to execute a stored compiled macro, the library is opened with no lock. The library remains in that state until the session either ends or attempts to add or update a macro. Therefore, the warning above is no longer generated. Prior to SAS 9.1.3 you need to use system commands to set Write access to the Sasmacr catalog to avoid this warning. |

**Warning: Argument *value* to function *value* referenced by the %SYSFUNC or %QSYSFUNC macro function is out of range.**

| Cause | Solution |
|---|---|
| The first **value** represents the position of the argument causing the problem. The second **value** represents the function that is used. This argument is either less than or greater than the range allowed. | Ensure that the argument is within the range needed, for example,<br>`%put %sysfunc(scan(a b c,0));`<br>The value **0** is less than the range allowed.<br>`%put %sysfunc(substr(abc,4,1));`<br>The value **4** is greater than the length of the first argument. |

**Warning: Missing semicolon between %THEN clause and *value* has been assumed.**

| Cause | Solution |
|---|---|
| The action following the %THEN statement is missing a semicolon. | Add a semicolon following the action for the %THEN statement, for example,<br>`%let var=;`<br>`%macro test;`<br>`%if 1=1 %then &var` ← missing semicolon<br>`%mend test;` |

**Warning: Attempt to delete macro variable *value* failed. Variable not found.**

| Cause | Solution |
|---|---|
| The macro variable referenced in a %SYMDEL statement does not exist. | Add the NOWARN option to the %SYMDEL statement, for example,<br>`%symdel aa / nowarn;` |
| The macro variable referenced in a %SYMDEL statement started with an ampersand. | The %SYMDEL statement requires the macro variable name without the ampersand. |

**Warning: Extraneous text on %SYMDEL statement ignored.**

| Cause | Solution |
|---|---|
| There is text following the forward slash in the %SYMDEL statement. | Only the NOWARN argument is valid following the forward slash. |

**Warning: Extraneous text in second argument to SYMDEL routine ignored.**

| Cause | Solution |
|---|---|
| There is text following the comma that does not equal the NOWARN argument. | Only the NOWARN argument is valid as the second argument following the comma. |

**Warning: The macro *value* was compiled with the SAS System *value*. The current version of the SAS System is *value*. The macro might not execute correctly. To avoid this message, recompile the macro with the *value* version of the SAS System.**

| Cause | Solution |
|---|---|
| A macro is being invoked on a release of SAS other than the release of SAS where it was compiled. | Move macro source code to new SAS release and compile. |
| The SASMACR catalog has been moved to a different operating system or release of SAS. | Stored compiled macros cannot be moved from one operating system to another or from one SAS release to another. The source code for the macros contained within the SASMACR catalog needs to be moved to the new location and compiled. |

**Warning: The text expression *value* contains a recursive reference to the macro variable *value*. The macro variable will be assigned the null value.**

| Cause | Solution |
|---|---|
| A macro variable is being set to itself where the original macro variable did not exist, for example,<br>`%let a=&a;`<br>If **&a** did not exist prior to this %LET statement, then the warning will be generated. | Ensure that the macro variable exists before setting it back to itself, for example,<br>`%global a;`<br>`%let a=&a;` |

**Warning: Extraneous text on %SYSMSTORECLEAR statement ignored.**

| Cause | Solution |
|---|---|
| There is text following the %SYSMSTORECLEAR statement. | Remove the text, nothing should fall between the %SYSMSTORECLEAR statement and the semicolon. |

**Warning: Extraneous argument text on %SYSMACDELETE call ignored: *value*.**

| Cause | Solution |
|---|---|
| There is text following the forward slash that does not equal the NOWARN argument. | Only the NOWARN argument is valid following the forward slash. |
| The macro name in the %SYSMACDELETE statement begins with a percent sign. | The %SYSMACDELETE statement requires the macro name without the percent sign. |

**Warning: The MCOVERAGE option was set, but no MCOVERAGELOC= was specified.**

**Warning: Generation of coverage data has been suspended and OPTION NOCOVERAGE has been set. Any fileref used in the MCOVERAGELOC option has been deassigned. To generate coverage data again, set OPTIONS MCOVERAGE and MCOVERAGELOC.**

| Cause | Solution |
|---|---|
| The MCOVERAGE system option has been set but no location has been specified on the MCOVERAGELOC= system option. | A valid location must be placed on the MCOVERAGELOC= system option. The MCOVERAGE system option must be specified again. |
| The MCOVERAGELOC= system option is pointing to a location that does not exist. | Ensure that the path on the MCOVERAGELOC= system option exists and is valid. The MCOVERAGE system option must be specified again. |

**Warning: Attempt to delete macro definition for *value* failed. Macro definition not found.**

| Cause | Solution |
|---|---|
| The macro name specified in the %SYSMACDELETE statement does not exist. | Add the NOWARN argument to the %SYSMACDELETE statement, for example,<br>`%sysmacdelete abc / nowarn;` |

**Warning: The macro *value* was compiled with ENCODING=*value*, this session is running with ENCODING=*value*.**

| Cause | Solution |
|---|---|
| The macro being invoked was compiled on a system with a different setting of the ENCODING= system option than the machine where the macro is being invoked. | Ensure that the ENCODING= system option is set to the same system as the system where the macro was compiled. |

*Appendix 3*

# SAS Tokens

**SAS Tokens** . . . . . **407**
**List of Tokens** . . . . . **407**

## SAS Tokens

When SAS processes a program, a component called the word scanner reads the program, character by character, and groups the characters into words. These words are referred to as tokens.

## List of Tokens

SAS recognizes four general types of tokens:

Literal
: One or more characters enclosed in single or double quotation marks. Examples of literals include the following:

***Table A3.1*** *Literals*

| | |
|---|---|
| 'CARY' | "2008" |
| 'Dr. Kemple-Long' | '<entry align="center">' |

Name
: One or more characters beginning with a letter or an underscore. Other characters can be letters, underscores, and digits.

***Table A3.2*** *Names*

| | | |
|---|---|---|
| data | _test | linesleft |
| f25 | univariate | otherwise |

| | |
|---|---|
| year_2008 | descending |

Number
A numeric value. Number tokens include the following:

- integers. Integers are numbers that do not contain a decimal point or an exponent. Examples of integers include 1, 72, and 5000. SAS date, time, and datetime constants such as '24AUG2008'D are integers, as are hexadecimal constants such as 0C4X.
- real (floating-point) numbers. Floating-point numbers contain a decimal point or an exponent. Examples include numbers such as 2.35, 5., 2.3E1, and 5.4E− 1.

Special character
Any character that is not a letter, number, or underscore. The following characters are some special characters:

= + − % & ; ( ) #

The maximum length of any type of token is 32,767 characters. A token ends when the tokenizer encounters one of the following situations:

- the beginning of a new token.
- a blank after a name or number token.
- in a literal token, a quotation mark of the same type that started the token. There is an exception. A quotation mark followed by a quotation mark of the same type is interpreted as a single quotation mark that becomes part of the literal token. For example, in **`'Mary''s'`**, the fourth quotation mark terminates the literal token. The second and third quotation marks are interpreted as a single character, which is included in the literal token.

*Appendix 4*

# Syntax for Selected Functions Used with the %SYSFUNC Function

**Summary Descriptions and Syntax** . . . . . 409
**Functions and Arguments for %SYSFUNC** . . . . . 409

## Summary Descriptions and Syntax

This appendix provides summary descriptions and syntax for selected functions that can be used with the %SYSFUNC function.

## Functions and Arguments for %SYSFUNC

The following table shows the syntax for selected functions that can be used with the %SYSFUNC function. This is not a complete list of the functions that can be used with %SYSFUNC. For a list of functions that cannot be used with %SYSFUNC, see Table 17.2 on page 275.

***Table A4.1*** *Functions and Arguments for %SYSFUNC*

| Function | Description and Syntax |
|---|---|
| ATTRC | Returns the value of a character attribute for a SAS data set.<br>**%SYSFUNC(ATTRC(*data-set-id,attr-name*))** |
| ATTRN | Returns the value of a numeric attribute for specified SAS data set.<br>**%SYSFUNC(ATTRN(*data-set_id,attr-name*))** |
| CEXIST | Verifies the existence of a SAS catalog or SAS catalog entry.<br>**%SYSFUNC(CEXIST(*entry <, U>*))** |
| CLOSE | Closes a SAS data set.**%SYSFUNC(CLOSE(*data-set-id*))** |
| CUROBS | Returns the number of the current observation.<br>**%SYSFUNC(CUROBS(*data-set-id*))** |

| Function | Description and Syntax |
|---|---|
| DCLOSE | Closes a directory.**%SYSFUNC(DCLOSE(*directory-id*))** |
| DINFO | Returns specified information items for a directory. **%SYSFUNC(DINFO(*directory-id,info-items*))** |
| DNUM | Returns the number of members in a directory. **%SYSFUNC(DNUM(*directory-id*))** |
| DOPEN | Opens a directory.**%SYSFUNC(DOPEN(*fileref*))** |
| DOPTNAME | Returns a specified directory attribute. **%SYSFUNC(DOPTNAME(*directory-id,nval*))** |
| DOPTNUM | Returns the number of information items available for a directory. **%SYSFUNC(DOPTNUM(*directory-id*))** |
| DREAD | Returns the name of a directory member. **%SYSFUNC(DREAD(*directory-id,nval*))** |
| DROPNOTE | Deletes a note marker from a SAS data set or an external file. **%SYSFUNC(DROPNOTE(*data-set-id* \| *file-id,note-id*))** |
| DSNAME | Returns the data set name associated with a data set identifier. **%SYSFUNC(DSNAME(<*data-set-id*>))** |
| EXIST | Verifies the existence of a SAS library member. **%SYSFUNC(EXIST(*member-name*<,*member-type*>))** |
| FAPPEND | Appends a record to the end of an external file. **%SYSFUNC(FAPPEND(*file-id*<,*cc*>))** |
| FCLOSE | Closes an external file, directory, or directory member. **%SYSFUNC(FCLOSE(*file-id*))** |
| FCOL | Returns the current column position in the File Data Buffer (FDB) **%SYSFUNC(FCOL(*file-id*))** |
| FDELETE | Deletes an external file. **%SYSFUNC(FDELETE(*fileref*))** |
| FETCH | Reads the next nondeleted observation from a SAS data set into the Data Set Data Vector (DDV). **%SYSFUNC(FETCH(*data-set-id*<,NOSET>))** |
| FETCHOBS | Reads a specified observation from a SAS data set into the DDV. **%SYSFUNC(FETCHOBS(*data-set-id,obs-number*<,*options*>))** |
| FEXIST | Verifies the existence of an external file associated with a fileref. **%SYSFUNC(FEXIST(*fileref*))** |

| Function | Description and Syntax |
|---|---|
| FGET | Copies data from the FDB. **%SYSFUNC(FGET(*file-id,cval<,length>*))** |
| FILEEXIST | Verifies the existence of an external file by its physical name. **%SYSFUNC(FILEEXIST(*file-name*))** |
| FILENAME | Assigns or deassigns a fileref for an external file, directory, or output device. **%SYSFUNC(FILENAME(*fileref,file-name<,device<,host-options<,dir-ref>>>*))** |
| FILEREF | Verifies that a fileref has been assigned for the current SAS session. **%SYSFUNC(FILEREF(*fileref*))** |
| FINFO | Returns a specified information item for a file. **%SYSFUNC(FINFO(*file-id,info-item*))** |
| FNOTE | Identifies the last record that was read. **%SYSFUNC(FNOTE(*file-id*))** |
| FOPEN | Opens an external file. **%SYSFUNC(FOPEN(*fileref<,open-mode<,record-length<,record-format>>>*))** |
| FOPTNAME | Returns the name of an information item for an external file. **%SYSFUNC(FOPTNAME(*file-id,nval*))** |
| FOPTNUM | Returns the number of information items available for an external file. **%SYSFUNC(FOPTNUM(*file-id*))** |
| FPOINT | Positions the read pointer on the next record to be read. **%SYSFUNC(FPOINT(*file-id,note-id*))** |
| FPOS | Sets the position of the column pointer in the FDB. **%SYSFUNC(FPOS(*file-id,nval*))** |
| FPUT | Moves data to the FDB of an external file starting at the current column position. **%SYSFUNC(FPUT(*file-id,cval*))** |
| FREAD | Reads a record from an external file into the FDB. **%SYSFUNC(FREAD(*file-id*))** |
| FREWIND | Positions the file pointer at the first record. **%SYSFUNC(FREWIND(*file-id*))** |
| FRLEN | Returns the size of the last record read, or the current record size for a file opened for output. **%SYSFUNC(FRLEN(*file-id*))** |
| FSEP | Sets the token delimiters for the FGET function. **%SYSFUNC(FSEP(*file-id,cval*))** |
| FWRITE | Writes a record to an external file. **%SYSFUNC(FWRITE(*file-id<,cc>*))** |

| Function | Description and Syntax |
|---|---|
| GETOPTION | Returns the value of a SAS system or graphics option. **%SYSFUNC(GETOPTION(*option-name*<,*reporting-options*<,...>>))** |
| GETVARC | Assigns the value of a SAS data set variable to a character DATA step or macro variable. **%SYSFUNC(GETVARC(*data-set-id*,*var-num*))** |
| GETVARN | Assigns the value of a SAS data set variable to a numeric DATA step or macro variable. **%SYSFUNC(GETVARN(*data-set-id*,*var-num*))** |
| LIBNAME | Assigns or deassigns a libref for a SAS library. **%SYSFUNC(LIBNAME(*libref*<,*SAS-data-library*<,*engine*<,*options*>>>))** |
| LIBREF | Verifies that a libref has been assigned. **%SYSFUNC(LIBREF(*libref*))** |
| MOPEN | Opens a directory member file. **%SYSFUNC(MOPEN(*directory-id*,*member-name*<*open-mode*<,*record-length*<,*record-format*>>>))** |
| NOTE | Returns an observation ID for current observation of a SAS data set. **%SYSFUNC(NOTE(*data-set-id*))** |
| OPEN | Opens a SAS data file. **%SYSFUNC(OPEN(<*data-file-name*<,*mode*>>))** |
| PATHNAME | Returns the physical name of a SAS library or an external file. **%SYSFUNC(PATHNAME(*fileref*))** |
| POINT | Locates an observation identified by the NOTE function. **%SYSFUNC(POINT(*data-set-id*,*note-id*))** |
| REWIND | Positions the data set pointer to the beginning of a SAS data set. **%SYSFUNC(REWIND(*data-set-id*))** |
| SPEDIS | Returns a number for the operation required to change an incorrect keyword in a WHERE clause to a correct keyword. **%SYSFUNC(SPEDIS(*query*,*keyword*))** |
| SYSGET | Returns the value of the specified host environment variable. **%SYSFUNC(sysget(*host-variable*))** |
| SYSMSG | Returns the error or warning message produced by the last function that attempted to access a data set or external file. **%SYSFUNC(SYSMSG())** |
| SYSRC | Returns the system error number or exit status of the entry most recently called. **%SYSFUNC(SYSRC())** |

| Function | Description and Syntax |
|---|---|
| VARFMT | Returns the format assigned to a data set variable.<br>**%SYSFUNC(VARFMT(*data-set-id*,*var-num*))** |
| VARINFMT | Returns the informat assigned to a data set variable.<br>**%SYSFUNC(VARINFMT(*data-set-id*,*var-num*))** |
| VARLABEL | Returns the label assigned to a data set variable.<br>**%SYSFUNC(VARLABEL(*data-set-id*,*var-num*))** |
| VARLEN | Returns the length of a data set variable.<br>**%SYSFUNC(VARLEN(*data-set-id*,*var-num*))** |
| VARNAME | Returns the name of a data set variable.<br>**%SYSFUNC(VARNAME(*data-set-id*,*var-num*))** |
| VARNUM | Returns the number of a data set variable.<br>**%SYSFUNC(VARNUM(*data-set-id*,*var-name*))** |
| VARTYPE | Returns the data type of a data set variable.<br>**%SYSFUNC(VARTYPE(*data-set-id*,*var-num*))** |

*Appendix 5*

# Using the Macro Facility with the Linux Operating Environment

**Automatic Macro Variables in Linux Environments** . . . . . **415**

**Macro Functions in Linux Environments** . . . . . **416**

**SAS System Options Used by the Macro Facility in Linux Environments** . . . . . **417**

**Using Autocall Libraries in Linux Operating Environment** . . . . . **417**
What Is an Autocall Library? . . . . . 417
Available Autocall Macros . . . . . 417
Guidelines for Naming Macro Files . . . . . 417
The SASAUTOS System Option . . . . . 418
Example: Setting Up and Testing a Macro in an Autocall Library . . . . . 418

## Automatic Macro Variables in Linux Environments

The following automatic macro variables are valid in all operating environments, but their values are determined by the operating environment:

SYSCC
contains the current SAS condition code. Upon exit, SAS translates this condition code to a return code that has a meaningful value for the operating environment.

*Note:* The value of SYSCC might not match the return code returned by the operating system.

Under Linux, the following codes can be returned:

0
Normal completion

1
SAS issued warnings

2
SAS issued errors

3
ABORT;

4
ABORT RETURN *n*;

5
ABORT ABEND *n*;

6
Internal error

*Note:* When ERRORCHECK=NORMAL, the return code is 0, even if an error exists in a LIBNAME or FILENAME statement, or in a LOCK statement in SAS/SHARE software. Also, the SAS job or session does not end abnormally when the %INCLUDE statement fails due to a nonexistent file. For more information, see the "ERRORCHECK= System Option" in *SAS Viya System Options: Reference*.

SYSDEVIC
Obsolete

SYSENV
reports whether SAS is running interactively. Values for SYSENV are **FORE** when the TERMINAL system option is in effect, and **BACK** when the NOTERMINAL system option is in effect.

*Note:* NOTERMINAL system option is the default for batch and line mode versions of SAS Viya.

SYSJOBID
lists the process identification number (PID) of the process that is executing SAS (for example, 00024).

SYSMAXLONG
returns the maximum long integer value allowed under Linux, which is 9,007,199,254,740,992. On 32-bit systems, the maximum is 2,147,483,647.

SYSRC
Obsolete

SYSSCP
returns the abbreviation for your processor architecture, such as **LAX 64**.

SYSSCPL
returns the name of the specific Linux environment that you are using, such as **Linux**. This variable returns the same value that is returned by the Linux command **uname**.

## Macro Functions in Linux Environments

The following functions have operating environment dependencies:

%SCAN
searches for a word that is specified by its position in a string. Here is the form of the %SCAN function:

**%SCAN**(*argument*,*n*,<*delimiters*>);
On ASCII systems, the default delimiters are the following: **blank . < ( + & ! $ * ) ; ^ - / , % |**

%SYSGET
returns the character string that is the value of the environment variable passed as the argument. Both Linux and SAS environment variables can be translated using the

%SYSGET function. A warning message is written if the global variable does not exist. Here is the form of the %SYSGET function:

**%SYSGET**(*environment-variable*);

For example, the following code writes the value of the HOME environment variable to the SAS log: `%let var1=%sysget(HOME); %put &var1;`

# SAS System Options Used by the Macro Facility in Linux Environments

The following system options have operating environment dependencies:

MSYMTABMAX
specifies the maximum amount of memory available to all symbol tables (global and local, combined). Under Linux, the default value for this option is 4M.

MVARSIZE
specifies the maximum number of bytes for any macro variable stored in memory. The default value for this option became 65534.

SASAUTOS
specifies the AUTOCALL library. For more information, see "The SASAUTOS System Option" on page 418.

# Using Autocall Libraries in Linux Operating Environment

## *What Is an Autocall Library?*

An autocall library contains files that define SAS macros. The following sections discuss aspects of autocall libraries that are dependent on the operating environment.

## *Available Autocall Macros*

There are two types of autocall macros, those macros that are provided by SAS, and those macros that you define yourself. To use the autocall facility, you must have the MAUTOSOURCE system option set.

When SAS is installed, the SASAUTOS system option is defined in the configuration file to refer to the location of the default macros supplied by SAS. The products licensed at your site determine the autocall macros that you have available. You can also define your own autocall macros and store them in one or more directories. SAS does not recognize autocall macros if their filenames are written in uppercase or in mixed case. Use only filenames that are lowercase.

## *Guidelines for Naming Macro Files*

Macro names in SAS are case insensitive, but they all map to a lowercase filename. If you store autocall macros in a Linux directory, the file extension must be .sas, and the

filename must be entirely in lowercase. In the Linux environment, each macro file in the directory must contain a macro definition with a macro name that matches the filename. For example, a file named prtdata.sas should define a macro named prtdata.

### The SASAUTOS System Option

To use your own autocall macros in your SAS program, specify their directories with the SASAUTOS system option.

*Note:* The SASAUTOS system option under Linux does not recognize filenames that are in uppercase or mixed case.

You can set the SASAUTOS system option when you start SAS, or you can use it in an OPTIONS statement during your SAS session. However, autocall libraries specified with the OPTIONS statement override any previous specification.

If you use the CONFIG system option to specify a configuration file, add your autocall library to the library concatenation supplied by SAS. If you use the default configuration files (sasv9.cfg), specify your autocall library there.

Autocall libraries are searched in the order in which you specify them.

### Example: Setting Up and Testing a Macro in an Autocall Library

This example shows how to set up and test a macro in an autocall library.

The following output shows the results of executing two Linux (cat) commands to display the contents of two files, and a SAS command to run the autocall.sas program:

```
$ cat maclib/testauto.sas
%macro testauto;
x echo 'Autocall library is working.';
%mend testauto;
$ cat source/autocall.sas
filename sysautos ('!SASROOT/sasautos' '$HOME/test/sasautos');
options mautosource sasautos=(sysautos '$HOME/macros/maclib');
%testauto
%TestAuto
%TESTAUTO
$ sas source/autocall.sas
Autocall library is working.
Autocall library is working.
Autocall library is working.
```

# Recommended Reading

Here is the recommended reading list for this title:

- *SAS Viya Data Management and Utility Procedures Guide*
- *SAS Viya Functions and CALL Routines: Reference*
- *Carpenter's Complete Guide to the SAS Macro Language*
- *SAS Macro Language Magic: Discovering Advanced Techniques*
- *SAS Macro Programming Made Easy*

For a complete list of SAS publications, go to sas.com/store/books. If you have questions about which titles you need, please contact a SAS Representative:

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# Glossary

**autocall facility**
a feature of SAS that enables you to store the source statements that define a macro and to invoke the macro as needed, without having to include the definition in your program.

**autocall macro**
a macro whose uncompiled source code and text are stored in an autocall macro library. Unlike a stored compiled macro, an autocall macro is compiled before execution the first time it is called.

**command-style macro**
a macro that is defined with the CMD option in the %MACRO statement.

**constant text (model text)**
the character strings that are stored as part of a macro or as a macro variable's value in open code, from which the macro processor generates text to be used as SAS statements or other macro program statements.

**dummy macro**
a macro that the macro processor compiles but does not store.

**global macro variable**
a macro variable that can be referenced in either global or local scope in a SAS program, except where there is a local macro variable that has the same name. A global macro variable exists until the end of the session or program.

**global scope**
in SAS macro programming, indicates broad context boundaries for referencing global macro variables anywhere within the current SAS session or SAS batch program.

**input stack**
the most recently read line of input from a SAS program and any text generated by the macro processor that is awaiting processing by the word scanner.

**keyword parameter**
a type of macro parameter that is identified by its name, followed by an equal sign. Multiple keyword parameters can be provided in any order, and must follow any positional parameters.

**local macro variable**
a macro variable that is available only within the macro in which it was created and within macros that are invoked from within that macro. A local macro variable ceases to exist when the macro that created it stops executing.

**local scope**
in SAS macro programming, indicates narrowed context boundaries for referencing local macro variables within the current macro.

**logical expression**
a type of macro expression that consists of a sequence of logical operators and operands. A logical expression returns a value of either true or false when it is executed.

**macro**
a SAS catalog entry that contains a group of compiled program statements and stored text.

**macro call (macro invocation)**
a statement that invokes a stored compiled macro program.

**macro compilation**
the process of converting a macro definition from the statements that you enter to a form that is ready for the macro processor to execute. The compiled macro is then stored for later use in the SAS program or session.

**macro execution**
the process of following the instructions that are given by compiled macro program statements in order to generate text, to write messages to the SAS log, to accept input, to create or change the values of macro variables, or to perform other activities. The generated text can be a SAS statement, a SAS command, or another macro program statement.

**macro expression**
any valid combination of symbols that returns a value when it is executed. The three types of macro expressions are text, logical, and arithmetic. A text expression generates text when it is resolved (executed) and can consist of any combination of text, macro variables, macro functions, and macro calls. A logical expression consists of logical operators and operands and returns a value of either true or false. An arithmetic expression consists of arithmetic operators and operands and returns a numeric value.

**macro facility**
a component of SAS software that you can use for extending and customizing SAS programs and for reducing the amount of text that must be entered in order to perform common tasks. The macro facility consists of the macro processor and the macro programming language.

**macro function**
a function that is defined by the macro facility. Each macro function processes one or more arguments and produces a result.

**macro invocation**
a statement that invokes a stored compiled macro program.

**macro language**
the programming language that is used to communicate with the macro processor.

**macro parameter**
a local macro variable that is defined within parentheses in a %MACRO statement. You supply values to a macro parameter when you invoke a macro.

**macro processor**
the component of SAS software that compiles and executes macros and macro program statements.

**macro quoting**
a function that tells the macro processor to interpret special characters and mnemonics as text rather than as part of the macro language.

**macro variable (symbolic variable)**
a variable that is part of the SAS macro programming language. The value of a macro variable is a string that remains constant until you change it.

**macro variable reference**
a string that contains the name of a macro variable that is referenced in order to substitute a value that is located or defined elsewhere.

**model text**
the character strings that are stored as part of a macro or as a macro variable's value in open code, from which the macro processor generates text to be used as SAS statements or other macro program statements.

**name-style macro**
a macro that is named and defined with the %MACRO statement.

**null value**
a special value that indicates the absence of information. Null values are analogous to SAS missing values.

**open code**
the part of a SAS program that is outside any macro definition.

**positional parameter**
a type of macro parameter that is named (using comma delimiters) in the %MACRO statement at invocation, and is defined in the corresponding position (again using comma delimiters) in the macro execution statement.

**quoting**
the process that causes the macro processor to read certain items as text rather than as symbols in the macro language. Quoting is also called removing the significance of an item and treating an item as text.

**quoting function**
a macro language function that performs quoting on its argument.

**reserved word**
a name that is reserved for use by an internal component of a software application and which therefore cannot be assigned by a user of that application to any type of data object.

**returned value**
a value that is the result of the execution of a function.

**SAS compilation**
the process of converting statements in the SAS language from the form in which you enter them to a form that is ready for SAS to use.

**SAS variable (variable)**
a column in a SAS data set or in a SAS data view. The data values for each variable describe a single characteristic for all observations (rows).

**session compiled macro**
a macro that the macro processor compiles and stores in a SAS catalog in the WORK library. These macros exist only during the current SAS session. Unlike stored compiled macros, session compiled macros cannot be called in any other SAS session.

**statement-style macro**
a macro that is defined with the STMT option in the %MACRO statement.

**stored compiled macro**
a macro program that was compiled in a previous session and which was stored in a permanent directory. Unlike session compiled macros, stored compiled macros can be called in any SAS program.

**symbol table**
the area in which the macro processor stores all macro variables and macro statement labels for a particular scope.

**symbolic substitution**
the process of resolving a macro variable reference (&variable-name)to its value.

**symbolic variable**
a variable that is part of the SAS macro programming language. The value of a macro variable is a string that remains constant until you change it.

**text expression**
a type of macro expression that generates text when it is resolved (executed). The text expression can include any combination of text, macro variables, macro functions, and macro calls.

**token**
in the SAS programming language, a collection of characters that communicates a meaning to SAS and that cannot be divided into smaller functional units. A token such as a variable name might look like an English word, but can also be a mathematical operator, or even an individual character such as a semicolon. A token can contain a maximum of 32,767 characters.

**tokenizer**
the part of the word scanner that divides input into tokens (also called words).

**unquoting**
the process of restoring the meaning of a quoted item.

**variable**
a column in a SAS data set or in a SAS data view. The data values for each variable describe a single characteristic for all observations (rows).

**word scanner**
the component of SAS that examines all tokens (words) in a SAS program and moves the tokens to the correct component of SAS for processing.

# Index


## Special Characters

/NOSECURE option
  error message 396
/SECURE option
  error message 396
/SOURCE option
  error message 395, 396
. (period)
  creating, to follow resolved text 32
. (period) delimiter 11
& (ampersand)
  indirect macro variable references and 34
& (ampersand) delimiter 4
% (percent sign)
  with %STR and %NRSTR functions 86
% (percent) delimiter 4
%* macro comment statement 294
%ABORT statement 292
  error message 393, 394, 397
%BQUOTE and %NRBQUOTE functions 250
%BQUOTE function 89
  examples 89
%BY statement
  error message 374
%CMPRES and %QCMPRES autocall macros 175
%COMPSTOR autocall macro 177
%COPY statement 296
  error message 394, 395
%DATATYP autocall macro 177
%DO %UNTIL loop
  error message 384
%DO %UNTIL statement 300
%DO %WHILE loop
  error message 383
%DO %WHILE statement 301
%DO groups
  ending 302
%DO loop
  error message 377, 379
%DO loops
  generating repetitive pieces of text 10
%DO statement 297
  error message 372, 374, 375, 377
%DO, iterative statement 298
%END statement 302
  error message 372
%EVAL function 251
  error message 367, 369, 371, 375, 378
%GLOBAL statement 303
  error message 372, 397
%GO
  error message 379
%GOTO statement 305
  destination of 310
  error message 372, 373, 379
%IF statement
  error message 369, 375
%IF-%THEN/%ELSE statement 306
%INCLUDE statement 4
%INDEX function 253
%INPUT statement 309
  text entered in response to 195
%KVERIFY autocall macro 178
%label statement 310
%LEFT autocall macro 179
%LENGTH function 254
%LET statement 311
  error message 388, 389
%LIST statement 4
%LOCAL statement 312
  error message 397
%LOWCASE and %QLOWCASE autocall macros 180
%MACRO statement 314
  error message 371
  PARMBUFF option 318
  SECURE option 319
  SOURCE option 318
  STORE option 319
  with positional parameters 317
%MEND statement 319
  error message 371
  warning message 400, 401
%NRBQUOTE function 89, 254
%NRQUOTE function 255

%NRSTR function 85, 255
examples 87
unmatched quotation marks and parentheses 86
%PUT statement 320
error message 398
tracking problems with 136
%QCMPRES autocall macro 181
%QLEFT autocall macro 181
%QLOWCASE autocall macro 182
%QSCAN function 255
%QSUBSTR function 256
%QSYSFUNC function 256
error message 385, 386, 388, 390
warning message 402
%QTRIM autocall macro 183
%QUOTE and %NRQUOTE functions 256
%QUPCASE function 258
%RETURN statement 323
%RUN statement 4
%SCAN and %QSCAN functions 258
%SCAN macro function 416
%STR and %NRSTR functions 262
%STR function 85
examples 87
percent signs with 86
unmatched quotation marks and parentheses 86
%SUBSTR and %QSUBSTR functions 265
%SUPERQ function 267
preventing warning messages 91
%SYMDEL statement 324
warning message 403
%SYMEXIST function 268
%SYMGLOBL function 269
%SYMLOCAL function 270
%SYSCALL statement 325
error message 386, 388, 390, 392
RANUNI CALL routine with 326
%SYSEVALF
error message 386
%SYSEVALF function 271
error message 387, 390
%SYSEXEC statement 326
%SYSFUNC and %QSYSFUNC functions 273
%SYSFUNC function
error message 385, 386, 388, 390
formatting values produced by 275
functions and arguments for 409
portable functions with 146
warning message 402
%SYSGET function 277, 278
warning message 402
%SYSGET macro function 416
%SYSLPUT statement 326
error message 392, 393
%SYSMACDELETE statement 327
warning message 404
%SYSMACEXEC function 278
%SYSMACEXIST function 279
%SYSMEXECDEPTH function 279
%SYSMEXECNAME function 281
%SYSMSTORECLEAR statement 328
warning message 404
%SYSPROD function 282
%SYSRC autocall macro 183
%SYSRPUT statement 328
checking return code values on remote host 109
error message 383, 388, 389
with SAS/CONNECT interfaces 109
%THEN statement
error message 378
warning message 403
%TO statement
error message 374
%TRIM and %QTRIM autocall macro 188
%UNQUOTE function 282
%UPCASE and %QUPCASE functions 283
%VERIFY autocall macro 190

## A

aborting macros 292
ampersand (&) delimiter 4
ampersands
indirect macro variable references and 34
arguments
left-aligning 179, 181
arithmetic expressions 71
defining 72
evaluating 72, 74
evaluating with floating-point arithmetic 271
evaluating with integer arithmetic 251
operands and operators 73
assigning macro variables 52
autocall facility 111
macro definition errors 129
naming macros and external files for 151
troubleshooting 128
autocall feature 336
autocall libraries 111, 112
catalogs as 113
directories as 113

location of 357
member names 113
on different hosts 112
saving macros in 112
searching for member not found earlier 353
specification errors 129
autocall macros 12, 167
calling 114
displaying source location in log 334
filenames for 130
list of 167
names for 130
required system options for 168
storing 116
storing centrally 144
supplied by SAS 116
automatic evaluation 155
automatic macro variables 12, 22, 162, 415
by category 23
defined by macro processor 22
displaying in log 322
host-specific values 147
list of 162
prefixes 162
read and write status of 22

**B**

batch jobs
name of 209
black hole problem 124
blanks
compressing multiple 175, 181
maintaining leading blanks 263
protecting from being compiled as text 264
removing from macro variables 235
removing leading and trailing 175, 179, 181
trimming trailing blanks 183, 188

**C**

CALL EXECUTE routine 227
example of common problem with 102
example of incorrect use 101
timing details 101
CALL routines
invoking 325
CALL SYMDEL routine 229
CALL SYMPUT routine 230
formatting rules for assigning character values 233
formatting rules for assigning numeric values 233
referencing a value before it is available 232
scope and 63, 232
with complete DATA step and empty local symbol table 68
with complete DATA step and nonempty local symbol table 64
with incomplete DATA step 66
with SYSPBUFF and empty local symbol table 69
CALL SYMPUTN routine 234
CALL SYMPUTX routine 235
calling autocall macros 114
calling macros 9, 37
calling stored compiled macros 116
case changes 180, 182, 283
case sensitivity 112
catalogs
as autocall libraries 113
libref for catalog containing stored compiled macros 358
searching for stored compiled macros 355
centrally storing autocall macros 144
character functions 157
character operands
comparing in logical expressions 77
character strings
passing to SAS programs 213, 360
substring of 265
character values
formatting rules for assigning 233
character width value 196
characters
locating 253
translating 276
CMDMAC system option 332
code
generating SAS code using macros 9
column values
storing in declared macro variables 288
command style macros 141
comments 10, 294
compilation
note on size and number of instructions 337
compilation functions 81
compilation quoting functions 159
compiled items 38
compiled macros
executing 40
compiled stored macro
error message 391, 392
compiler 15

compiling macro definitions 38, 115
compressing blanks 175, 181
condition codes 196
conditional execution 228
conditional processing 306
constant text 9
CPU
  number available to SAS 212

## D

damaged data sets 200
data files
  name of file most recently created 209
data sets
  confirming existence of 276
  creating macro variables and assigning values from 234
  damaged 200
  determining number of variables and observations in 275, 276
  libref and name of most recently created 201
  retrieving variable values previously assigned from 243
DATA step
  assigning values to macro variables 230
  functions in 104
  interacting with macro facility during execution 100
  passing values into a parameter list 229
  resolving text expressions during execution 239
  returning value of macro variable, during execution 242
DATA step compiler 15
  macro resolution problems during compilation 127
DATA step interfaces 100, 165
  CALL EXECUTE routine timing details 101
  example of common problem with CALL EXECUTE routine 102
  listed by category and use 100
  using CALL EXECUTE routine incorrectly 101
data type 177
dates
  execution date for SAS job or session 198, 199
  execution day for SAS job or session 200
  formatting current date in a TITLE statement 275
day of the week
  for execution of SAS jobs or sessions 200
debugging 118
  autocall facility 128
  autocall library specifications 129
  autocall macro definition errors 129
  black hole problem 124
  common macro problems 119
  developing bug-free macros 119
  developing macros in layered approach 118
  displaying information about stored compiled macros 130
  encountering errors 118
  examining generated SAS statements 133
  examining macro variable resolution 135
  expression evaluation 131
  file and macro names for autocall 130
  macro functions 124
  macro variable resolution 121
  macro variable scope 122
  nesting information generated by MLOGICNEST 133
  nesting information generated by MPRINTNEST 134
  open code recursion 123
  storing MPRINT output in external file 134
  techniques for 132
  timing issues 126
  tracing flow of execution 132
  tracing generated statements for 351
  tracing macro execution for 348
  tracing resolution of macro variable references 360
  tracking %PUT statement problems 136
  tracking system option problems 132
  troubleshooting macros 119
  unresolved macros 124
  warning messages and 118
defining macros 9, 37
delete macro variable
  warning message 403
delimiters 4
  delimiting macro variable names within text 32
  for IN operator 345
  period as 11
delta character 95
DES= option
  error message 384
device type
  %INCLUDE file 207

directories
  as autocall libraries 113
directory
  %INCLUDE file 207
double quotation marks 8
dummy macro
  error message 381
dummy macros 39, 124

## E

eaual sign
  error message 375
efficient macros
  *See* macros, efficient
encoding
  for SAS sessions 202
ENCODING= system option
  warning message 405
error conditions
  %SYSRC mnemonics for 183
error messages 120, 367
  text of last message generated in log 205
error return codes 204
error types 118
errors
  debugging and 118
evaluation functions 158
executing compiled macros 40
execution errors 118
execution functions 82
execution, tracing flow of 132
existence of data sets 276
existence of macro variables 241, 268
exits
  providing in a large macro 305
expression
  error message 376
expressions
  *See also* macro expressions
  generating indirect macro variable references with 33
  troubleshooting evaluation problems 131
external files
  naming for autocall facility 151
  routing MPRINT output to 345, 351
  storing MPRINT output in 134

## F

filename
  %INCLUDE file 208
FILENAME statement
  return code from 206
fileref
  %INCLUDE file 208
filerefs
  limiting to eight characters 266
  verifying 190
floating-point evaluation 271
floating-point operands
  evaluating 75
floating-point values
  comparing in logical expressions 76
flow of execution, tracing 132
forcing local macro variables 59
functions
  *See also* macro functions
  *See also* macro quoting functions
  assigning results to macro variables 142
  executing 273
  for use with %SYSFUNC function 409
  in DATA step and macro facility 104
  portable 146
  user-written 273

## G

global macro variables 8, 22, 47, 48
  creating 61, 303
  creating in macro definitions 304
  creating, based on value of local variables 63
  indicating whether macro variables are global 246
  returning values as numeric 245
  with same name as a local variable 314
global symbol table 48
  deleting variables from 229, 324

## H

hexadecimal character constants 3
hexadecimal values 3
host name 207
  of computers running multiple TCPIP stacks 219
host-specific macro variables 151
  automatic macro variables with 147

## I

IMPLMAC system option 332
IN (#) logical operator
  macro processor and 347
IN operator
  delimiter for 345
index variable
  error message 379
indexes

executing a macro section repetitively, based on an index variable 298
indirect macro variable references 33
creating a series of, with single macro call 34
generating with an expression 33
using more than two ampersands 34
input stacks 13
integer arithmetic evaluation 251
integer expressions 73
interactive mode 202
interfaces 12, 99, 165
DATA step interfaces 100
functions in DATA step and macro facility 104
SAS/CONNECT interfaces 108
with SCL 106
with SQL procedure 105
internal macro header name
error message 382
INTO clause 287
invalid macro name
error message 369
invalid macro parameter name
error message 375
invocation
warning message 400
invocation status
of macro currently executing 211
invoking macros 9
iterative %DO
error message 377

**J**

jobs
execution day 200
execution of 105
job ID 209

**K**

keyword parameter
error message 378, 379

**L**

labels
branching macro processing to specified label 305
large macros
providing exits in 305
layered approach 118
leading blanks
maintaining 263
removing 175, 181
removing from macro variables 235
left-alignment 179, 181
length of a string 254
LIBNAME statement
return code from 210
library damaged
error message 383
librefs
for catalogs containing stored compiled macros 358
of most recently created data set 201
licenses for SAS products 282
literal
error message 380
literals 14
local hosts
assigning macro variable values from remote host to 328
local macro variables 8, 47, 49
creating 56, 312
creating global variables based on value of 63
displaying in log 323
forcing 59
indicating whether macro variables are local 247
with same name as a global variable 314
local symbol table 49
CALL SYMPUT routine and 64, 68, 69
LOCK statement
return code from 210
log
compilation notes in 337
displaying automatic macro variables 322
displaying local variables 323
displaying macro execution information 343
displaying nesting information 349, 352
displaying source location of autocall macros 334
displaying user-generated variables 322
text of last error message generated in 205
text of last warning message 224
tracing resolution of macro variable references 360
writing contents of symbol tables to 51
writing text or macro variable information to 320
LOGAPPLNAME= system option 211
logical expressions 71
comparing character operands 77
comparing floating-point values 76
comparing missing values 76

comparing numeric operands 76
defining 72
evaluating 72, 76
evaluating with floating-point arithmetic 271
evaluating with integer arithmetic 251
operands and operators 73
login
of current SAS process 222
long macro variables
storing values in segments 266
lowercase characters
converting to uppercase 283
converting uppercase characters to 180, 182


## M


macro calls 9
% (percent) delimiter and 4
creating a series of indirect macro variable references 34
macro character functions 157
macro debugging
*See* debugging
macro definition
warning message 405
macro definitions 9, 37
allowing new definitions 336
beginning 314
compiling 38, 115
creating global variables in 304
ending 319
macro statements used in 154
nested 141
redefining 354
storing 115
troubleshooting 129
macro evaluation functions 158
macro execution
tracing generated statements for debugging 351
macro expressions 71
*See also* arithmetic expressions
*See also* logical expressions
text expressions 71
macro facility 3
functions in 104
interacting with, during DATA step execution 100
interfaces 12, 99, 165
reserved words 365
SCL interfaces to 106
searching for stored compiled macros 355
system options in 169
word rules 365
macro function
error message 376, 377
warning message 401
macro functions 156, 416
%SYSFUNC and %QSYSFUNC function 11
assigning results to macro variables 142
character functions 157
evaluation functions 158
lists of 161
manipulating macro variable values with 35
quoting functions 159
troubleshooting 124
macro keyword
error message 382
macro language 4
additional features of 11
as string based language 3
autocall macros 167
automatic variables 162
availability of 333
elements 153
elements with system dependencies 150
functions 156
macro facility interfaces 165
reserved words in 26
statements 154
system options in macro facility 169
macro libraries
copying items from 296
macro name
error message 382
macro names 9
for autocall facility 151
macro parameters
positional 317
validating 300
macro processing 13, 37
branching to specified label 305
calling macros 37
compiling macro definitions 38
defining macros 37
executing compiled macros 40
statement processing with macro activity 15
statement processing without macro activity 14
summary of 46
macro processor 3, 15
compiling macro definitions 38
evaluating arithmetic expressions 74
evaluating logical expressions 76
executing compiled macros 40
IN (#) logical operator and 347

tracing execution for debugging 348
variables defined by 22
warning message when reference does not match variable 359
macro quoting 80
how it works 95
masking special characters and mnemonics 80
mnemonics in passed parameters 82
necessity of 80
referring to already quoted variables 90
special characters in passed parameters 82
unquoting text 93
macro quoting functions 8, 80, 96, 159
%BQUOTE 89
%NRBQUOTE 89
%NRSTR 85
%QSCAN 96
%STR 85
%SUPERQ 91
amount of text to mask 90
compilation functions 81
compilation quoting functions 159
execution functions 82
execution of 159
overview 81
Q functions 96
summary of 92
unmatched quotation marks and parentheses 160
when to use 83
which function to use 83
macro source code
saving 115
macro statements 11, 154
executing immediately 126
for automatic evaluation 155
lists of 154
open code recursion 123
used in macro definitions 154
used in open code 154
MACRO system option 333
macro triggers 16
macro variable name
error message 378
macro variable names
prefixes 122
macro variable references 4, 30
combining with text 31
creating a period to follow resolved text 32
delimiting names within text 32
generating suffixes for 11
in submit blocks 107
indirect referencing 33
period (.) as delimiter 11
quoting values that might contain 264
resolved by SCL 107
resolving 240
tracing resolution of 360
warning message when reference does not match variable 359
warning message when references cannot resolve 342
macro variable resolution
errors 118, 121
examining with SYMBOLGEN 135
problems during DATA step compilation 127
problems with 121
macro variable scopes
*See* scopes of macro variables
macro variables 8, 21
*See also* automatic macro variables
*See also* global macro variables
*See also* local macro variables
*See also* user-defined macro variables
& (ampersand) delimiter and 4
additional scan of long values 144
affecting job execution 105
assigning 52
assigning a response to 310
assigning DATA step values to 230
assigning function results to 142
assigning SQL procedure values 287
assigning values from remote host to local host 328
assigning values to, and removing blanks 235
changing values of 55
creating and assigning a value 311
creating on remote host or server 326
creating, and assigning values from a data set 234
defined by macro processor 22
defining 8
deleting from global symbol table 229, 324
delimiting names within text 32
displaying user-generated variables in log 322
displaying values 33
existence of 241, 268
global 22
host-specific 151
indicating global or local scope 269, 270
indicating whether macro variables are global 246
indicating whether macro variables are local 247

length of 21
manipulating values with macro functions 35
maximum value size for storing in memory 356
mnemonics in 8
modifying values of, on remote host or server 326
passing unresolved values 268
quoting 251
resetting to null 144
resolving 52
retrieving values previously assigned from a data set 243
returning value of, to DATA step during execution 242
scanning values for words 35
scope of, when created with CALL SYMPUT routine 232
special characters in 8
storing all row values in one variable 289
storing column values in declared variables 288
storing long values in segments 266
storing one copy of long values 145
storing row values in list of 289
supplying values to, during macro execution 309
system-specific 23
warning message when reference does not match variable 359
writing information to log 320
macros 37
*See also* autocall macros
*See also* macros, efficient
*See also* macros, portable
% (percent) delimiter and 4
aborting 292
black hole problem 124
calling 37
calling or invoking 9
comments in 10
conditionally processing a portion of 306
defining 9, 37
developing bug-free 119
developing in layered approach 118
dummy macros 39, 124
executing a section repetitively 298
executing a section repetitively until a condition is true 300
executing a section repetitively while a condition is true 301
executing conditionally 228
generating SAS code 9
in SCL programs (examples) 107
invocation status 211
maximum size for execution in memory 344
name style 141
number executing in current job or session 208
parameter values 214
providing exits in large macros 305
redefining 354
reusing 111
saving in autocall libraries 112
saving with stored compiled macro facility 115
session compiled 111
sharing between SCL programs 107
solving common problems 119
statement-style 332
storing 111
strings within 9
terminating 324
troubleshooting 119
unresolved 124
wise use of 140
macros, efficient 139
additional scanning of macro variables 144
assigning function results to macro variables 142
avoiding nested macro definitions 141
centrally storing autocall macros 144
efficiency in perspective 140
MSYMTABMAX= system option and 144
MVARSIZE= system option and 144
name style macros 141
resetting macro variables to null 144
stored compiled macro facility and 143
storing long macro variable values 145
turning off system options 143
wise use of macros 140
macros, portable 139, 146
%SYSFUNC and 146
automatic variables with host-specific values 147
host-specific macro variables 151
macro language elements with system dependencies 150
naming macros and external files for autocall facility 151
maintenance level 223, 224
markup tags
removing from titles 302
masking 8, 80, 181, 182, 183
deciding how much text to mask 90
referring to already quoted variables 90

summary of 92
unmasking 282
masking functions
%BQUOTE 89, 250
%NRBQUOTE 89, 250
%NRQUOTE 255, 256
%NRSTR 85, 255, 262
%QUOTE 256
%STR 85, 262
%SUPERQ 267
%UNQUOTE 282
MAUTOCOMPLOC system option 333
MAUTOLOCDISPLAY system option 334
MAUTOLOCINDES system option 335
MAUTOSOURCE system option 336
warning message 401
MCOMPILE system option 336
MCOMPILENOTE system option 337
MCOVERAGE system option
warning message 405
MCOVERAGE system options 338
MCOVERAGELOC= system option 342
warning message 405
memory
amount available to symbol tables 355
maximum size for variable values stored in 356
maximum size of macros executed 344
MERROR system option 342
MEXECNOTE system option 343
MEXECSIZE system option 344
MFILE system option 345
MINDELIMITER= option
error message 396
MINDELIMITER= system option 345
MINOPERATOR option
error message 397
MINOPERATOR system option 347
missing semicolons
open code recursion and 123
missing values
comparing in logical expressions 76
MLOGIC system option 348
tracing flow of execution with 132
MLOGICNEST system option 349
nesting information generated by 133
mnemonics
in macro variables 8
in passed parameters 82
masking 80, 85
quoting values that might contain 257
model text 9
MPRINT system option 351
examining generated SAS statements 133
routing output to external file 345, 351
storing output in external file 134
MPRINTNEST system option 352
nesting information generated by 134
MRECALL system option 353
MREPLACE system option 354
MSTORED option
error message 384, 394
MSTORED system option 355
MSYMTABMAX= system option 355
adjusting values for efficiency 144
MVARSIZE= system option 356
adjusting values for efficiency 144

## N

name style macros 141
names
as tokens 14
batch jobs 209
external files, for autocall facility 151
host name 207
of most recently created data set 201
of procedure being processed 217
operating system 218
prefixes for macro variable names 122
process name 217
userids 209
nested macro definitions 141
nesting
error message 368
nesting information
generated by MLOGICNEST 133, 349
generated by MPRINTNEST 134, 352
nesting scopes 47
NOIMPLMAC system option 332
NOMACRO system option 333
warning message 402
NOMAUTOCOMPLOC system option 333
NOMAUTOLOCDISPLAY system option 334
NOMAUTOLOCINDES system option 335
NOMAUTOSOURCE system option 336
warning message 401
NOMCOMPILE system option 336
NOMCOVERAGE system options 338
NOMERROR system option 342
NOMEXECNOTE system option 343
NOMFILE system option 345
NOMINOPERATOR option
error message 397
NOMINOPERATOR system option 347
NOMLOGIC system option 348
NOMLOGICNEST system option 349

NOMPRINT system option 351
NOMPRINTNEST system option 352
NOMRECALL system option 353
NOMREPLACE system option 354
NOMSTORED system option 355
NOSERROR system option 359
NOSYMBOLGEN system option 360
notes
  on macro compilation 337
numbers
  as tokens 14
numeric operands
  comparing in logical expressions 76
  evaluating 74
numeric values
  formatting rules for assigning 233
  returning global macro variable values as 245

## O

observations
  determining number in a data set 275, 276
ODS pathname 213
open code 8, 22
  error message 381
  macro statements used in 154
open code recursion 123
open parenthesis
  error message 368
operands 73
  character operands 77
  floating-point operands 75
  numeric operands 74, 76
operating environment
  name of 218
  passing character strings to SAS program steps 213
operating environment commands 326
operating environment condition codes 196
operating environment variables
  returning value of specified variable 277, 278
operating system identifier 218
operators 73
output
  storing MPRINT output 134
overflow
  error message 379

## P

parameter list
  error message 370
parameter lists
  passing DATA step values to 229
parameter values
  text supplied as 214
parameters
  passing parameters containing special characters and mnemonics 82
parentheses
  unmatched 160
  unmatched, with %STR and %NRSTR functions 86
PARMBUFF option
  %MACRO statement 318
passing character strings 213
passing unresolved values 268
percent (%) delimiter 4
percent sign (%)
  with %STR function 86
period (.)
  creating, to follow resolved text 32
period (.) delimiter 11
portable functions 146
portable macros
  *See* macros, portable
positional parameter
  error message 370, 379
positional parameters 317
printing
  conditionally printing reports 308
procedures
  name of procedure being processed 217
  passing values to 213
  return codes provided by 208
process name 217
processors
  number available to SAS 212
program flow, controlling 311
program steps
  passing character strings to 213
programs
  passing character strings to 360
  passing user identification to 361

## Q

quotation marks 8
  unmatched 160
  unmatched, with %STR and %NRSTR functions 86
quoted strings 8
quoting
  values that may contain macro references 264
  values that might contain mnemonic operators 257
quoting functions 8, 159

%BQUOTE 250
%NRBQUOTE 250
%NRQUOTE 256
%NRQUOTE function 255
%NRSTR 255, 262
%QUOTE 256
%STR 262
%SUPERQ 267

## R

RANUNI CALL routine
invoking with %SYSCALL statement 326
read and write status
of automatic macro variables 22
read-only symbolic variable
error message 372
READONLY option
error message 398, 399
recursion 123
recursive reference
error message 371
warning message 404
recursive references 123
release version 223, 224
remote hosts
assigning macro variable values to local host 328
checking return code values 109, 329
creating or modifying macro variables on 326
remote servers
creating or modifying macro variables on 326
repetitive pieces of text, generating 10
reports
conditionally printing 308
reserved words 26, 365
resetting macro variables to null 144
RESOLVE function 239
warning message 402
resolved text
creating a period to follow 32
resolving macro variable references 239
resolving macro variables 52
writing to log for debugging 360
return code status 203
return codes 203
checking values on remote host 109, 329
errors 204
for damaged data sets 200
from last FILENAME statement 206
from LIBNAME statement 210
from LOCK statement 210
provided by SAS procedures 208
testing for 183
warnings 204
reusing macros 111
rows
storing all values in one macro variable 289
storing values in list of macro variables 289

## S

SAS code
generating with macros 9
SAS Component Language
*See* SCL
SAS jobs
execution date 198, 199
execution day 200
number of macros executing in current job 208
SAS process
user ID or login of current process 222
SAS programs
macro processing and 13
passing character strings to 213, 360
passing user identification to 361
SAS sessions
encoding for 202
execution day 200
SAS software
licenses for products 282
maintenance level 223, 224
release version 223, 224
SAS System
error message 380
SAS System version
warning message 404
SAS/CONNECT interfaces 108
%SYSRPUT with 109
checking return code values on remote host 109
SAS/TOOLKIT 11
SASAUTOS= system option 357
error message 371
SASMACR catalog
error message 382
warning message 402
SASMSTORE option
error message 384, 385, 392
SASMSTORE= system option 358
saving macro source code 115
saving macros
in autocall libraries 112
stored compiled macro facility for 115

scanning macro variable values for words 35
SCL 106
  example of macros in 107
  interfaces 106, 166
  macro variable references in submit blocks 107
  resolving macro references 107
SCL programs 106
  examples of macros in 107
  returning global macro variable values as numeric 245
  sharing macros between 107
scopes of macro variables 47
  assigning macro variables 52
  CALL SYMPUT routine and 63
  changing macro variable values 55
  examples 55
  global macro variables 48
  global macro variables, based on local variable values 63
  global macro variables, creating 61
  indicating whether macro variables are global 246, 269
  indicating whether macro variables are local 247, 270
  local macro variables 49
  local macro variables, creating 56
  local macro variables, forcing 59
  nesting 47
  resolving macro variables 52
  solving problems 122
  special cases 63
  variables created with CALL SYMPUT routine 232
  writing symbol table contents to log 51
search order
  assigning or resolving macro variables 52
searching
  autocall libraries 353
  for a word, by position in a string 258
  for stored compiled macros 355
SECURE option
  %MACRO statement 319
segments
  storing long macro variable values in 266
semantic errors 118
semicolon not found
  error message 380
SERROR system option 359
session compiled macros 111
sharing macros between SCL programs 107
single quotation marks 8
site number 218
source code 143
  saving 115
source level autocall
  warning message 401
SOURCE option
  %MACRO statement 318
special characters
  as tokens 14
  in macro variables 8
  in passed parameters 82
  macro quoting guidelines 83
  masking 80, 85
special tokens 14
SQL procedure 105
  assigning values to macro variables 287
  controlling job execution 105
  interfaces 105, 166
  INTO clause 105
statement style macros 141
statement-style macros
  invoking 332
statements
  examining generated SAS statements 133
  macro statements 11
  processing with macro activity 15
  processing without macro activity 14
  tracing for debugging 351
STORE option
  %MACRO statement 319
stored compiled macro facility 111
  efficiency and 143
  overview 115
  saving macros with 115
stored compiled macros 177
  calling 116
  displaying information about 130
  libref for catalog containing 358
  searching catalogs for 355
storing autocall macros
  centrally 144
  supplied by SAS 116
storing macro definitions 115
storing macros 111
  saving macros in autocall libraries 112
  saving macros with stored compiled macro facility 115
storing MPRINT output
  in external files 134
strings
  length of 254
  locating first character in 253
  passing character strings to SAS programs 213, 360
  reducing length of 254

searching for words by position in 258
substring of a character string 265
within macros 9
stripped for printing 136
submit blocks
macro variable references in 107
substrings
of a character string 265
suffixes
generating for macro variable references 11
symbol tables 15, 22, 48
amount of memory available to 355
global 48, 229, 324
local 49
writing contents to log 51
SYMBOLGEN system option 360
examining macro variable resolution 135
symbolic reference
warning message 399
symbolic variable name
error message 367, 368, 370
SYMDEL routine
warning message 403
SYMEXIST function 241
SYMGET function 242
SYMGETN function 245
SYMGLOBL function 246
SYMLOCAL function 247
syntax 4
syntax errors 118
SYSADDRBITS automatic macro variable 194
SYSBUFFR automatic macro variable 195
SYSCC automatic macro variable 195
error message 398
SYSCC macro variable 415
SYSCHARWIDTH automatic macro variable 196
SYSCMD automatic macro variable 196
SYSDATASTEPPHASE automatic macro variable 196
SYSDATE automatic macro variable 197
SYSDATE9 automatic macro variable 198, 199
SYSDAY automatic macro variable 199
SYSDEVIC automatic macro variable 200
SYSDMG automatic macro variable 200
SYSDSN automatic macro variable 201
SYSENCODING automatic macro variable 202
SYSENDIAN automatic macro variable 202
SYSENV automatic macro variable 202
SYSENV macro variable 416
SYSERR automatic macro variable 203
SYSERRORTEXT automatic macro variable 205
SYSFILRC automatic macro variable 206
SYSHOSTINFOLONG automatic macro variable 206
SYSHOSTNAME automatic macro variable 207
SYSINCLUDEFILEDEVICE automatic macro variable 207
SYSINCLUDEFILEDIR automatic macro variable 207
SYSINCLUDEFILEFILEREF automatic macro variable 208
SYSINCLUDEFILENAME automatic macro variable 208
SYSINDEX automatic macro variable 208
SYSINFO automatic macro variable 208
SYSJOBID automatic macro variable 209
SYSJOBID macro variable 416
SYSLAST automatic macro variable 209
SYSLCKRC automatic macro variable 210
SYSLIBRC automatic macro variable 210
SYSLOGAPPLNAME automatic macro variable 211
SYSMACRONAME automatic macro variable 211
SYSMAXLONG automatic macro variable 211
SYSMAXLONG macro variable 416
SYSMENV automatic macro variable 211
SYSMSG automatic macro variable 212
SYSNCPU automatic macro variable 212
SYSNOBS automatic macro variable 212
SYSODSESCAPECHAR automatic macro variable 213
SYSODSPATH automatic macro variable 213
SYSPARM automatic macro variable 213
with host-specific values 149, 150
SYSPARM= system option 360
SYSPBUFF automatic macro variable 214
CALL SYMPUT routine and 69
SYSPRINTTOLIST automatic macro variable 215
SYSPRINTTOLOG automatic macro variable 215
SYSPROCESSID automatic macro variable 215

SYSPROCESSMODE automatic macro variable 216
SYSPROCESSNAME automatic macro variable 217
SYSPROCNAME automatic macro variable 217
SYSRC automatic macro variable 217
SYSSCP and SYSSCPL automatic macro variables 217
SYSSCP automatic macro variable 218
  with host-specific values 148
SYSSCPL automatic macro variable 218
SYSSITE automatic macro variable 218
SYSSIZEOFLONG automatic macro variable 218
SYSSIZEOFPTR automatic macro variable 218
SYSSIZEOFUNICODE automatic macro variable 219
SYSTCPIPHOSTNAME automatic macro variable 219
system options
  in macro facility 169
  required for autocall macros 168
  tracking problems with 132
  turning off, for efficiency 143
system-specific macro variables 23
SYSTIME automatic macro variable 219
SYSTIMEZONE automatic macro variable 220
SYSTIMEZONEIDENT automatic macro variable 220
SYSTIMEZONEOFFSET automatic macro variable 221
SYSUSERID automatic macro variable 222
SYSVER automatic macro variable 222
SYSVLONG automatic macro variable 223
SYSVLONG4 automatic macro variable 223
SYSWARNINGTEXT automatic macro variable 224

## T

TCPIP stacks 207
  host name of computers running 219
terminating macros 324
text
  combining macro variable references with 31
  creating a period to follow resolved text 32
  delimiting macro variable names within 32
  generating repetitive pieces of 10
  writing to log 320
text expressions 71
  resolving during DATA step execution 239
text items 38
text strings
  replacing using macro variables 8
text substitution 4
timing issues 126
  macro resolution problems during DATA step compilation 127
  macro statement executing immediately 126
TITLE statement
  formatting current date in 275
titles
  removing markup tags from 302
tokenization 14
tokens 14, 407
  list of 407
tracing
  flow of execution 132
  generation of statements 351
  resolution of macro variable references 360
tracking problems
  with %PUT statement 136
  with system options 132
trailing blanks
  removing 175, 179, 181
  removing from macro variables 235
  trimming 183, 188
translating characters 276
trimming trailing blanks 183, 188
troubleshooting 119
  autocall facility 128
  autocall library specifications 129
  autocall macro definition errors 129
  black hole problem 124
  common macro problems 119
  displaying information about stored compiled macros 130
  expression evaluation 131
  file and macro names for autocall 130
  macro functions 124
  macro variable resolution 121
  macro variable scope 122
  open code recursion 123
  timing issues 126
  unresolved macros 124

## U

unmasking 282

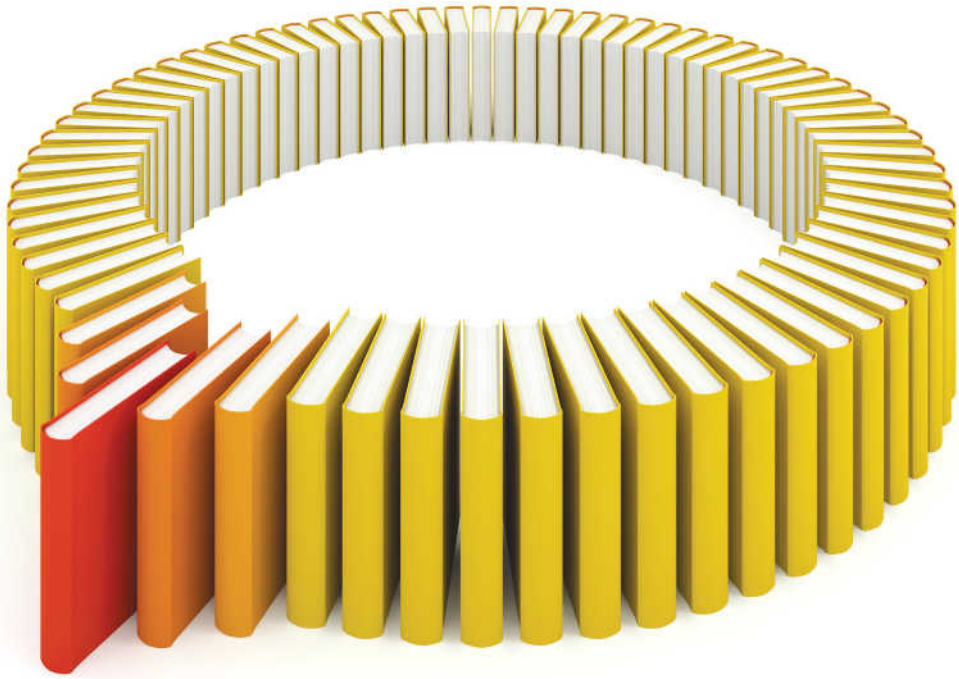
unmatched quotation marks and parentheses 86
macro quoting functions and 160
unquoting text 93
unresolved macros
troubleshooting 124
unresolved values
passing 268
uppercase characters
converting to 283
converting to lowercase 180, 182
user identification
passing to SAS programs 361
user IDs
of current SAS process 222
user-defined macro variables 22, 26
assigning values 27
assignment types for values 28
creating 27
overview 26
user-generated macro variables
displaying in log 322
user-written functions
executing 273
userids
name of 209

## V

variable name
error message 367
variables
determining number in a data set 275, 276
value of specified operating system variable 277, 278
verifying text or text expressions 190
version 223

## W

warning conditions
%SYSRC mnemonics for 184
warning messages 120, 399
debugging and 118
preventing 91
text of last message formatted for log display 224
when macro references cannot resolve 342
when variable reference does not match variable 359
warning return codes 204
weekdays
for execution of SAS jobs or sessions 200
width
character width value 196
word rules 365
word scanner 14, 16
words
scanning macro variable values for 35
searching for, by position in a string 258
words, reserved 365



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