CHAPTER 1

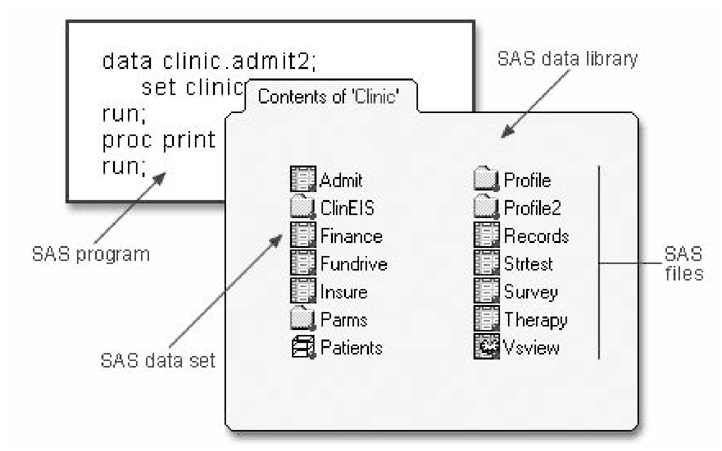
Basic Concepts

Overview

Introduction

To program effectively using SAS, you need to understand basic concepts about SAS programs and the SAS files that they process. In particular, you need to be familiar with SAS data sets.

In this chapter, you'll examine a simple SAS program and see how it works. You'll learn details about SAS data sets (which are files that contain data that is logically arranged in a form that SAS can understand). You'll see how SAS data sets are stored temporarily or permanently in SAS libraries. Finally, you'll learn how to use SAS windows to manage your SAS session and to process SAS programs.



Objectives

In this chapter, you learn about

- □ the structure and components of SAS programs
- □ the steps involved in processing SAS programs
- □ SAS libraries and the types of SAS files that they contain
- □ temporary and permanent SAS libraries
- □ the structure and components of SAS data sets.
- □ the SAS windowing environment.

SAS Programs

You can use SAS programs to access, manage, analyze, or present your data. Let's begin by looking at a simple SAS program. This program creates a new SAS data set from an existing SAS data set and then prints a listing of the new data set. A SAS data set is a data file that is formatted in a way that SAS can understand.

```
data clinic.admit2;
   set clinic.admit;
run;
proc print data=clinic.admit2;
run;
```

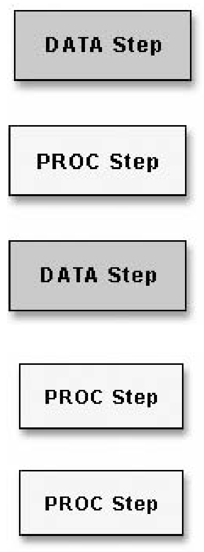
Let's see how this program works.

Components of SAS Programs

Our sample SAS program contains two steps: a DATA step and a PROC step.

```
data clinic.admit2
   set clinic.admit;
run;
proc print data=clinic.admit2;
run;
```

These two types of steps, alone or combined, form most SAS programs.



A SAS program can consist of a DATA step

or a PROC step

or any combination of DATA and PROC steps.

DATA steps typically create or modify SAS data sets. They can also be used to produce custom-designed reports. For example, you can use DATA steps to

- put your data into a SAS data set
- compute values
- check for and correct errors in your data
- produce new SAS data sets by subsetting, merging, and updating existing data sets.

PROC (procedure) steps are pre-written routines that enable you to analyze and process the data in a SAS data set and to present the data in the form of a report. They sometimes create new SAS data sets that contain the results of the procedure. PROC steps can list, sort, and summarize data. For example, you can use PROC steps to

- create a report that lists the data
- produce descriptive statistics
- create a summary report
- produce plots and charts.

Characteristics of SAS Programs

Next let's look at the individual statements in our sample program. SAS programs consist of SAS statements. A SAS statement has two important characteristics:

- It usually begins with a SAS keyword.
- It always ends with a semicolon.

As you've seen, a DATA step begins with a DATA statement, which begins with the keyword DATA. A PROC step begins with a PROC statement, which begins with the keyword PROC. Our sample program contains the following statements:

Statements	Sample Program Code
❶ a DATA statement	`data clinic.admit2;`
❷ a SET statement	`   set clinic.admit;`
❸ a RUN statement	`run;`

Statements	Sample Program Code
❹ a PROC PRINT statement	**proc print data=clinic.admit2;**
❺ another RUN statement	**run;**

Layout for SAS Programs

SAS statements are free-format. This means that

□ they can begin and end anywhere on a line

□ one statement can continue over several lines

□ several statements can be on a line.

Blanks or special characters separate *words* in a SAS statement.

You can specify SAS statements in uppercase or lowercase. In most situations, text that is enclosed in quotation marks is case sensitive.

You've examined the general structure of our sample program. But what happens when you run the program?

Processing SAS Programs

When you submit a SAS program, SAS begins reading the statements and checking them for errors.

DATA and PROC statements signal the beginning of a new step. When SAS encounters a subsequent DATA, PROC, or RUN statement (for DATA steps and most procedures) or a QUIT statement (for some procedures), SAS stops reading statements and executes the previous step in the program. In our sample program, each step ends with a RUN statement.

```
data clinic.admit2;
   set clinic.admit;
run;
proc print data=clinic.admit2;
run;
```

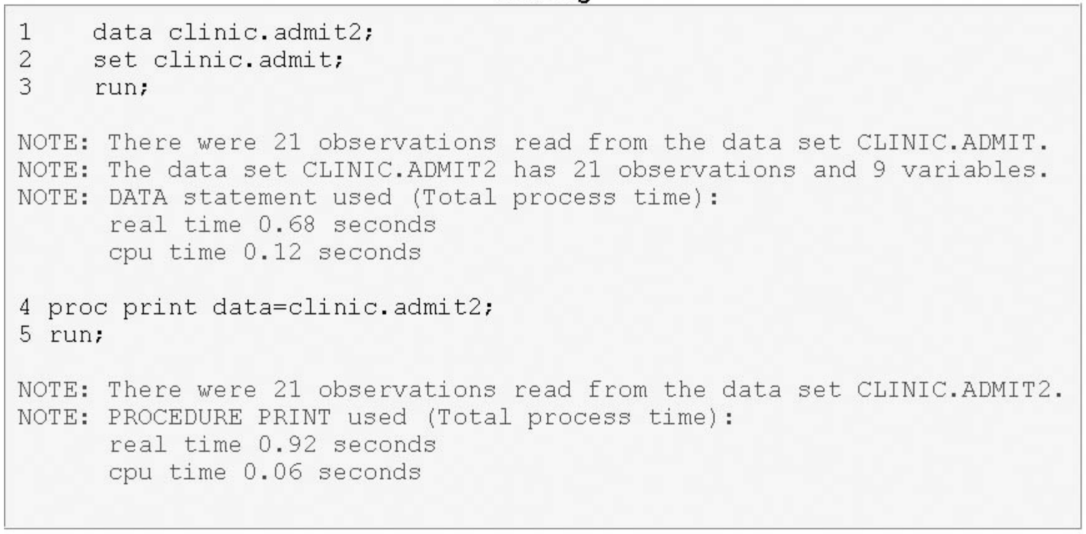
The beginning of a new step (DATA or PROC) implies the end of the previous step. Though the RUN statement is not always required between steps in a SAS program, using it can make the SAS program easier to read and debug, and it makes the SAS log easier to read.

Log Messages

Each time a step is executed, SAS generates a log of the processing activities and the results of the processing. The SAS log collects messages about the processing of SAS programs and about any errors that occur.

When SAS processes our sample program, you see the log messages shown below. Notice that you get separate sets of messages for each step in the program.

SAS Log



```
1    data clinic.admit2;
2    set clinic.admit;
3    run;

NOTE: There were 21 observations read from the data set CLINIC.ADMIT.
NOTE: The data set CLINIC.ADMIT2 has 21 observations and 9 variables.
NOTE: DATA statement used (Total process time):
      real time 0.68 seconds
      cpu time 0.12 seconds

4 proc print data=clinic.admit2;
5 run;

NOTE: There were 21 observations read from the data set CLINIC.ADMIT2.
NOTE: PROCEDURE PRINT used (Total process time):
      real time 0.92 seconds
      cpu time 0.06 seconds
```

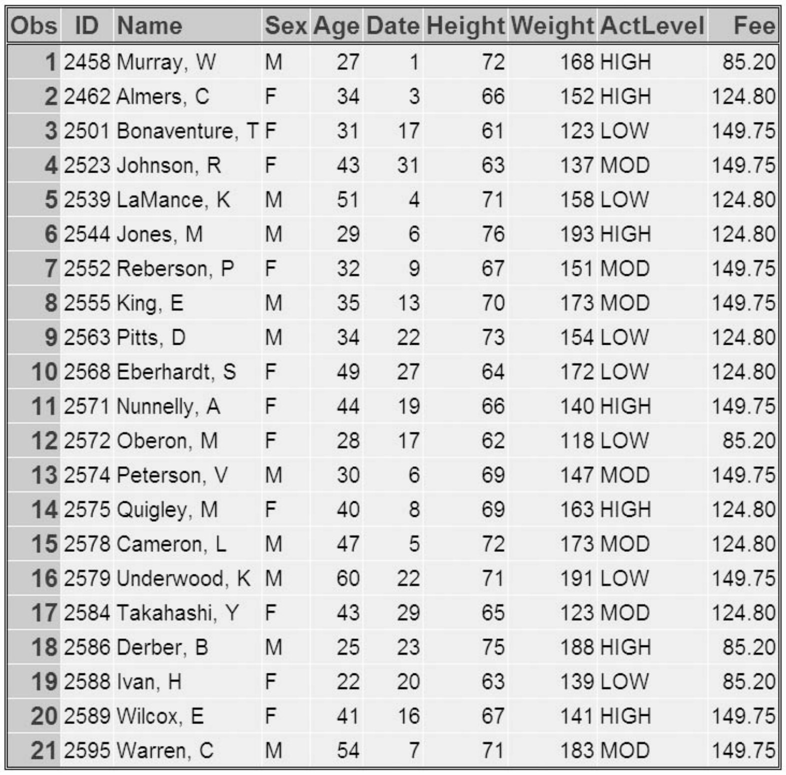
Results of Processing

Suppose you submit the sample program below:

```
data clinic.admit2;
  set clinic.admit;
run;
proc  print data=clinic.admit2;
 run;
```

When the program is processed, it

- creates the SAS data set Clinic.Admit2 in the DATA step. The DATA step produces messages in the SAS log, but it does not create a report or other output.
- creates the following listing report of the SAS data set Clinic.Admit2:



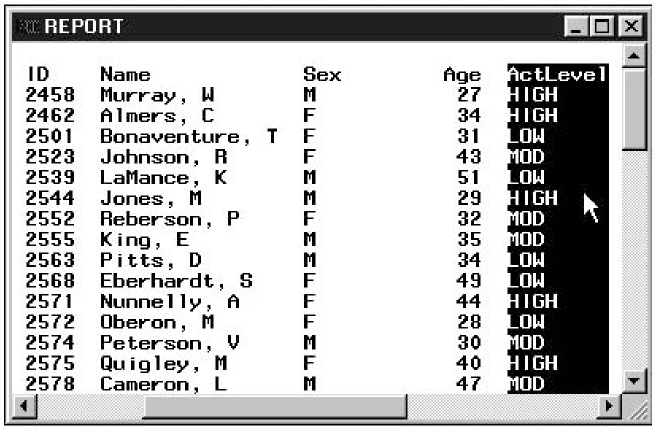
Obs	ID	Name	Sex	Age	Date	Height	Weight	ActLevel	Fee
1	2458	Murray, W	M	27	1	72	168	HIGH	85.20
2	2462	Almers, C	F	34	3	66	152	HIGH	124.80
3	2501	Bonaventure, T	F	31	17	61	123	LOW	149.75
4	2523	Johnson, R	F	43	31	63	137	MOD	149.75
5	2539	LaMance, K	M	51	4	71	158	LOW	124.80
6	2544	Jones, M	M	29	6	76	193	HIGH	124.80
7	2552	Reberson, P	F	32	9	67	151	MOD	149.75
8	2555	King, E	M	35	13	70	173	MOD	149.75
9	2563	Pitts, D	M	34	22	73	154	LOW	124.80
10	2568	Eberhardt, S	F	49	27	64	172	LOW	124.80
11	2571	Nunnelly, A	F	44	19	66	140	HIGH	149.75
12	2572	Oberon, M	F	28	17	62	118	LOW	85.20
13	2574	Peterson, V	M	30	6	69	147	MOD	149.75
14	2575	Quigley, M	F	40	8	69	163	HIGH	124.80
15	2578	Cameron, L	M	47	5	72	173	MOD	124.80
16	2579	Underwood, K	M	60	22	71	191	LOW	149.75
17	2584	Takahashi, Y	F	43	29	65	123	MOD	124.80
18	2586	Derber, B	M	25	23	75	188	HIGH	85.20
19	2588	Ivan, H	F	22	20	63	139	LOW	85.20
20	2589	Wilcox, E	F	41	16	67	141	HIGH	149.75
21	2595	Warren, C	M	54	7	71	183	MOD	149.75

Throughout this book, procedure output is shown in HTML in the style shown above unless otherwise noted. You can learn how to create HTML output in Chapter 2, "Referencing Files and Setting Options," on page 37.

You've seen the results of submitting our sample program. For other SAS programs, the results of processing might vary:

- Some SAS programs open an interactive window (a window that you can use to directly modify data), such as the REPORT window.

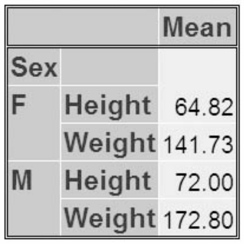
```
proc report data=clinic.admit;
   columns id name sex age actlevel;
   label name='Name' sex='Sex' age='Age'
         actlevel='ActLevel';
run;
```



```
ID     Name              Sex         Age  ActLevel
2458   Murray, W         M            27  HIGH
2462   Almers, C         F            34  HIGH
2501   Bonaventure, T    F            31  LOW
2523   Johnson, R        F            43  MOD
2539   LaMance, K        M            51  LOW
2544   Jones, M          M            29  HIGH
2552   Reberson, P       F            32  MOD
2555   King, E           M            35  MOD
2563   Pitts, D          M            34  LOW
2568   Eberhardt, S      F            49  LOW
2571   Nunnelly, A       F            44  HIGH
2572   Oberon, M         F            28  LOW
2574   Peterson, V       M            30  MOD
2575   Quigley, M        F            40  HIGH
2578   Cameron, L        M            47  MOD
```

- SAS programs often invoke procedures that create output in the form of a report, as is the case with the TABULATE procedure:

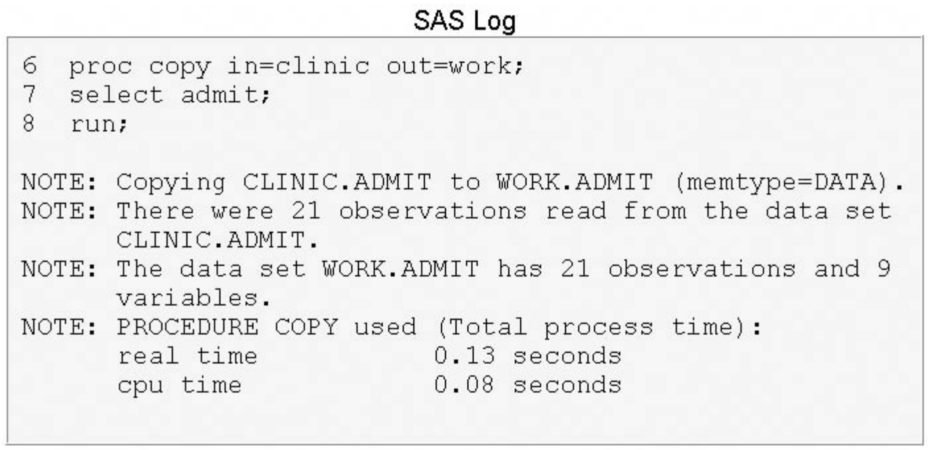
```
proc tabulate data=clinic.admit;
   class sex;
   var height weight;
   table sex*(height weight),mean;
 run;
```



		Mean
Sex		
F	Height	64.82
	Weight	141.73
M	Height	72.00
	Weight	172.80

- Other SAS programs perform tasks such as sorting and managing data, which have no visible results except for messages in the log. (All SAS programs produce log messages, but some SAS programs produce only log messages.)

```
proc copy in=clinic out=work;
   select admit;
run;
```



SAS Log

```
6  proc copy in=clinic out=work;
7  select admit;
8  run;

NOTE: Copying CLINIC.ADMIT to WORK.ADMIT (memtype=DATA).
NOTE: There were 21 observations read from the data set
      CLINIC.ADMIT.
NOTE: The data set WORK.ADMIT has 21 observations and 9
      variables.
NOTE: PROCEDURE COPY used (Total process time):
      real time           0.13 seconds
      cpu time            0.08 seconds
```

You can turn off log messages by using system options, which you can learn about in Chapter 2, "Referencing Files and Setting Options," on page 37.

SAS Libraries

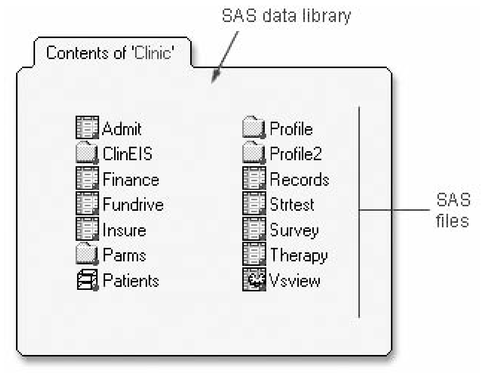
You've learned about SAS programs and SAS data sets. Now let's look at SAS libraries to see how SAS data sets and other SAS files are organized and stored.

How SAS Files Are Stored

Every SAS file is stored in a SAS library, which is a collection of SAS files. A SAS data library is the highest level of organization for information within SAS.

SAS libraries have different implementations depending on your operating environment, but a library generally corresponds to the level of organization that your host operating system uses to access and store files. In some operating environments, a library is a physical collection of files. In others, the files are only logically related.

For example, in the Windows and UNIX environments, a library is typically a group of SAS files in the same folder or directory.



The table below summarizes the implementation of SAS libraries in various operating environments.

In this environment...	A SAS library is...
Windows, UNIX, OpenVMS, OS/2 (directory based-systems)	a group of SAS files that are stored in the same directory. Other files can be stored in the directory, but only the files that have SAS file extensions are recognized as part of the SAS library. For more information, see the SAS documentation for your operating environment.
CMS	a group of SAS files that have the same file type.
z/OS (OS/390)	a specially formatted host data set in which only SAS files are stored.

Storing Files Temporarily or Permanently

Depending on the library name that you use when you create a file, you can store SAS files temporarily or permanently.

Temporary SAS libraries last only for the current SAS session.

Storing files temporarily:
: If you don't specify a library name when you create a file (or if you specify the library name Work), the file is stored in the temporary SAS data library. When you end the session, the temporary library and all of its files are deleted.

Permanent SAS Libraries are available to you during subsequent SAS sessions.

Storing files permanently:
: To store files permanently in a SAS data library, you specify a library name other than the default library name Work.
: For example, by specifying the library name Clinic when you create a file, you specify that the file is to be stored in a permanent SAS data library until you delete it.

You can learn how to set up permanent SAS libraries in Chapter 2, "Referencing Files and Setting Options," on page 37.

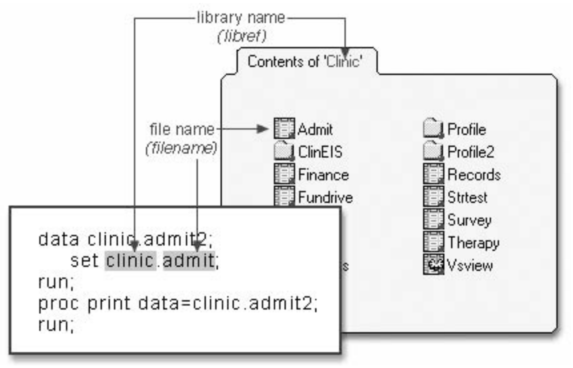
Referencing SAS Files

Two-Level Names

To reference a permanent SAS data set in your SAS programs, you use a two-level name:

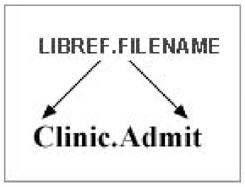
libref.filename

In the two-level name, *libref* is the name of the SAS data library that contains the file, and *filename* is the name of the file itself. A period separates the libref and filename.



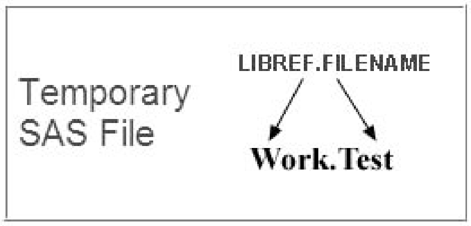
```
data clinic.admit2;
    set clinic.admit;
run;
proc print data=clinic.admit2;
run;
```

For example, in our sample program, Clinic.Admit is the two-level name for the SAS data set Admit, which is stored in the library named Clinic.

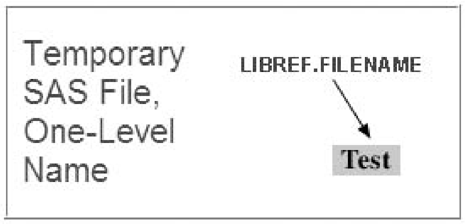


Referencing Temporary SAS Files

To reference temporary SAS files, you can specify the default libref Work, a period, and the filename. For example, the two-level name Work.Test references the SAS data set named Test that is stored in the temporary SAS library Work.

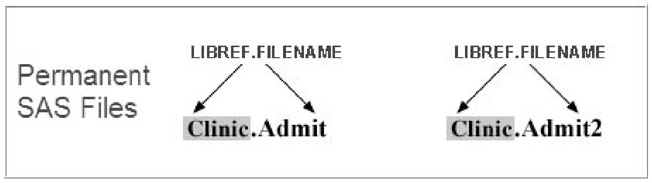


Alternatively, you can use a one-level name (the *filename* only) to reference a file in a temporary SAS library. When you specify a one-level name, the default libref Work is assumed. For example, the one-level name Test also references the SAS data set named Test that is stored in the temporary SAS library Work.



Referencing Permanent SAS Files

You can see that Clinic.Admit and Clinic.Admit2 are permanent SAS data sets because the library name is Clinic, not Work.



So referencing a SAS file in any library except Work indicates that the SAS file is stored permanently. For example, when our sample program creates Clinic.Admit2, it stores the new Admit2 data set permanently in the SAS library Clinic.

Rules for SAS Names

SAS data set names

- can be 1 to 32 characters long
- must begin with a letter (A-Z, either uppercase or lowercase) or an underscore (_)
- can continue with any combination of numbers, letters, or underscores.

These are examples of valid data set names:

- Payroll
- LABDATA1995_1997
- _EstimatedTaxPayments3

SAS Data Sets

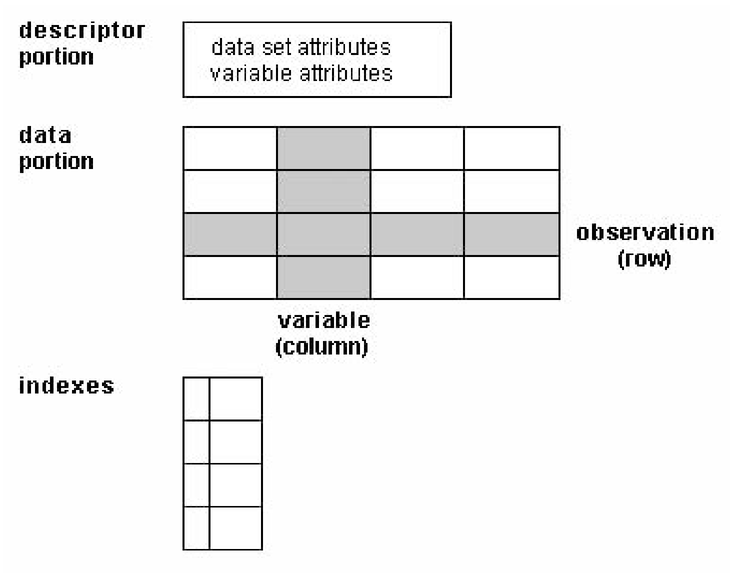
So far, you've seen the components and characteristics of SAS programs, including how they reference SAS data sets. Data sets are one type of SAS file. There are other types of SAS files (such as catalogs), but this chapter focuses on SAS data sets. For many procedures and for some DATA step statements, data must be in the form of a SAS data set to be processed. Now let's take a closer look at SAS data sets.

Overview of Data Sets

As you saw in our sample program, for many of the data processing tasks that you perform with SAS, you

- access data in the form of a SAS data set
- analyze, manage, or present the data.

Conceptually, a SAS data set is a file that consists of two parts: a descriptor portion and a data portion. Sometimes a SAS data set also points to one or more indexes, which enable SAS to locate records in the data set more efficiently. (The data sets that you work with in this chapter do not contain indexes.)



Descriptor Portion

The descriptor portion of a SAS data set contains information about the data set, including

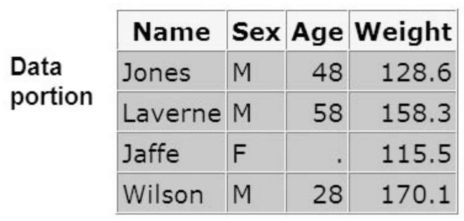
- □ the name of the data set
- □ the date and time that the data set was created
- □ the number of observations
- □ the number of variables.

Let's look at another SAS data set. The table below lists part of the descriptor portion of the data set Clinic.Insure, which contains insurance information for patients who are admitted to a wellness clinic. (It's a good idea to give your data set a name that is descriptive of the contents.)

Data Set Name:	CLINIC.INSURE
Member Type:	DATA
Engine:	V8
Created:	10:05 Tuesday, March 30, 1999
Observations:	21
Variables:	7
Indexes:	0
Observation Length:	64

Data Portion

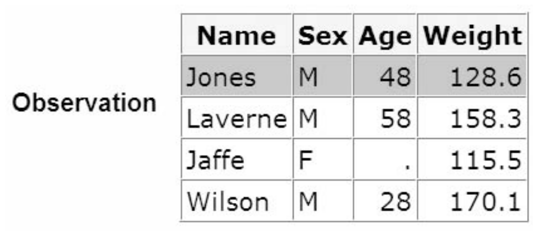
The data portion of a SAS data set is a collection of data values that are arranged in a rectangular table. In the example below, the name **`Jones`** is a data value, the weight **`158.3`** is a data value, and so on.


Data portion

Name	Sex	Age	Weight
Jones	M	48	128.6
Laverne	M	58	158.3
Jaffe	F	.	115.5
Wilson	M	28	170.1

Observations (Rows)

Rows (called observations) in the data set are collections of data values that usually relate to a single object. The values **`Jones`**, **`M`**, **`48`**, and **`128.6`** comprise a single observation in the data set shown below.

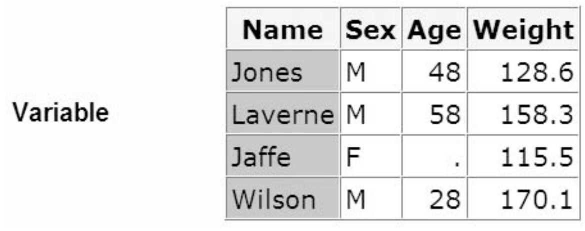

Observation

Name	Sex	Age	Weight
Jones	M	48	128.6
Laverne	M	58	158.3
Jaffe	F	.	115.5
Wilson	M	28	170.1

This data set has four observations, each containing information about an individual. A SAS data set can store any number of observations.

Variables (Columns)

Columns (called variables) in the data set are collections of values that describe a particular characteristic. The values **`Jones`**, **`Laverne`**, **`Jaffe`**, and **`Wilson`** comprise the variable Name in the data set shown below.

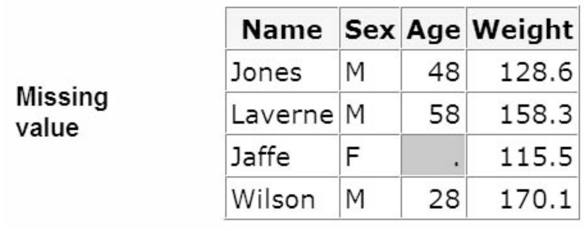


Name	Sex	Age	Weight
Jones	M	48	128.6
Laverne	M	58	158.3
Jaffe	F	.	115.5
Wilson	M	28	170.1

This data set contains four variables for each observation: Name, Sex, Age, and Weight. A SAS data set can store thousands of variables.

Missing Values

The rectangular arrangement of rows and columns in a SAS data set implies that every variable must exist for each observation. If a data value is unknown for a particular observation, a missing value is recorded in the SAS data set.


Missing
value

Name	Sex	Age	Weight
Jones	M	48	128.6
Laverne	M	58	158.3
Jaffe	F	.	115.5
Wilson	M	28	170.1

Variable Attributes

In addition to general information about the data set, the descriptor portion contains information about the attributes of each variable in the data set. The attribute information includes the variable's name, type, length, format, informat, and label.

When you write SAS programs, it's important to understand the attributes of the variables that you use. For example, you might need to combine SAS data sets that contain same-named variables. In this case, the variables must be the same type (character or numeric).

The following is a partial listing of the attribute information in the descriptor portion of the SAS data set Clinic.Insure. First, let's look at the name, type, and length variable attributes.

Variable	Type	Length	Format	Informat	Label
Policy	Num	8			Policy Number
Total	Num	8	DOLLAR8.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

Name

Each variable has a name that conforms to SAS naming conventions. Variable names follow exactly the same rules as SAS data set names. Like data set names, variable names

- can be 1 to 32 characters long
- must begin with a letter (A-Z, either uppercase or lowercase) or an underscore (_)
- can continue with any combination of numbers, letters, or underscores.

Variable	Type	Length	Format	Informat	Label
Policy	Num	8			Policy Number
Total	Num	8	DOLLAR8.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

Your site may choose to restrict variables names to those valid in SAS 6, to uppercase variable names automatically, or to remove all restrictdions on variable names.

Type

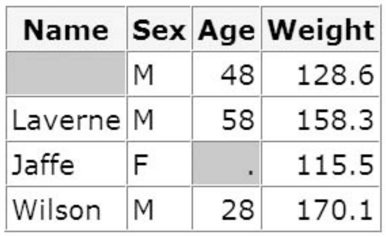
A variable's type is either character or numeric.

- Character variables, such as Name (shown below), can contain *any values*.
- Numeric variables, such as Policy and Total (shown below), can contain *only numeric values* (the digits 0 through 9, +, -, ., and E for scientific notation).

Variable	Type	Length	Format	Informat	Label
Policy	Num	8			Policy Number
Total	Num	8	DOLLAR8.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

A variable's type determines how missing values for a variable are displayed. In the following data set, Name and Sex are character variables, and Age and Weight are numeric variables.

- □ For character variables such as Name, a *blank* represents a missing value.
- □ For numeric variables such as Age, a *period* represents a missing value.



Name	Sex	Age	Weight
	M	48	128.6
Laverne	M	58	158.3
Jaffe	F	.	115.5
Wilson	M	28	170.1

Length

A variable's length (the number of bytes used to store it) is related to its type.

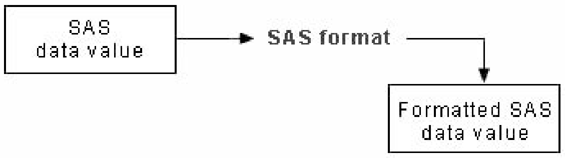
- □ Character variables can be up to 32,767 bytes long. In the example below, Name has a length of 20 characters and uses 20 bytes of storage.
- □ All numeric variables have a default length of 8. Numeric values (no matter how many digits they contain) are stored as floating-point numbers in 8 bytes of storage, unless you specify a different length.

Variable	Type	Length	Format	Informat	Label
Policy	Num	8			Policy Number
Total	Num	8	DOLLAR8.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

You've seen that each SAS variable has a name, type, and length. In addition, you can optionally define format, informat, and label attributes for variables. Let's look briefly at these optional attributes—you'll learn more about them in later chapters as you need to use them.

Format

Formats are variable attributes that affect the way data values are written. SAS software offers a variety of character, numeric, and date and time formats. You can also create and store your own formats. To write values out using a particular form, you select the appropriate format.



For example, to display the value `1234` as $1234.00 in a report, you can use the DOLLAR8.2 format, as shown for Total below.

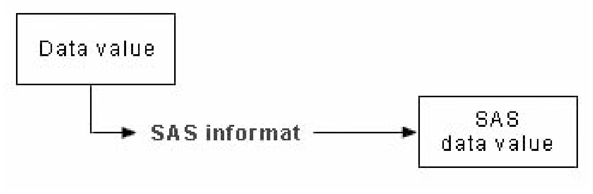
Variable	Type	Length	Format	Informat	Label
Policy	Num	8			Policy Number
Total	Num	8	DOLLAR8.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

Usually you have to specify the maximum width (*w*) of the value to be written. Depending on the particular format, you may also need to specify the number of decimal places (*d*) to be written. For example, to display the value `5678` as 5,678.00 in a report, you can use the COMMA8.2 format, which specifies a width of 8 including 2 decimal places.

You can permanently assign a format to a variable in a SAS data set, or you can temporarily specify a format in a PROC step to determine the way the data values appear in output.

Informat

Whereas formats write values out using some particular form, informats read data values in certain forms into standard SAS values. Informats determine how data values are read into a SAS data set. You *must* use informats to read numeric values that contain letters or other special characters.



For example, the numeric value `$12,345.00` contains two special characters, a dollar sign ($) and a comma (,). You can use an informat to read the value while removing the dollar sign and comma, and then store the resulting value as a standard numeric value. For Total below, the COMMA10. informat is specified.

Variable	Type	Length	Format	Informat	Label
Policy	Num	8			Policy Number
Total	Num	8	DOLLAR8.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

Label

A variable can have a label, which consists of descriptive text up to 256 characters long. By default, many reports identify variables by their names. You may want to display more descriptive information about the variable by assigning a label to the variable.

For example, you can label Policy as Policy Number, Total as Total Balance, and Name as Patient Name to display these labels in reports.

Variable	Type	Length	Format	Informat	Label
Policy	Num	8			Policy Number
Total	Num	8	DOLLAR8.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

You may even want to use labels to shorten long variable names in your reports!

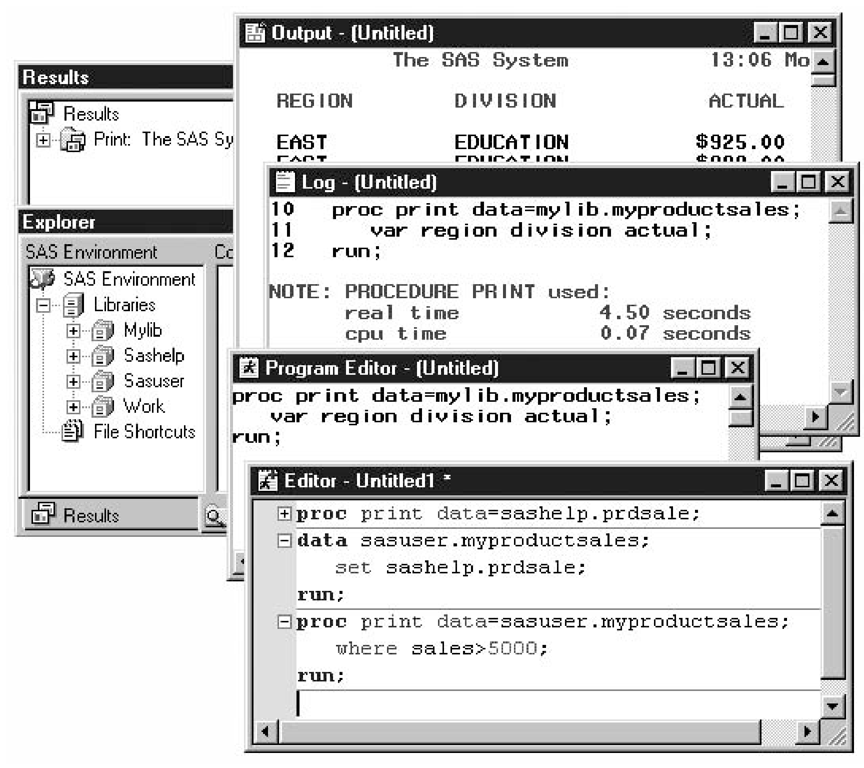
Using the Programming Workspace

Using the Main SAS Windows

When you start SAS, by default several primary windows are available to you. These include the Explorer, Log, Output, Results, and code editing window(s). The window you use to edit your SAS programs may vary, depending on your operating system and needs.

You use these SAS windows to explore and manage your files, to enter and submit SAS programs, to view messages, and to view and manage your output.

We'll tour each of these windows shortly.



```
                The SAS System               13:06 Mo

  REGION          DIVISION                ACTUAL

  EAST            EDUCATION              $925.00
```

```
10    proc print data=mylib.myproductsales;
11       var region division actual;
12    run;

NOTE: PROCEDURE PRINT used:
      real time             4.50 seconds
      cpu time              0.07 seconds
```

```
proc print data=mylib.myproductsales;
   var region division actual;
run;
```

```
proc print data=sashelp.prdsale;
data sasuser.myproductsales;
   set sashelp.prdsale;
run;
proc print data=sasuser.myproductsales;
   where sales>5000;
run;
```

Your operating environment, and any options that you use when you start SAS, determine

- □ which of the main SAS windows are displayed by default
- □ their general appearance
- □ their position.

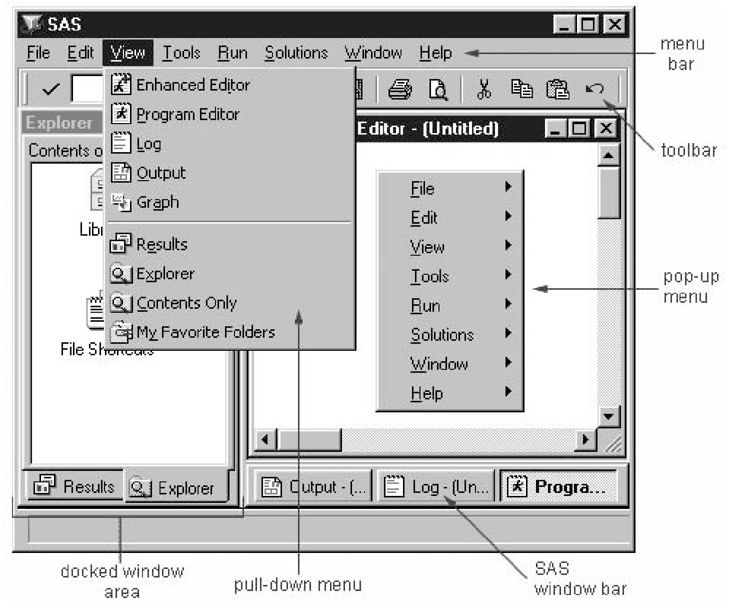
Features of SAS Windows

SAS windows have many features that help you get your work done. For example, you can

- □ maximize, minimize, and restore windows
- □ use pull-down menus, pop-up menus, and toolbars
- □ get more help.

You're probably familiar with most of these features, but you might want to check the tips at the bottom of this page.

This chapter and later chapters show SAS 9 windows in the Windows operating environment.



Minimizing and Restoring Windows

In the Windows and OS/2 environments, you can click the **`Minimize`** button to send a window that you aren't using to the SAS window bar. To restore the window to its former position, click the corresponding button on the SAS window bar.

In other operating environments, minimizing the window shrinks it to an icon.

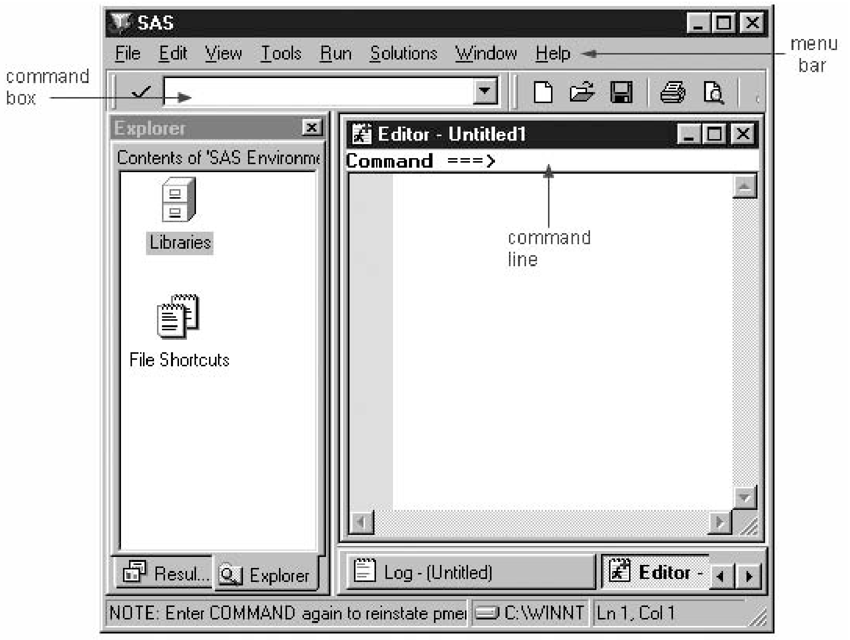
Docking and Undocking Windows

In the Windows and OS/2 environments, the Explorer and Results windows are docked by default, so they can be resized but not minimized. If you prefer, you can select **Window ▶ Docked** to undock the active window, or you can turn docking off completely in the Preferences dialog box.

Issuing Commands

In SAS, you can issue commands by

- making selections from a menu bar
- by typing commands in a command box (or Toolbox) or on a command line.



In most operating environments, SAS displays a menu bar by default. In the Windows environment, the menu bar selections correspond to the active window. To display a menu bar if it is not displayed, you can type **`pmenus`** in the command box (or ToolBox) or on the command line.

In all operating environments, SAS displays a command box (or ToolBox) or command line by default. You can display a command line in a particular window by activating that window and then using the Tools menu as indicated below:

- In the Windows environment, select **Tools** ▶ **Options** ▶ **Preferences**, then select the **`View`** tab and select the **`Command line`** checkbox.
- In the UNIX, VMS, and z/OS environments, select **Tools** ▶ **Options** ▶ **Turn Command Line On**.
- In the z/OS environment, you can display both a command line and a menu bar simultaneously in a window by selecting **Tools** ▶ **Options** ▶ **Command...**.

In the Windows, UNIX, and VMS operating environments, you can also display a command line in a window by activating the window, typing **`command`** in the command box (or ToolBox), and pressing Enter.

See the online help for a complete list of command-line commands.

Using Pop-Up Menus

Pop-up menus are context sensitive; they list actions that pertain only to a particular screen region or selection. Generally, you display pop-up menus by clicking the right mouse button. If you like, you can specify a function key to open pop-up menus. Simply select **Tools** ▶ **Options** ▶ **Keys** and type **`wpopup`** as a function key setting.

To open a pop-up menu in the z/OS or CMS operating environments, type **`?`** in the selection field beside the item.

Getting Help

Help is available for all windows in SAS. From the **`Help`** menu, you can access comprehensive online help and documentation for SAS, or you can access task-oriented help for the active window. The Help menu is discussed in more detail later in this chapter.

Customizing Your SAS Environment

You can customize many features of the SAS workspace such as toolbars, pop-up menus, icons, and so on. Select the **`Tools`** menu to explore some of the customization options that are available.

You'll practice using features of SAS windows throughout this chapter. Now let's look at each of the main SAS windows individually.

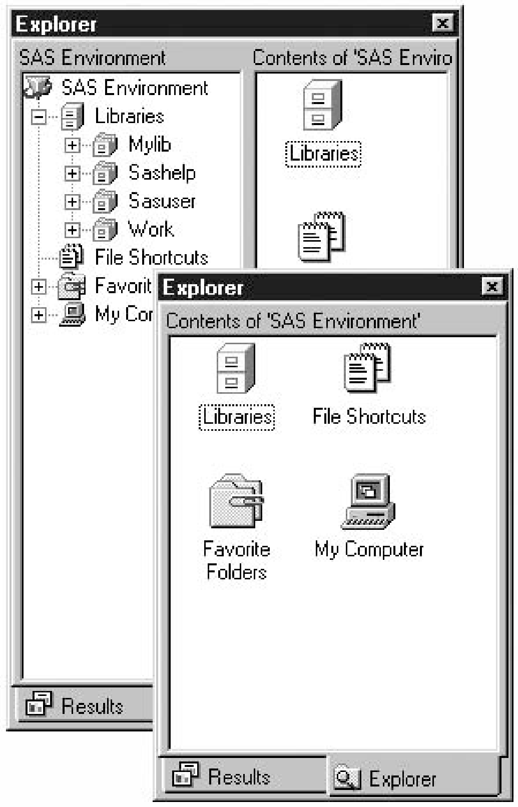
The Explorer Window

In the Explorer window, you can view and manage your SAS files, which are stored in SAS data libraries. Recall that the library name is a logical name for the physical location of the files (such as a directory). You can think of the library name as a temporary nickname or shortcut.

You use the Explorer window to

- □ create new libraries and SAS files
- □ open any SAS file
- □ perform most file management tasks such as moving, copying, and deleting files
- □ create shortcuts to files that were not created with SAS.

Notice that the Explorer window displays a tree view of its contents.



You can display the Explorer window by selecting **View ▶ Explorer**. In the Windows and z/OS operating environments, if the Explorer window is docked, you can click the **`Explorer`** tab to display the window.

Navigating the Explorer Window

You can find your way around the Explorer window by double-clicking folders to open them and see their contents. You can also use pop-up menus to perform actions on a file (such as viewing its properties, or copying it). Pop-up menus contain different options for different file types.

To open a pop-up menu in the z/OS or CMS operating environments, type **?** in the selection field beside the item in the Explorer window. To simulate a double-click, type **s** in the selection field beside the item.

Code Editing Windows

You can use the following editors to write and edit SAS programs:

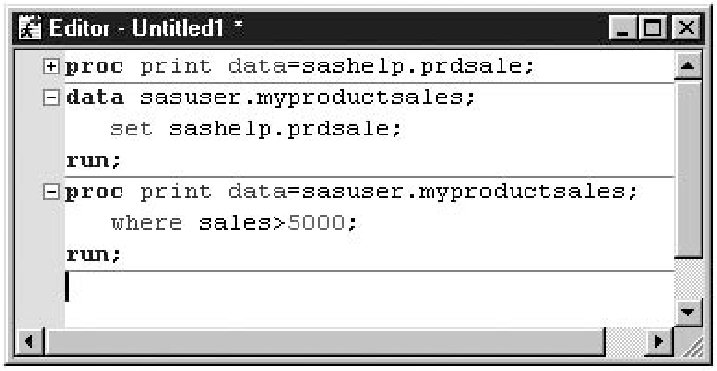
- the Enhanced Editor window
- the Program Editor window
- the SAS Notepad window
- the host editor of your choice.

This training focuses on the two SAS code editing windows: the Enhanced Editor and the Program Editor windows. The Enhanced Editor is available only in the Windows environment.

The features of both editors are described below. In the remaining chapter and in future chapters, the general term code editing window will be used to refer to your preferred SAS code editing window.

Enhanced Editor Window

In the Windows operating environment, an Enhanced Editor window opens by default. You can use the Enhanced Editor window to enter, edit, and submit SAS programs. The initial window title is Editor - Untitled*n* until you open a file or save the contents of the editor to a file. Then the window title changes to reflect that filename. When the contents of the editor are modified, an asterisk is added to the title.



```
proc print data=sashelp.prdsale;
data sasuser.myproductsales;
   set sashelp.prdsale;
run;
proc print data=sasuser.myproductsales;
   where sales>5000;
run;
```

You can redisplay or open additional Enhanced Editor windows by selecting **View ▶ Enhanced Editor**.

Enhanced Editor Features

In the Enhanced Editor, you can perform standard editing tasks such as

- opening SAS programs in various ways, including drag and drop

□ entering, editing, and submitting SAS programs
□ using the command line or menus
□ saving SAS programs
□ clearing contents.

In addition, the Enhanced Editor provides useful editing features, including

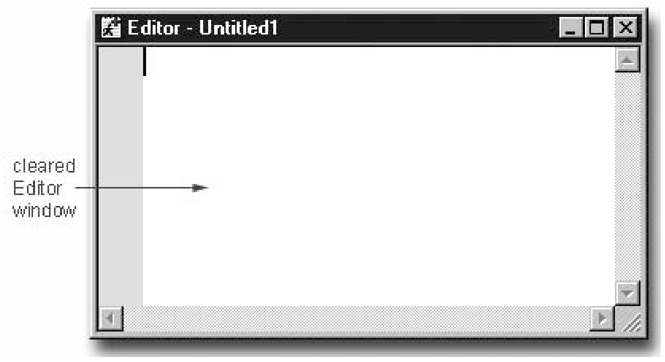
□ color coding and syntax checking of the SAS programming language
□ expandable and collapsible sections
□ recordable macros
□ support for keyboard shortcuts (Alt or Shift plus keystroke)
□ multi-level undo and redo.

For more information about the Enhanced Editor, open or activate the Enhanced Editor window, then select **Help** ▶ **Using This Window**.

Clearing the Editor

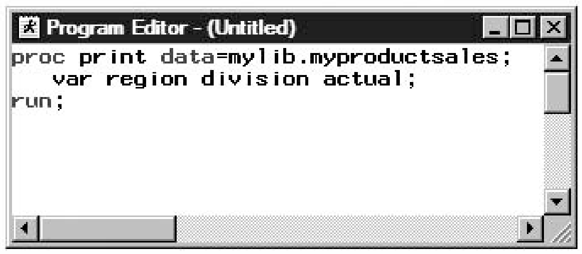
In the Enhanced Editor and the SAS Notepad window, the code does not disappear when you submit it.

To clear any of these windows, you can activate the window and select **Edit** ▶ **Clear All**.



The Program Editor Window

As in the Enhanced Editor window, in the Program Editor window you enter, edit, and submit SAS programs. You can also open existing SAS programs. You can display the Program Editor window by selecting **View** ▶ **Program Editor**.



```
proc print data=mylib.myproductsales;
   var region division actual;
run;
```

Features

As in the Enhanced Editor window, in the Program Editor window you can perform standard editing tasks such as

- □ opening SAS programs in various ways, including drag and drop
- □ entering, editing, and submitting SAS programs
- □ using the command line or menus
- □ saving SAS programs
- □ clearing contents
- □ recalling submitted statements.

However, the Program Editor does not provide some features of the enhanced Editor, such as color-coding and syntax checking (this feature is available in SAS 9.2), expandable and collapsible sections, and recordable macros.

For more information about these features, open or activate the Program Editor window, then select **Help ▶ Using This Window**.

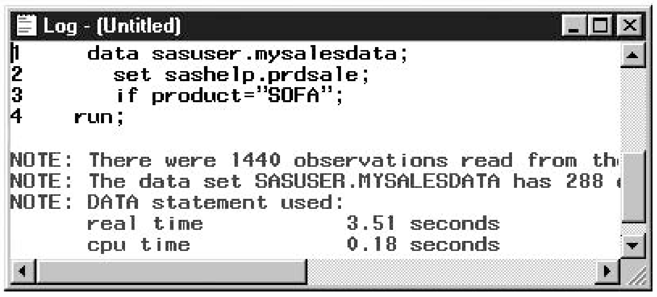
Clearing the Editor

At any time you can clear program code from the Program Editor window by activating the window and selecting **Edit ▶ Clear All**.

When you submit SAS programs in the Program Editor window, the code in the window is automatically cleared.

The Log Window

The Log window displays messages about your SAS session and about any SAS programs that you submit. You can display the Log window by selecting **View ▶ Log**.



```
1     data sasuser.mysalesdata;
2       set sashelp.prdsale;
3       if product="SOFA";
4    run;

NOTE: There were 1440 observations read from th
NOTE: The data set SASUSER.MYSALESDATA has 288 
NOTE: DATA statement used:
      real time           3.51 seconds
      cpu time            0.18 seconds
```

In the previous practice, you submitted a SAS program that produced log messages similar to those shown above.

The Output Window

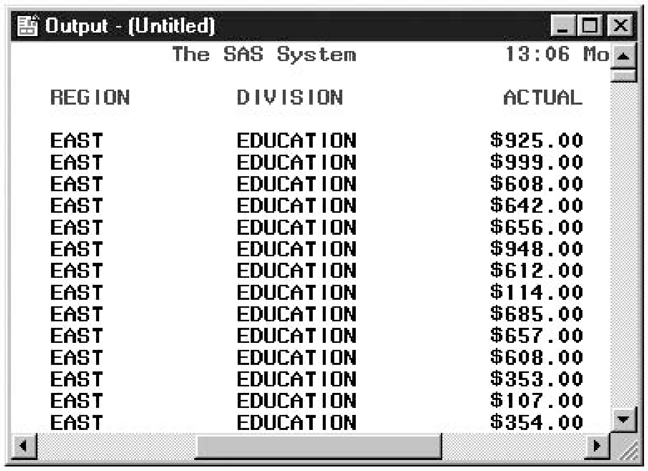
You can create two basic types of SAS output:

- □ a listing, which is traditional SAS output
- □ an HTML document.

In the Output window, you browse listing output from SAS programs that you submit. (You can use a browser to view HTML output.)

By default, the Output window is positioned behind the code editing and Log windows. When you create output, the Output window automatically moves to the front of your display.

You can display the Output window at any time by selecting **View ▶ Output**.



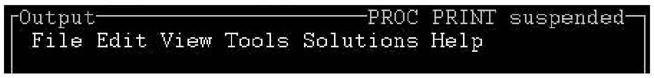
```
             The SAS System           13:06 Mo

  REGION        DIVISION            ACTUAL

  EAST          EDUCATION          $925.00
  EAST          EDUCATION          $999.00
  EAST          EDUCATION          $608.00
  EAST          EDUCATION          $642.00
  EAST          EDUCATION          $656.00
  EAST          EDUCATION          $948.00
  EAST          EDUCATION          $612.00
  EAST          EDUCATION          $114.00
  EAST          EDUCATION          $685.00
  EAST          EDUCATION          $657.00
  EAST          EDUCATION          $608.00
  EAST          EDUCATION          $353.00
  EAST          EDUCATION          $107.00
  EAST          EDUCATION          $354.00
```

Not all SAS programs create output in the Output window. Some open interactive windows. Others, such as the programs that you submitted earlier in this chapter, only produce messages in the Log window.

⚠ In mainframe operating environments, when you create multiple pages of output, a message in the Output window border indicates that the procedure is suspended. In the example below, PROC PRINT output is suspended.



```
Output                    PROC PRINT suspended
 File Edit View Tools Solutions Help
```

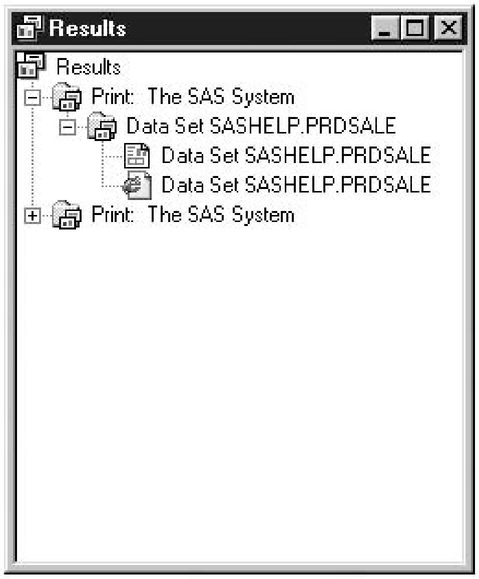
To remove the message and view the remaining output, simply scroll to the bottom of the output.

The Results Window

The Results window helps you navigate and manage output from SAS programs that you submit. You can view, save, and print individual items of output.

On most operating systems, the Results window is positioned behind the Explorer window and is empty until you submit a SAS program that creates output. Then the Results window moves to the front of your display. You can display the Results window at any time by selecting **View ▶ Results**.

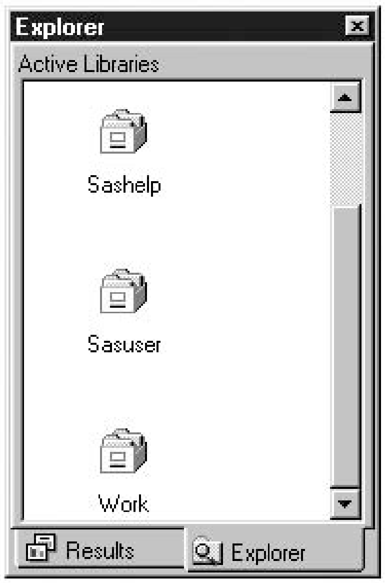
The Results window displays separate icons for listing output and HTML output. In the example below, the first Print folder contains both types of output.



Creating SAS Libraries

Earlier in this chapter, you saw that SAS files are stored in libraries. By default, SAS defines several libraries for you (including Sashelp, Sasuser, and Work). You can also define additional libraries.

Sashelp	a permanent library that contains sample data and other files that control how SAS works at your site. This is a read-only library.
Sasuser	a permanent library that contains SAS files in the Profile catalog that store your personal settings. This is also a convenient place to store your own files.
Work	a temporary library for files that do not need to be saved from session to session.



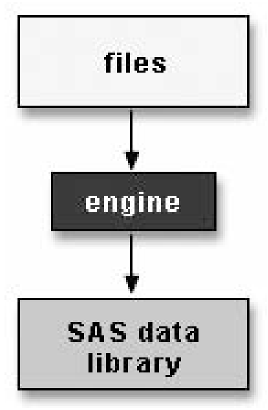
□ You can also *define* additional libraries. When you define a library, you indicate the location of your SAS files to SAS. Once you define a library, you can manage SAS files within it.

□ When you *delete* a SAS library, the pointer to the library is deleted, and SAS no longer has access to the library. However, the contents of the library still exist in your operating environment.

Defining Libraries

To define a library, you assign a library name to it and specify a path, such as a directory path. (In some operating environments you must create the directory or other storage location before defining the library.)

You also specify an engine, which is a set of internal instructions that SAS uses for writing to and reading from files in a library.



In this chapter, you learn how to define SAS libraries using SAS windows. You can also define SAS libraries using programming statements. shows you how to write LIBNAME statements to define SAS libraries.

In the next practice, look at the engines that are available for creating libraries. Depending on your operating environment and on the SAS/ACCESS products that you license, you can create libraries with various engines. Each engine enables you to read a different file format, including file formats from other software vendors.

Creating and Using File Shortcuts

You've seen that the Explorer window gives you access to your SAS files. You can also create a file shortcut to an external file.

An external file is a file that is created and maintained in your host operating environment. External files contain data or text, such as

□ SAS programming statements

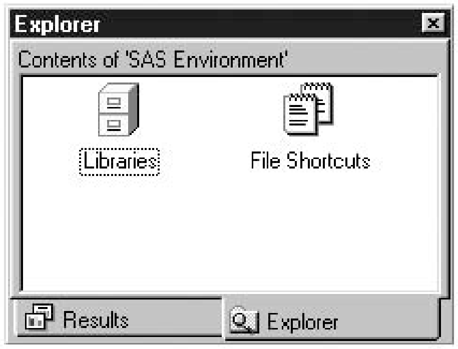
□ records of raw data

□ procedure output.

SAS can use external files, but they are not managed by SAS.

A file shortcut (or *fileref*) is an optional name that is used to identify an external file to SAS. File shortcuts are stored in the File Shortcuts folder in the Explorer window. You can use a file shortcut to open, browse, and submit a file.

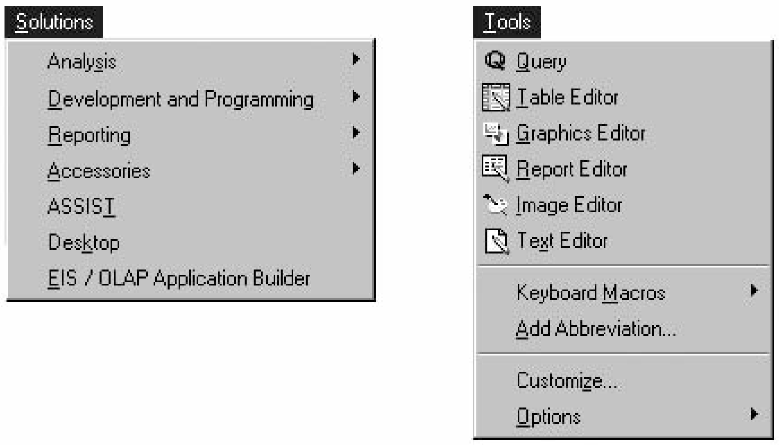
When you delete a file shortcut, the pointer to the file is deleted, and SAS no longer has access to the file. However, the file still exists in your operating environment.



If you have used SAS before, a file shortcut is the same as a *file reference* or *fileref*.

Using SAS Solutions and Tools

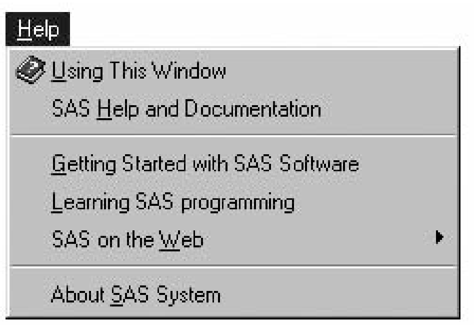
Along with windows for working with your SAS files and SAS programs, SAS provides a set of ready-to-use solutions, applications, and tools. You can access many of these tools by using the Solutions and Tools menus.



For example, earlier in this chapter you opened the Sashelp.Prdsale table, which was displayed in the table editor by default. You can also open the table editor from the Tools menu. Then you can enter, browse, or edit data.

Getting Help

You've learned to use SAS windows to perform common SAS tasks. As you begin working in SAS, be sure to take advantage of the different types of online help that are available from the Help menu.



- **`Using This Window`** is task-oriented help for the active window.
- **`SAS Help and Documentation`** is a complete guide to syntax, examples, procedures, concepts, and what's new.
- **`Getting Started tutorials`** are listed under Help for products where they are available.
- Selecting **`Learning SAS programming`** enables you to create data that is used in online training courses, and displays SAS OnlineTutor if you have a site license.
- If you have Internet access, **`SAS on the Web`** provides links to information including Technical Support and Frequently Asked Questions.

In SAS, Version 8, both documentation and SAS OnlineTutor are located under **`Books and Training`**.

In SAS 9, **`About SAS System`** reads **`About SAS 9`**.

For a quick overview of how to access SAS online help, documentation, and other resources from your SAS software or on the web, select **Help ▶ SAS Documentation** from the top of this page or any chapter page.

Chapter Summary

Text Summary

Components of SAS Programs

SAS programs consist of two types of steps: DATA steps and PROC (procedure) steps. These two steps, alone or combined, form most SAS programs. A SAS program can consist of a DATA step, a PROC step, or any combination of DATA and PROC steps. DATA steps typically create or modify SAS data sets, but they can also be used to produce custom-designed reports. PROC steps are pre-written routines that enable you to analyze and process the data in a SAS data set and to present the data in the form of a report. They sometimes create new SAS data sets that contain the results of the procedure.

Characteristics of SAS Programs

SAS programs consist of SAS statements. A SAS statement usually begins with a SAS keyword and always ends with a semicolon. A DATA step begins with the keyword DATA. A PROC step begins with the keyword PROC. SAS statements are free-format, so they can begin and end anywhere on a line. One statement can continue over several lines, and several statements can be on a line. Blanks or special characters separate "words" in a SAS statement.

Processing SAS Programs

When you submit a SAS program, SAS reads SAS statements and checks them for errors. When it encounters a subsequent DATA, PROC, RUN, or QUIT statement, SAS executes the previous step in the program.

Each time a step is executed, SAS generates a log of the processing activities and the results of the processing. The SAS log collects messages about the processing of SAS programs and about any errors that occur.

The results of processing can vary. Some SAS programs open an interactive window or invoke procedures that create output in the form of a report. Other SAS programs perform tasks such as sorting and managing data, which have no visible results other than messages in the log.

SAS Libraries

Every SAS file is stored in a SAS library, which is a collection of SAS files such as SAS data sets and catalogs. In some operating environments, a SAS library is a physical collection of files. In others, the files are only logically related. In the Windows and UNIX environments, a SAS library is typically a group of SAS files in the same folder or directory.

Depending on the libref you use, you can store SAS files in temporary SAS libraries or in permanent SAS libraries.

- Temporary SAS files that are created during the session are held in a special work space that is assigned the default libref Work. If you don't specify a libref when you create a file (or if you specify Work), the file is stored in the temporary SAS library. When you end the session, the temporary library is deleted.
- To store files permanently in a SAS library, you assign it a libref other than the default Work. For example, by assigning the libref Clinic to a SAS library, you specify that files within the library are to be stored until you delete them.

Referencing SAS Files

To reference a SAS file, you use a two-level name, *libref.filename*. In the two-level name, *libref* is the name for the SAS library that contains the file, and *filename* is the name of the file itself. A period separates the libref and filename.

To reference temporary SAS files, you specify the default libref Work, a period, and the filename. Alternatively, you can simply use a one-level name (the filename only) to reference a file in a temporary SAS library. Referencing a SAS file in any library *except Work* indicates that the SAS file is stored permanently.

SAS data set names can be 1 to 32 characters long, must begin with a letter (A-Z, either uppercase or lowercase) or an underscore (_), and can continue with any combination of numbers, letters, or underscores.

SAS Data Sets

For many of the data processing tasks that you perform with SAS, you access data in the form of a SAS data set and use SAS programs to analyze, manage, or present the data. Conceptually, a SAS data set is a file that consists of two parts: a descriptor portion and a data portion. Some SAS data sets also contain one or more indexes, which enable SAS to locate records in the data set more efficiently.

The descriptor portion of a SAS data set contains information about the data set.

The data portion of a SAS data set is a collection of data values that are arranged in a rectangular table. Observations in the data set correspond to rows or data lines in a raw data file or in an external database. An observation is the information about each object in a SAS data set. Variables in the data set correspond to columns in a raw data file or in an external database. A variable is the set of data values that describe a particular characteristic. If a data value is unknown for a particular observation, a missing value is recorded in the SAS data set.

Variable Attributes

In addition to general information about the data set, the descriptor portion contains attribute information for each variable in the data set. The attribute information includes the variable's name, type, and length. A variable's type determines how missing values for a variable are displayed by SAS. For character variables, a *blank* represents a missing value. For numeric variables, a *period* represents a missing value. You can also specify format, informat, and label attributes for variables.

Using the Main SAS Windows

You use the following windows to explore and manage your files, to enter and submit SAS programs, to view messages, and to view and manage your output.

Use this window ...	**To ...**
Explorer	view your SAS files
	create new libraries and SAS files
	perform most file management tasks such as moving, copying, and deleting files
	create shortcuts to files that were not created with SAS
Enhanced Editor (code editing window)	enter, edit, and submit SAS program
	The Enhanced Editor window is available only in the Windows operating environment.
Program Editor (code editing window)	enter, edit, and submit SAS programs
Log	view messages about your SAS session and about any SAS programs that you submit
Output	browse output from SAS programs
Results	navigate and manage output from SAS programs
	view, save, and print individual items of output

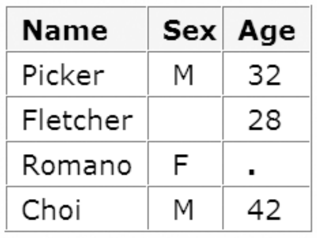
Points to Remember

- □ Before referencing SAS files, you must assign a name (libref, or library reference) to the library in which the files are stored (or specify that SAS is to assign the name automatically).
- □ You can store SAS files either temporarily or permanently.
- □ Variable names follow the same rules as SAS data set names. However, your site may choose to restrict variable names to those valid in Version 6 SAS, to uppercase variable names automatically, or to remove all restrictions on variable names.

Chapter Quiz

Select the best answer for each question. After completing the quiz, you can check your answers using the answer key in the appendix.

1 How many observations and variables does the data set below contain?



Name	Sex	Age
Picker	M	32
Fletcher		28
Romano	F	.
Choi	M	42

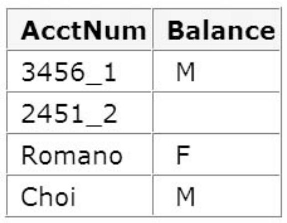
a 3 observations, 4 variables
b 3 observations, 3 variables
c 4 observations, 3 variables
d can't tell because some values are missing

2 How many program steps are executed when the program below is processed?

```
data user.tables;
   infile jobs;
   input date name $ job $;
run;
proc sort data=user.tables;
   by name;
run;
proc print data=user.tables;
run;
```

a three
b four
c five
d six

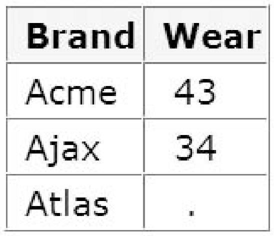
3 What type of variable is the variable AcctNum in the data set below?



AcctNum	Balance
3456_1	M
2451_2	
Romano	F
Choi	M

a numeric
b character
c can be either character or numeric
d can't tell from the data shown

4 What type of variable is the variable Wear in the data set below, assuming that there is a missing value in the data set?



Brand	Wear
Acme	43
Ajax	34
Atlas	.

a numeric
b character
c can be either character or numeric
d can't tell from the data shown

5 Which of the following variable names is valid?

a 4BirthDate
b $Cost
c _Items_
d Tax-Rate

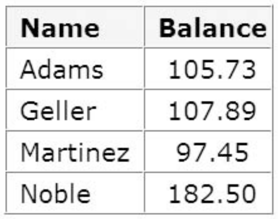
6 Which of the following files is a permanent SAS file?

a Sashelp.PrdSale
b Sasuser.MySales
c Profits.Quarter1
d all of the above

7 In a DATA step, how can you reference a temporary SAS data set named Forecast?

a Forecast
b Work.Forecast
c Sales.Forecast (after assigning the libref Sales)
d only a and b above

8 What is the default length for the numeric variable Balance?



Name	Balance
Adams	105.73
Geller	107.89
Martinez	97.45
Noble	182.50

a 5
b 6
c 7
d 8

9 How many statements does the following SAS program contain?

```
proc print data=new.prodsale
                label double;
   var state day price1 price2; where state='NC';
   label state='Name of State'; run;
```

   a three
   b four
   c five
   d six

10 What is a SAS library?

   a collection of SAS files, such as SAS data sets and catalogs
   b in some operating environments, a physical collection of SAS files
   c in some operating environments, a logically related collection of SAS files
   d all of the above