THE POWER TO KNOW.

SAS® Certification Prep Guide: Base Programming for SAS®9, Fourth Edition

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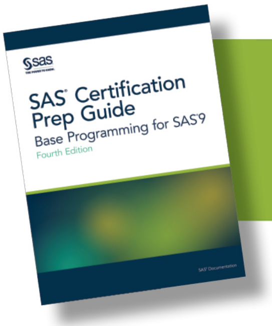

An Introduction to SAS® Certification Guide: Base Programming for SAS®9, Fourth Edition. Full book available for purchase here.

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How to Prepare for the SAS Base Programming for SAS®9 Exam

Requirements and Details

Requirements

To complete examples in this book, you must have access to Base SAS, SAS Enterprise Guide, or SAS Studio. See Chapter 1, “Setting Up Practice Data,” to ensure you have proper access.

Exam Objectives and Updates to This Book

The current exam objectives and a list of any updates to this book are available at www.sas.com/certify. Exam objectives are subject to change.

Take a Practice Exam

Practice exams are available for purchase through SAS and Pearson VUE. For more information about practice exams, see www.sas.com/base_programmer_cert.

Registering for the Exam

To register for the official SAS Base Programming for SAS®9 exam, see the SAS Global Certification website at www.sas.com/certify.

Additional Resources for Learning SAS Programming

From SAS Software	
Help	• SAS®9: Select **Help** ⇨ **SAS Help and Documentation**. • SAS Enterprise Guide: Select **Help** ⇨ **SAS Enterprise Guide Help**. • SAS Studio: Select the Help icon ? .
Documentation	• SAS®9: Select **Help** ⇨ **SAS Help and Documentation**. • SAS Enterprise Guide: Access online documentation on the web. • SAS Studio: Select the Help icon ? and then click **Help**.

On the Web	
Base SAS Glossary	support.sas.com/baseglossary
Bookstore	www.sas.com/books
Certification	www.sas.com/certify
Community	communities.sas.com
Knowledge Base	support.sas.com/notes
Learning Center	www.sas.com and click **Learn**. Then select **Get Started Learning SAS**.
SAS Documentation	support.sas.com/documentation documentation.sas.com
SAS Global Academic Program	www.sas.com and click **Learn**. Then select **For Students and Educators**.
SAS OnDemand	support.sas.com/ondemand/
Training	www.sas.com/training
Technical Support	support.sas.com. Then select **Technical Support**.

Syntax Conventions

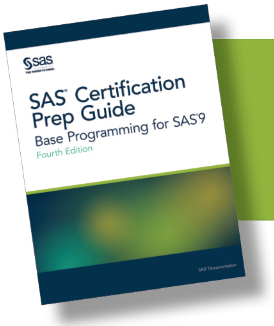
In this book, SAS syntax looks like this example:

DATA *output-SAS-data-set*
        (**DROP**=*variables(s)* | **KEEP**=*variables(s)*);
    SET *SAS-data-set* <*options*>;
    BY *variable(s)*
RUN;

Here are the conventions that are used in the example:

- DATA, DROP=, KEEP=, SET, BY, and RUN are in uppercase bold because they must be spelled as shown.
- *output-SAS-data-set*, *variable(s)*, *SAS-data-set*, and *options* are in italics because each represents a value that you supply.
- <*options*> is enclosed in angle brackets because it is optional syntax.
- DROP= and KEEP= are separated by a vertical bar (|) to indicate that they are mutually exclusive.

The example syntax that is shown in this book includes only what you need to know in order to prepare for the certification exam. For complete syntax, see the appropriate SAS reference guide.



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Base Programming for SAS9
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Getting Started

In the SAS Base Programming for SAS®9 exam, you are not tested on the details of running SAS software in the various environments. However, you might find such information useful when working with the practice data.

You can access a brief overview on the windows and menus of the SAS windowing environment, Enterprise Guide, and SAS Studio at http://video.sas.com/. From **Categories** select **How To Tutorials** ⇨ **Programming**. Select the video for your SAS environment. Other tutorials are available from the SAS website.

The Basics of the SAS Language

SAS Statements

A SAS statement is a type of SAS language element that is used to perform a particular operation in a SAS program or to provide information to a SAS program. SAS statements are free-format. This means that they can begin and end anywhere on a line, that one statement can continue over several lines, and that several statements can be on the same line. Blank or special characters separate words in a SAS statement.

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

Here are two important rules for writing SAS programs:

- A SAS statement ends with a semicolon.
- A statement usually begins with a SAS keyword.

There are two types of SAS statements:

- statements that are used in DATA and PROC steps
- statements that are global in scope and can be used anywhere in a SAS program

Global Statements

Global statements are used anywhere in a SAS program and stay in effect until changed or canceled, or until the SAS session ends. Here are some common global statements: TITLE, LIBNAME, OPTIONS, and FOOTNOTE.

DATA Step

The DATA step creates or modifies data. The input for a DATA step can be of several types, such as raw data or a SAS data set. The output from a DATA step can be of several types, such as a SAS data set or a report. A SAS data set is a data file that is formatted in a way that SAS can understand.

For example, you can use DATA steps to do the following:

- 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, supersetting, merging, and updating existing data sets

PROC Step

The PROC (procedure) step analyzes data, produces output, or manages SAS files. The input for a PROC step is usually a SAS data set. The output from a PROC step can be of several types, such as a report or an updated SAS data set.

For example, you can use PROC steps to do the following:

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

A Simple SAS Program

This program uses an existing SAS data set to create a new SAS data set containing a subset of the original data set. It then prints a listing of the new data set using PROC PRINT.

```
data sasuser.admit2;
   set sasuser.admit;
   where age>39;
run;
proc print data=sasuser.admit2;
run;
```

The sample SAS program contains a DATA step and a PROC step. The DATA step produced a new SAS data set. Only those observations with an age value greater than 39 are written to the new SAS data set.

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. The sample program contains the following statements:

Table 2.1 *SAS Program Statements*

Statements	Sample Program Code
DATA statement	`data sasuser.admit2;`
SET statement	`set sasuser.admit;`
Additional programming statements	`where age>39;`
RUN statement	`run;`
PROC PRINT statement	`proc print data=sasuser.admit2;`

Statements	Sample Program Code
RUN statement	`run;`

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. The RUN statement (for most procedures and the DATA step) and the QUIT statement (for some procedures) mark step boundaries. The beginning of a new step (DATA or PROC) also implies the end of the previous step. At a step boundary, SAS executes any statements that have not previously executed and ends the step. In the sample program, each step ends with a RUN statement.

```
data sasuser.admit2;
   set sasuser.admit;
   where age>39;
run;
proc print data=sasuser.admit2;
run;
```

TIP The RUN statement is not required between steps in a SAS program. It is a best practice to use a RUN statement because it can make the SAS program easier to read and the SAS log easier to understand when debugging.

Log Messages

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

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

Log 2.1 *SAS Log Messages for Each Program Step*

```
5    data sasuser.admit2;
6        set sasuser.admit;
7        where age>39;
8    run;

NOTE: There were 10 observations read from the data set SASUSER.ADMIT.
      WHERE age>39;
NOTE: The data set SASUSER.ADMIT2 has 10 observations and 9 variables.
NOTE: DATA statement used (Total process time):
      real time           0.00 seconds
      cpu time            0.00 seconds

9    proc print data=sasuser.admit2;
NOTE: Writing HTML Body file: sashtml.htm
10   run;

NOTE: There were 10 observations read from the data set SASUSER.ADMIT2.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.35 seconds
      cpu time            0.24 seconds
```

Results of Processing

The DATA Step

Suppose you submit the sample program below:

```
data sasuser.admit2;
    set sasuser.admit;
    where age>39;
run;
```

When the program is processed, it creates a new SAS data set (sasuser.admit2) containing only those observations with age values greater than 39. The DATA step creates a new data set and produces messages in the SAS log, but it does not create a report or other output.

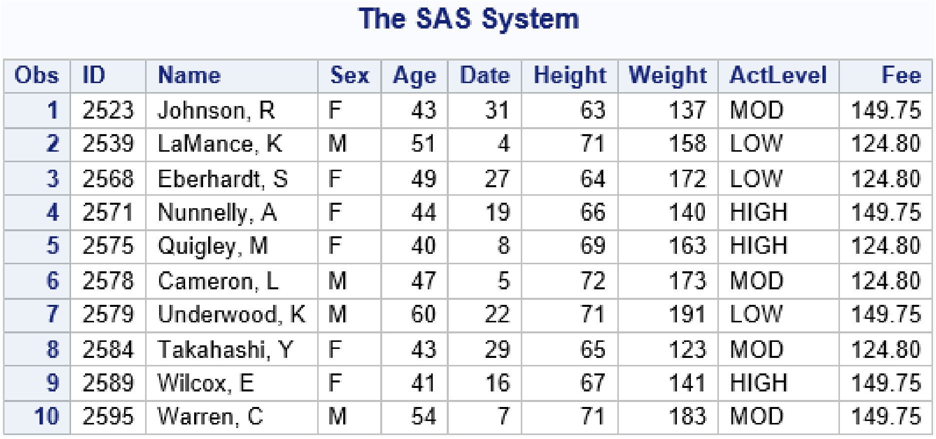
The PROC Step

If you add a PROC PRINT step to this same example, the program produces the same new data set as before, but it also creates the following report, which is displayed in HTML:

```
data sasuser.admit2;
    set sasuser.admit;
    where age>39;
run;
proc print data=sasuser.admit2;
run;
```

Note: The default output in SAS Enterprise Guide is SAS Report. To change the default output in SAS Enterprise Guide to HTML, click **Tools** and select **Options** ⇨ **Results** ⇨ **Results General**. Then select HTML. Ensure that you have cleared SAS Report.

Figure 2.1 PRINT Procedure Output



The SAS System

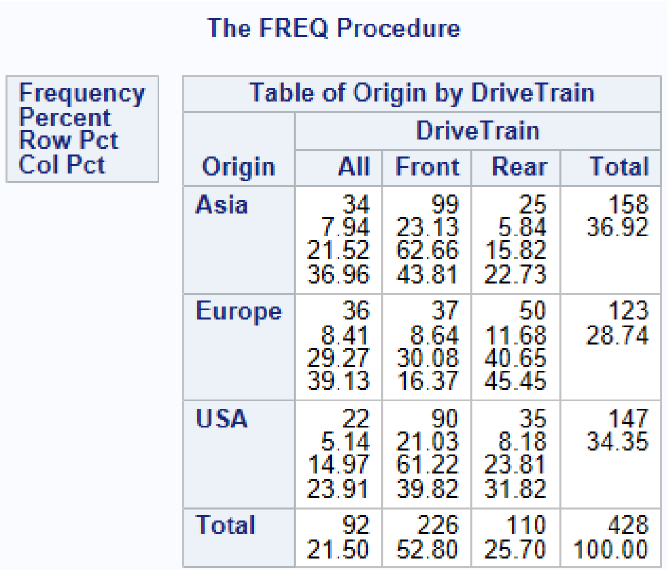
Obs	ID	Name	Sex	Age	Date	Height	Weight	ActLevel	Fee
1	2523	Johnson, R	F	43	31	63	137	MOD	149.75
2	2539	LaMance, K	M	51	4	71	158	LOW	124.80
3	2568	Eberhardt, S	F	49	27	64	172	LOW	124.80
4	2571	Nunnelly, A	F	44	19	66	140	HIGH	149.75
5	2575	Quigley, M	F	40	8	69	163	HIGH	124.80
6	2578	Cameron, L	M	47	5	72	173	MOD	124.80
7	2579	Underwood, K	M	60	22	71	191	LOW	149.75
8	2584	Takahashi, Y	F	43	29	65	123	MOD	124.80
9	2589	Wilcox, E	F	41	16	67	141	HIGH	149.75
10	2595	Warren, C	M	54	7	71	183	MOD	149.75

Other Procedures

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

```
proc freq data=sashelp.cars;
  table origin*DriveTrain;
run;
```

Figure 2.2 FREQ Procedure Output



The FREQ Procedure

Frequency
Percent
Row Pct
Col Pct

Table of Origin by DriveTrain				
	DriveTrain			
Origin	All	Front	Rear	Total
Asia	34 7.94 21.52 36.96	99 23.13 62.66 43.81	25 5.84 15.82 22.73	158 36.92
Europe	36 8.41 29.27 39.13	37 8.64 30.08 16.37	50 11.68 40.65 45.45	123 28.74
USA	22 5.14 14.97 23.91	90 21.03 61.22 39.82	35 8.18 23.81 31.82	147 34.35
Total	92 21.50	226 52.80	110 25.70	428 100.00

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=sasuser out=work;
   select admit;
run;
```

Log 2.2 *SAS Log: COPY Procedure Output*

```
11   proc copy in=sasuser out=work;
12       select admit;
13   run;

NOTE: Copying SASUSER.ADMIT to WORK.ADMIT (memtype=DATA).
NOTE: There were 21 observations read from the data set SASUSER.ADMIT.
NOTE: The data set WORK.ADMIT has 21 observations and 9 variables.
NOTE: PROCEDURE COPY used (Total process time):
      real time           0.02 seconds
      cpu time            0.01 seconds
```

SAS Libraries

Definition

A SAS library contains one or more files that are defined, recognized, and accessible by SAS, and that are referenced and stored as a unit. One special type of file is called a *catalog*. In SAS libraries, catalogs function much like subfolders for grouping other members.

Predefined SAS Libraries

By default, SAS defines several libraries for you:

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 and that stores your personal settings. This is also a convenient place to store your own files.

  Note: If you are using SAS Studio or SAS University Edition, you might not have Write access to the Sasuser directory. To verify whether you have Write access, see “Determine Whether You Have Write Access” on page 1.

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. After you define a library, you can manage SAS files within it.

Note: If you are using SAS Studio, you might encounter Webwork library. Webwork is the default output library in interactive mode. For more information about the Webwork library, see *SAS Studio: User's Guide*.

Defining Libraries

To define a library, you assign a library name to it and specify the location of the files, such as a directory path.

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

You can define SAS libraries using programming statements. For information about how to write LIBNAME statements to define SAS libraries, see Assigning Librefs on page 28.

TIP Depending on your operating environment and 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.

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.

How SAS Files Are Stored

A SAS library is the highest level of organization for information within SAS.

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.

Table 2.2 *Environments and SAS Libraries*

Environment	Library Definition
Windows, UNIX	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.
z/OS	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.

Table 2.3 *Temporary and Permanent SAS Libraries*

Temporary SAS libraries last only for the current SAS session.	If you do not 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 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.	To store files permanently in a SAS library, specify a library name other than the default library name Work. For example, by specifying the library name **`sasuser`** when you create a file, you specify that the file is to be stored in a permanent SAS library until you delete it.

Referencing SAS Files

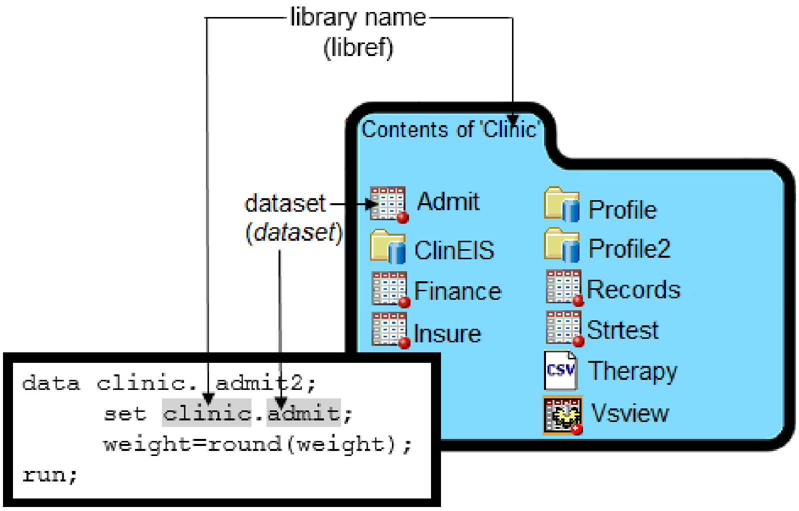
Referencing Permanent SAS Data Sets

To reference a permanent SAS data set in your SAS programs, use a two-level name consisting of the library name and the data set name:

libref.dataset

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

Figure 2.3 *Two-Level Permanent SAS Name*



```
data clinic. admit2;
      set clinic.admit;
      weight=round(weight);
run;
```

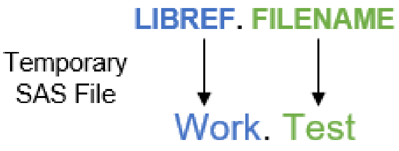
For example, suppose you want to create a new permanent SAS library named Clinic. In the sample program, Clinic.Admit is the two-level name for the SAS data set Admit, which is stored in the library named Clinic.

```
data clinic.admit2;
   set clinic.admit;
   weight =round(weight);
run;
```

Referencing Temporary SAS Files

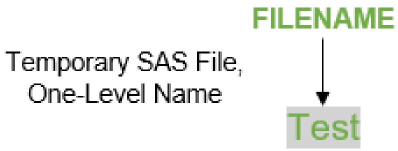
To reference temporary SAS files, you can specify the default libref Work, a period, and the data set name. For example, the two-level name, Work.Test, references the SAS data set named Test that is stored in the temporary SAS library Work.

Figure 2.4 Two-Level Temporary SAS Library Name



Alternatively, you can use a one-level name (the data set name 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.

Figure 2.5 One-Level Temporary SAS Library Name



Rules for SAS Names

The following rules apply to the names of SAS data sets, variables, and libraries:

- They must begin with a letter (A-Z, either uppercase or lowercase) or an underscore (_).
- They can continue with any combination of numbers, letters, or underscores.
- They can be 1 to 32 characters long.
- SAS library names (librefs) can be 1 to 8 characters long.

These are examples of valid data set names and variable names:

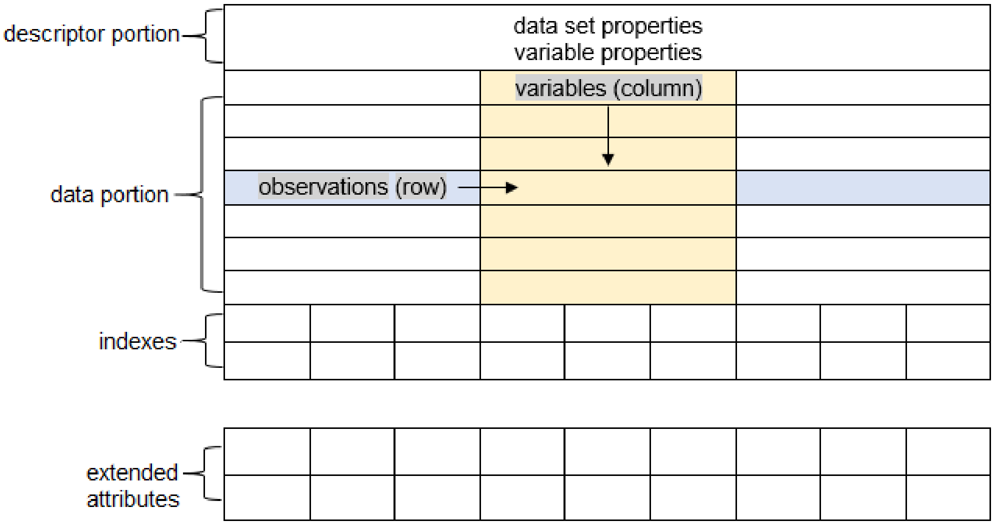
- Payroll
- LABDATA1995_1997
- _EstimatedTaxPayments3

SAS Data Sets

Overview of Data Sets

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 rows in the data set more efficiently. (The data sets that are shown in this chapter do not contain indexes.) Extended attributes are user-defined attributes that further define a SAS data set.

Figure 2.6 *Parts of a SAS Data Set*



Descriptor Portion

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

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

The table below lists part of the descriptor portion of the data set sasuser.insure, which contains insurance information for patients who are admitted to a wellness clinic.

Table 2.4 *Descriptor Portion of Attributes in a SAS Data Set*

Data Set Name:	SASUSER.INSURE
Member Type:	DATA

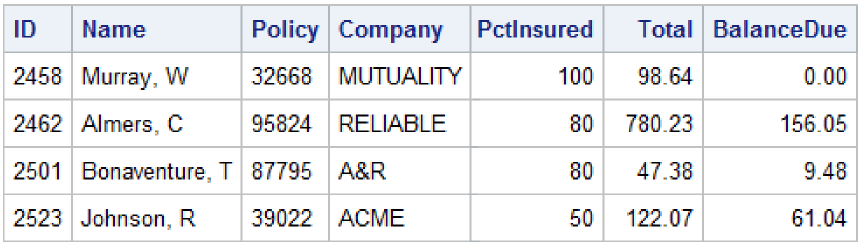
Engine:	V9
Created:	10:05 Thursday, February 16, 2017
Observations:	21
Variables:	7
Indexes:	0
Observation Length:	64

Data Portion

Data Portion Overview

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 company **MUTUALITY** is a data value, Policy **32668** is a data value, and so on.

Figure 2.7 Parts of a SAS Data Set: Data Portion

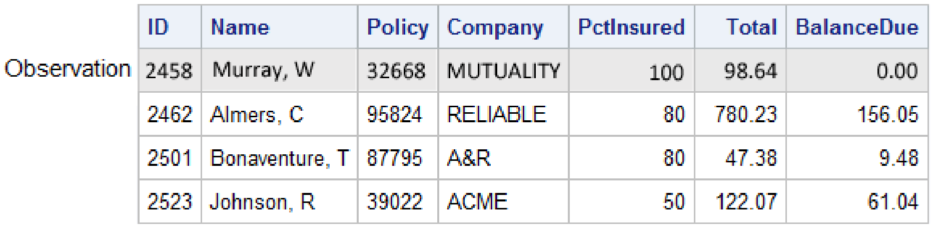


ID	Name	Policy	Company	PctInsured	Total	BalanceDue
2458	Murray, W	32668	MUTUALITY	100	98.64	0.00
2462	Almers, C	95824	RELIABLE	80	780.23	156.05
2501	Bonaventure, T	87795	A&R	80	47.38	9.48
2523	Johnson, R	39022	ACME	50	122.07	61.04

Observations (Rows)

Observations (also called rows) in the data set are collections of data values that usually relate to a single object. The values **2458**, **Murray W**, **32668**, **MUTUALITY**, **100**, **98.64**, and **0.00** comprise a single observation in the data set shown below.

Figure 2.8 Parts of a SAS Data Set: Observations



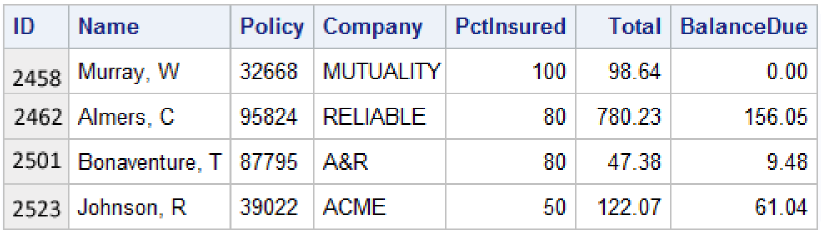
	ID	Name	Policy	Company	PctInsured	Total	BalanceDue
Observation	2458	Murray, W	32668	MUTUALITY	100	98.64	0.00
	2462	Almers, C	95824	RELIABLE	80	780.23	156.05
	2501	Bonaventure, T	87795	A&R	80	47.38	9.48
	2523	Johnson, R	39022	ACME	50	122.07	61.04

This data set has 21 observations, each containing information about an individual. To view the full descriptor portion of this data set, see Table 2.4 on page 15. A SAS data set can store any number of observations.

Variables (Columns)

Variables (also called columns) in the data set are collections of values that describe a particular characteristic. The values `2458`, `2462`, `2501`, and `2523` comprise the variable ID in the data set shown below.

Figure 2.9 Parts of a SAS Data Set: Variables



Variables

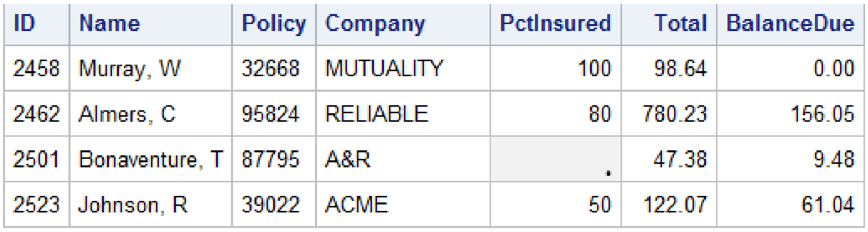
ID	Name	Policy	Company	PctInsured	Total	BalanceDue
2458	Murray, W	32668	MUTUALITY	100	98.64	0.00
2462	Almers, C	95824	RELIABLE	80	780.23	156.05
2501	Bonaventure, T	87795	A&R	80	47.38	9.48
2523	Johnson, R	39022	ACME	50	122.07	61.04

This data set contains seven variables: ID, Name, Policy, Company, PctInsured, Total, and BalanceDue. A SAS data set can store thousands of variables.

Missing Values

Every variable and observation in a SAS data set must have a value. If a data value is unknown for a particular observation, a missing value is recorded in the SAS data set. A period (.) is the default value for a missing numeric value, and a blank space is the default value for a missing character value.

Figure 2.10 Parts of a SAS Data Set: Missing Data Values



ID	Name	Policy	Company	PctInsured	Total	BalanceDue
2458	Murray, W	32668	MUTUALITY	100	98.64	0.00
2462	Almers, C	95824	RELIABLE	80	780.23	156.05
2501	Bonaventure, T	87795	A&R	.	47.38	9.48
2523	Johnson, R	39022	ACME	50	122.07	61.04

Missing Value

Variable Attributes

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

When you write SAS programs, it is 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). If the same-named variables are both character variables, you still need to check that the variable lengths are the same. Otherwise, some values might be truncated.

Here is a partial listing of the attribute information in the descriptor portion of the SAS data set sasuser.insure.

Table 2.5 *Variable Attributes in the Descriptor Portion of a SAS Data Set sasuser.insure*

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

Variable Names

Rules for Variable Names

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

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

Table 2.6 *Variable Name Attributes*

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

VALIDVARNAME= System Option

Note: If you use characters other than the ones that are valid when the VALIDVARNAME system option is set to V7 (letters of the Latin alphabet, numerals, or underscores), then you must express the variable name as a name literal and you must set VALIDVARNAME=ANY. If the name includes either a percent sign (%) or an ampersand (&), then you must use single quotation marks in the name literal in order to avoid interaction with the SAS macro facility.

VALIDVARNAME specifies the rules for valid SAS variable names that can be created and processed during a SAS session.

Syntax, VALIDVARNAME=

VALIDVARNAME= *V7|UPCASE|ANY*

V7 specifies that variable names must follow these rules:

- SAS variable names can be up to 32 characters long.
- The first character must begin with a letter of the Latin alphabet (A - Z, either uppercase or lowercase) or an underscore (_). Subsequent characters can be letters of the Latin alphabet, numerals, or underscores.
- Trailing blanks are ignored. The variable name alignment is left-justified.
- A variable name cannot contain blanks or special characters except for an underscore.
- A variable name can contain mixed-case letters. SAS stores and writes the variable name in the same case that is used in the first reference to the variable. However, when SAS processes a variable name, SAS internally converts it to uppercase. Therefore, you cannot use the same variable name with a different combination of uppercase and lowercase letters to represent different variables. For example, `cat`, `Cat`, and `CAT` all represent the same variable.
- Do not assign variables the names of special SAS automatic variables (such as _N_ and _ERROR_) or variable list names (such as _NUMERIC_, _CHARACTER_, and _ALL_) to variables.

UPCASE specifies that the variable name follows the same rules as V7, except that the variable name is uppercase, as in earlier versions of SAS.

ANY specifies that SAS variable names must follow these rules:

- The name can begin with or contain any characters, including blanks, national characters, special characters, and multi-byte characters.
- The name can be up to 32 bytes long.
- The name cannot contain any null bytes.
- Leading blanks are preserved, but trailing blanks are ignored.
- The name must contain at least one character. A name with all blanks is not permitted.
- A variable name can contain mixed-case letters. SAS stores and writes the variable name in the same case that is used in the first reference to the variable. However, when SAS processes a variable name, SAS internally converts it to uppercase. Therefore, you cannot use the same variable name with a different combination of uppercase and lowercase letters to represent different variables. For example, `cat`, `Cat`, and `CAT` all represent the same variable.

CAUTION:

> **Throughout SAS, using the name literal syntax with SAS member names that exceed the 32-byte limit or have excessive embedded quotation marks might cause unexpected results.** The VALIDVARNAME=ANY system option enables compatibility with other DBMS variable (column) naming conventions, such as allowing embedded blanks and national characters.

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 Total (shown below), can contain only numeric values (the numerals 0 through 9, +, -, ., and E for scientific notation).

Table 2.7 Type Attribute

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

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 bytes. Numeric values are stored as floating-point numbers in 8 bytes of storage.

Table 2.8 Length Attribute

Variable	Type	Length	Format	Informat	Label
Policy	Char	8			Policy Number
Total	Num	8	DOLLAR9.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

Format

Formats are variable attributes that affect how data values are written. Formats do not change the stored value in any way; they merely control how that value is displayed. 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 $1,234.00 in a report, you can use the DOLLAR9.2 format, as shown for Total below.

Table 2.9 Format Attribute

Variable	Type	Length	Format	Informat	Label
Policy	Char	8			Policy Number

Variable	Type	Length	Format	Informat	Label
Total	Num	8	DOLLAR9.2	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 might 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.

TIP 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 how 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.

Table 2.10 *Informat Attribute*

Variable	Type	Length	Format	Informat	Label
Policy	Char	8			Policy Number
Total	Num	8	DOLLAR9.2	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 might want to replace the name with 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.

Table 2.11 Label Attribute

Variable	Type	Length	Format	Informat	Label
Policy	Char	8			Policy Number
Total	Num	8	DOLLAR9.2	COMMA10.	Total Balance
Name	Char	20			Patient Name

You can use labels to shorten long variable names in your reports.

SAS Indexes

An index is a separate file that you can create for a SAS data file in order to provide direct access to a specific observation. The index file has the same name as its data file and a member type of INDEX. Indexes can provide faster access to specific observations, particularly when you have a large data set. The purpose of SAS indexes is to optimize WHERE expressions and to facilitate BY-group processing. For more information, see "Specifying WHERE Expressions" on page 72 and see "Group Processing Using the BY Statement" on page 183.

Extended Attributes

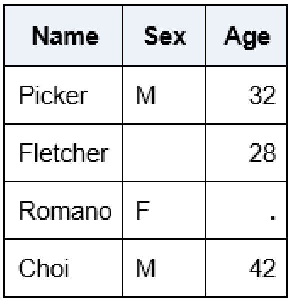
Extended attributes are user-defined metadata that is defined on a data set or on a variable (column). Extended attributes are represented as name-value pairs and are created using the DATASETS procedure.

TIP You can use PROC CONTENTS to display data set and variable extended attributes.

Chapter Quiz

Select the best answer for each question. 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. cannot 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 yyddmm8. name $ job $;
run;
proc sort data=user.tables;
   by name;
run;
proc print data=user.tables;
run;
```

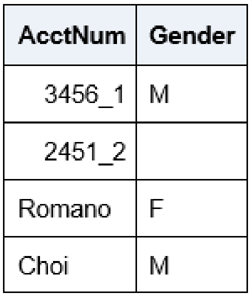
a. three

b. four

c. five

d. six

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



AcctNum	Gender
3456_1	M
2451_2	
Romano	F
Choi	M

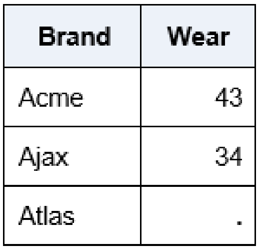
a. numeric

b. character

c. can be either character or numeric

d. cannot tell from the data shown

4. What type of variable is the variable Wear in the data set below?



Brand	Wear
Acme	43
Ajax	34
Atlas	.

a. numeric

b. character

c. can be either character or numeric

d. cannot tell from the data shown

5. With the system option VALIDVARNAME=ANY, which of the following variable names is valid?

a. 4BirthDate

b. $Cost

c. _Items_

d. Tax-Rate

e. All of the above

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?

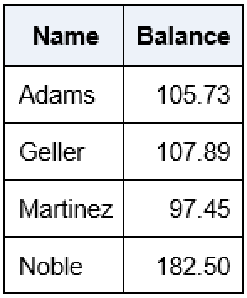
a. Forecast

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=clinic.admit
                label double;
   var ID Name Sex Age; where Sex=F;
   label Sex='Gender'; 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. a group of SAS files in the same folder or directory

d. all of the above

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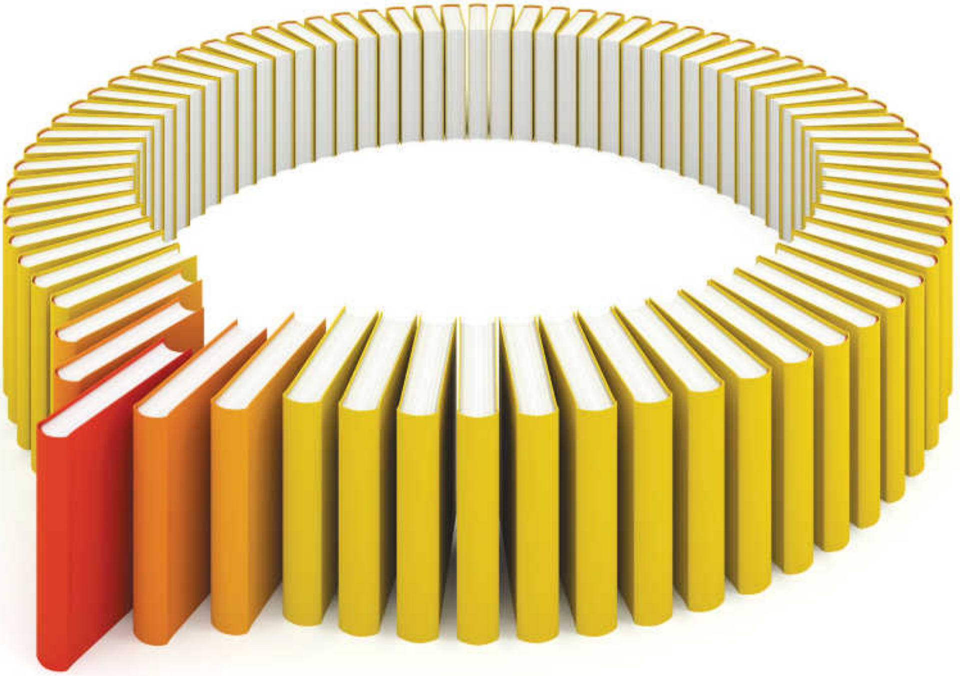

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