Basic SAS® PROCedures for Quick Results

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Abstract

As IT professionals, saving time is critical. Delivering timely and quality looking reports and information to management, end users, and customers is essential. The SAS System provides numerous *"canned"* PROCedures for generating quick results to take care of these needs ... and more. Attendees learn how basic SAS PROCedures such as PRINT and FORMS produce detail output; CHART, FREQ, MEANS, PLOT, SQL, and UNIVARIATE summarize and create graphical, tabular, and statistical output; and utility PROCedures to manage data libraries; Additional topics include techniques for informing the SAS System which data set to use as input to a procedure, how to subset data using a WHERE statement (or WHERE= data set option), and how to perform BY-group processing.

Introduction

Once data has been collected and stored in a SAS data set, results can be produced quickly using one or more procedures. The SAS System provides numerous ready-to-use procedures designed for data analysis and presentation. Procedures are designed to be simple to use, and are what differentiate SAS from other software products. SAS' built-in procedures offer users with a unique ability to generate quick results – requiring little, if any, programming skills. Using a procedure, or PROC, is similar to filling out a simple request form. By specifying the name of procedure and one or more options, you can produce results quickly and easily.

Procedures frequently write their results to the Output window (in SAS Display Manager), an output SAS data set, or an output file. When output is produced, it is often customized so it satisfies certain requirements such as automatic centering, printing or displaying dates and page numbers, and so on. Having the ability to customize the way output appears as well as the type of information that is produced is what makes procedures an indispensable tool for users everywhere.

SAS supports four categories of procedures: 1) reporting, 2) statistical, 3) scoring, and 4) utility. This paper investigates the use of several base-SAS procedures to enable the production of quick and useful reports, statistics, and tables of data, and will also look at procedures that can be used to perform simple data set management tasks.

The Anatomy of a PROC

Each procedure (or PROC) has unique characteristics and elements, but many common ones too. Each PROC consists of a keyword, one or more statements, and options – of which some are required and others are basically ─ optional. Although the statements and options vary from PROC to PROC, the basic anatomy of a PROC looks something like the following:

```
PROC procname DATA= _____;
   TITLE _____;
   FOOTNOTE _____;
   BY _____;
   LABEL _____;
   FORMAT _____;
RUN; <or> QUIT;
```

The PROC Statement

Every PROC begins with the keyword PROC and is a required element. This keyword signals to the SAS supervisor (the internal traffic cop that controls everything that goes on in the SAS System) that a *"canned"* procedure is being launched, and not a DATA step or MACRO program.

The name of the PROC follows the keyword PROC – our example above references the anatomy PROC. In its simplest and purest form this is all that is required by a few procedures to run. As you might expect though, the results may also tend to be basic and output will appear without any customizations.

Once the name of the PROC is specified, you may then specify one or more options available with the PROC, and in any order. In our basic skeletal example above, the DATA= option appears. This option, if specified, informs the SAS System what data set

to use as input to the PROC. If omitted, it automatically defaults to the most recently created data set – which may not be the most data set most recently used. (Readers will see several PROCs and their various options on the following pages).

TITLE and FOOTNOTE Statements
TITLE and FOOTNOTE statements are classified as global statements and can generally be used universally throughout the SAS System (e.g., PROCs and DATA steps). A maximum of ten TITLE and FOOTNOTE statements can be specified in any PROC. TITLE statements, when specified, appear at the top of each output page and FOOTNOTE statements, if present, appear at the bottom of each page of output. Readers are cautioned to use care when specifying TITLE and FOOTNOTE statements since they reduce the available space for printing detail lines.

BY Statement
A BY statement is optional in all PROCs except the SORT procedure. A BY statement in PROC SORT tells SAS what the order or arrangement should be for observations in a data set. A BY statement in any other PROC informs SAS to perform a separate analysis on the values in each BY group opposed to one large group. The data must have been sorted before it can be used in a reporting procedure.

LABEL Statement
A LABEL statement is also optional, and if present allows a more descriptive label to be assigned as variable (or column) headings. If omitted, SAS uses the variable names as column headers on output. When a LABEL statement is used in a PROC the assigned descriptive labels are only available for duration of the PROC step, and are not saved with the data set.

FORMAT Statement
A FORMAT statement is an optional statement that, when used, tells SAS to display information on output in a designated way. For example, you could have a date value displayed or written using a *mm/dd/yyyy* form such as 08/20/2001 or a *Month dd, yyyy* form such as August 20, 2001 to enhance readability. In the absence of a FORMAT statement, data is displayed using an internal date offset (the number of days from January 1, 1960) or a user-defined date format stored as part of the data set.

RUN or QUIT Statement
A RUN or QUIT statement tells SAS to terminate the PROC step before executing the next step in a program. A RUN statement is normally specified to designate an end to a non-interactive procedure like PROC PRINT, whereas a QUIT statement is specified to terminate an interactive procedure such as PROC SQL (more will be said about interactive procedures later). Although not required statements, specifying a RUN or QUIT statement can provide modest CPU improvements since the SAS Supervisor knows when one step ends and another begins.

A Print-Oriented World
Information is the lifeblood of virtually every organization in today's print-oriented world. And it appears that the need for even more information by decision makers is growing, according to Terence Mullin of Quest Software, a software services company located in Irvine, California. Often an organization's intellectual property is collected and stored in multiple locations and not in a centralized information repository. With much of this information kept in scattered locations, from employees' PCs to network file servers and databases, information is not always available for a controlled reporting process. Although this can present huge problems for an organization's decision makers, it is sadly a fact of life.

Description of Data Sets Used in Output
The examples in this paper reference a data set containing a compilation of popular movies that I have watched over the years. This Movies data set consists of 22 observations, six variables, and contains the following data sorted in ascending order by the Movie Rating.

	Title	Length	Category	Year	Studio	Rating
1	The Wizard of Oz	101	Adventure	1939	MGM / UA	G
2	Casablanca	103	Drama	1942	MGM / UA	PG
3	Jaws	125	Action Adventure	1975	Universal Studios	PG
4	Rocky	120	Action Adventure	1976	MGM / UA	PG
5	Star Wars	124	Action Sci-Fi	1977	Lucas Film Ltd	PG
6	Poltergeist	115	Horror	1982	MGM / UA	PG
7	The Hunt for Red October	135	Action Adventure	1989	Paramount Pictures	PG
8	National Lampoon's Vacation	98	Comedy	1983	Warner Brothers	PG-13
9	Christmas Vacation	97	Comedy	1989	Warner Brothers	PG-13
10	Ghost	127	Drama Romance	1990	Paramount Pictures	PG-13
11	Jurassic Park	127	Action	1993	Universal Pictures	PG-13
12	Forrest Gump	142	Drama	1994	Paramount Pictures	PG-13
13	Michael	106	Drama	1997	Warner Brothers	PG-13
14	Titanic	194	Drama Romance	1997	Paramount Pictures	PG-13
15	Dressed to Kill	105	Drama Mysteries	1980	Filmways Pictures	R
16	Scarface	170	Action Cops & Robber	1983	Universal Studios	R
17	The Terminator	108	Action Sci-Fi	1984	Live Entertainment	R
18	Lethal Weapon	110	Action Cops & Robber	1987	Warner Brothers	R
19	Coming to America	116	Comedy	1988	Paramount Pictures	R
20	Silence of the Lambs	118	Drama Suspense	1991	Orion	R
21	Dracula	130	Horror	1993	Columbia TriStar	R
22	Brave Heart	177	Action Adventure	1995	Paramount Pictures	R

SAS Reporting Procedures

You may be wondering how the SAS System and its many PROCs can help with your reporting needs. The answer is simple. SAS software and its many "canned, ready-to-go" PROCs turn information into structured and meaningful reports. As of 2001, more than 3.5 million software customers in 115 countries, and 98% of the Fortune 100 companies and 90% of the Fortune 500 companies can attest to the fact that producing detailed reports with the SAS System has never been easier.

> **SAS and its many "canned, ready-to-go" PROCs turn information into structured and meaningful reports.**

Being able to put a powerful reporting tool in the hands of so many users, and not only programmers, is also an asset – not a liability. Having said this – it remains critical that an organization maintain a controlled environment to ensure information being dispensed in any report does not violate privacy and security issues. It is also critical to maintain a high level of accuracy in all reported information.

SAS reporting PROCs consist of a broad range of easy-to-use report formats. Because output is frequently requested in a variety of formats to satisfy a vast number of requirements, SAS is ready and able to help by bundling base-SAS PROCs that produce reports in the following formats:

1) **Detail** – prints one or more observations without collapsing data that meet specific report criteria.

2) **Summary** – collapses and prints information.

3) **Tabular** – collapses and prints information with borders.

4) **Statistical** – computes and prints descriptive statistics.

5) **Graphical** – prints information as simple line-oriented bar and pie charts, and line plots.

An alphabetical list of several SAS reporting PROCs and their output formats is illustrated in table 1 below.

Report Output Style	PROC
Detail Output	FORMS
	PRINT
	REPORT
	SQL
Summary Output	CHART
	FREQ
	MEANS
	PLOT
	SQL
	UNIVARIATE
Tabular Output	FREQ
	TABULATE
Statistical Output	MEANS
	SQL
	UNIVARIATE
Graphical Output	CHART
	PLOT

Table 1. PROCs and Report Formats

PROCs for All That Detail

Sometimes a report must show all the detail it can. When this is the case, SAS provides the PRINT, REPORT, and SQL procedures to generate detail reports and the FORMS procedure to produce repetitive forms and labels. Although each PROC is relatively easy to use, they can also provide the level of support needed by even the most demanding programmer. By using one or more statements and options each PROC can produce simple to semi-custom reports.

Using PROC PRINT

The PRINT procedure is a popular reporting tool that is used by users everywhere. In its simplest form, PROC PRINT prints all variables for all observations in a data set. The SAS System writes a default title line at the top of each report page automatically.

Suppose you had to create a report containing all Movie data (all observations and variables) with the littlest amount of code possible. The PROC PRINT statement illustrated below produces a detail-oriented report consisting of all observations and variables.

Procedure Code:

```
PROC PRINT DATA=SASUSER.MOVIES;
RUN;
```

When the PROC PRINT code is executed, the SAS System applies certain defaults in creating report output including the default title, the number of observations, and list and order of variables that are displayed.

Results:

Let's take it a step further. Suppose you did not want all the variables from the Movies data set – say you wanted only the Movie Title, Length, and Rating in that order. You could start with the PROC PRINT code from the previous example and insert a VAR statement between the PROC and RUN statements to tell SAS what variables to output along with their specific order on the report.

Procedure Code:

```
PROC PRINT DATA=SASUSER.MOVIES;
 VAR TITLE LENGTH RATING;
RUN;
```

Results:


```
                           The SAS System

            Obs      Title                      Length    Rating

             1       The Wizard of Oz             101     G
             2       Casablanca                   103     PG
             3       Jaws                         125     PG
             4       Rocky                        120     PG
             5       Star Wars                    124     PG
             6       Poltergeist                  115     PG
             7       The Hunt for Red October     135     PG
             8       National Lampoon's Vacation   98     PG-13
             9       Christmas Vacation            97     PG-13
            10       Ghost                        127     PG-13
            11       Jurassic Park                127     PG-13
            12       Forrest Gump                 142     PG-13
            13       Michael                      106     PG-13
            14       Titanic                      194     PG-13
            15       Dressed to Kill              105     R
            16       Scarface                     170     R
            17       The Terminator               108     R
            18       Lethal Weapon                110     R
            19       Coming to America            116     R
            20       Silence of the Lambs         118     R
            21       Dracula                      130     R
            22       Brave Heart                  177     R
```

Although the PROC PRINT code from the previous example printed the three variables you asked for, it also printed the Observation number as column one on the report. The observation number is automatically displayed as the first column on all PROC PRINT output – but can be suppressed by specifying the NOOBS option. Suppose you wanted to remove the observation column and change the current title appearing at the top of the report.

Procedure Code:

```
PROC PRINT DATA=SASUSER.MOVIES NOOBS;
 TITLE 'Movie Classics';
 VAR TITLE LENGTH RATING;
RUN;
```

Results:


```
                        Movie Classics

          Title                      Length    Rating

          The Wizard of Oz             101     G
          Casablanca                   103     PG
          Jaws                         125     PG
          Rocky                        120     PG
          Star Wars                    124     PG
          Poltergeist                  115     PG
          The Hunt for Red October     135     PG
          National Lampoon's Vacation   98     PG-13
          Christmas Vacation            97     PG-13
          Ghost                        127     PG-13
          Jurassic Park                127     PG-13
          Forrest Gump                 142     PG-13
          Michael                      106     PG-13
          Titanic                      194     PG-13
          Dressed to Kill              105     R
          Scarface                     170     R
          The Terminator               108     R
          Lethal Weapon                110     R
          Coming to America            116     R
          Silence of the Lambs         118     R
          Dracula                      130     R
          Brave Heart                  177     R
```

It is frequently necessary to subset the rows of data generated on output with a WHERE statement. Suppose you wanted to generate a report on PG and PG-13 rated movies.

Procedure Code:

```
PROC PRINT DATA=SASUSER.MOVIES NOOBS;
 TITLE 'Movie Classics';
 VAR TITLE LENGTH RATING;
 WHERE RATING IN ('PG','PG-13');
RUN;
```

Results:

```
                        Movie Classics

        Title                    Length      Rating

        Casablanca               103         PG
        Jaws                     125         PG
        Rocky                    120         PG
        Star Wars                124         PG
        Poltergeist              115         PG
        The Hunt for Red October 135         PG
        National Lampoon's Vacation  98      PG-13
        Christmas Vacation        97         PG-13
        Ghost                    127         PG-13
        Jurassic Park            127         PG-13
        Forrest Gump             142         PG-13
        Michael                  106         PG-13
        Titanic                  194         PG-13
```

Let's make one last change to the PROC PRINT code. Suppose you wanted to compute a total number of minutes for all movies in a rating group (e.g., G, PG, PG-13, and R). Since the Movies data set was originally sorted in ascending order by Rating, a BY statement can be specified with the Rating variable. A SUM statement is used to compute the total number of minutes for all movies in a By-group.

Procedure Code:

```
PROC PRINT DATA=SASUSER.MOVIES NOOBS;
 TITLE 'Movie Classics';
 BY RATING;
 VAR TITLE LENGTH RATING;
 SUM LENGTH;
RUN;
```

Results (Partial Output – Excludes R Ratings):

```
                        Movie Classics
------------------------ Rating=G ------------------------

        Title              Length      Rating
        The Wizard of Oz   101           G

------------------------ Rating=PG -----------------------

        Title                      Length      Rating
        Casablanca                 103         PG
        Jaws                       125         PG
        Rocky                      120         PG
        Star Wars                  124         PG
        Poltergeist                115         PG
        The Hunt for Red October   135         PG
        ------------------------   ------
        Rating                     722

---------------------- Rating=PG-13 ----------------------

        Title                      Length      Rating
        National Lampoon's Vacation  98        PG-13
        Christmas Vacation          97         PG-13
        Ghost                      127         PG-13
        Jurassic Park              127         PG-13
        Forrest Gump               142         PG-13
        Michael                    106         PG-13
        Titanic                    194         PG-13
        ------------------------   ------
        Rating                     891
```

Using PROC SQL
The SQL procedure is known as the Structured (or Standard) Query Language and is a popular reporting tool among database users (e.g., SAS, Oracle, IBM, etc.). In its simplest form, PROC SQL prints all variables (or columns) for all observations (or rows) in a data set (or table). As was illustrated with PROC PRINT, the SAS System writes a default title line at the top of each report page automatically. One or more TITLE statements can be specified to customize the title at the top of each page.

Besides using different statement syntax, an obvious distinction between PROC PRINT and PROC SQL is that a QUIT statement is specified for the latter, rather than a RUN statement, to terminate processing. The QUIT statement is used with interactive procedures.

Suppose you had to create a report containing all Movie data (all observations and variables) with the littlest amount of code possible. The PROC SQL statement illustrated below produces a detail-oriented report (similar to PROC PRINT) consisting of all observations and variables.

Procedure Code:

```
PROC SQL;
 TITLE 'Movie Classics';
 SELECT *
   FROM SASUSER.MOVIES;
QUIT;
```

When the PROC SQL code is executed, the SAS System applies certain defaults in creating report output including the default title, the number of observations, and list of variables.

Results:

PROC SQL allows for the subsetting of observations as was illustrated earlier with a WHERE statement in PROC PRINT. The only difference is that a WHERE clause is used in PROC SQL.

Procedure Code:

```
PROC SQL;
 TITLE 'Movie Classics';
 SELECT *
  FROM SASUSER.MOVIES
   WHERE RATING IN ('PG','PG-13');
QUIT;
```

Results:

Using PROC FORMS

The FORMS procedure provides a handy tool for printing label and form information. Generally the FORMS procedure is used when information is of a repetitive nature, such as mailing labels. In its simplest form, PROC FORMS prints just the information you specify using one or more LINE statements. Suppose you wanted to output the Movie Title, Category, and Rating variables for each observation in a single column.

Procedure Code:

```
TITLE;
PROC FORMS DATA=SASUSER.MOVIES;
  LINE 1 TITLE;
  LINE 2 CATEGORY;
  LINE 3 RATING;
RUN;
```

Results (Partial Output):

The FORMS procedure statement has several options that can be specified to control the appearance of output. Table 2 below illustrates many important options and their descriptions.

Option	Description
DATA=	Identifies the input data set.
FILE=	Identifies an external output file.
LINES=	Number of lines in a form unit.
WIDTH=	Number of columns in a form unit.
ACROSS=	Number of form units across a page.
BETWEEN=	Number of spaces between form units.
DOWN=	Number of lines to skip before printing the first form unit.
ALIGN=	Number of dummy form units to print for alignment purposes.
COPIES=	Number of form units to print for each observation in data set.

Table 2. PROC FORMS options

Suppose you wanted to print the same information as the previous example, but instead of a single column of form units, you prefer to instruct PROC FORMS to construct two columns of form units. This is a popular format used with many of the leading printer-label products in use today (e.g., Avery).

Procedure Code:

```
TITLE;
PROC FORMS DATA=SASUSER.MOVIES
          ACROSS=2;
  LINE 1 TITLE;
  LINE 2 CATEGORY;
  LINE 3 RATING;
RUN;
```

Results:

```
The Wizard of Oz          Casablanca
Adventure                 Drama
G                         PG

Jaws                      Rocky
Action Adventure          Action Adventure
PG                        PG

Star Wars                 Poltergeist
Action Sci-Fi             Horror
PG                        PG

The Hunt for Red October  National Lampoon's Vacation
Action Adventure          Comedy
PG                        PG-13

Christmas Vacation        Ghost
Comedy                    Drama Romance
PG-13                     PG-13

Jurassic Park             Forrest Gump
Action                    Drama
PG-13                     PG-13

Michael                   Titanic
Drama                     Drama Romance
PG-13                     PG-13

Dressed to Kill           Scarface
Drama Mysteries           Action Cops & Robber
R                         R

The Terminator            Lethal Weapon
Action Sci-Fi             Action Cops & Robber
R                         R

Coming to America         Silence of the Lambs
Comedy                    Drama Suspense
R                         R

Dracula                   Brave Heart
Horror                    Action Adventure
R                         R
```

PROCs That Summarize

Detail reports are great in many situations – but sometimes contain so much information that it makes understanding their contents nearly impossible. When this is the case, a summary report may be in order. The purpose of a summary report is to collapse all the detail information in a report into easy-to-understand summary-level information. This helps to digest the enormous amounts of data frequently stored in a data set.

SAS provides the CHART, FREQ, MEANS, PLOT, SQL, TABULATE, and UNIVARIATE procedures to generate summary-level reports. For purposes of illustration, CHART, FREQ, MEANS, and UNIVARIATE will be presented.

As illustrated with the detail-level reporting procedures, each PROC is relatively easy to use, but each can also provide the level of support needed by even the most demanding programmer. By using one or more statements and options each PROC can produce simple to semi-custom reports.

Using PROC CHART

The CHART procedure is a line-oriented graphics tool that is used to print simple histograms (horizontal and vertical bar charts), block charts, and pie charts for numeric and character data. In its simplest form, PROC CHART summarizes the observations in a data set based on the variables listed in the type of chart being produced.

Suppose you wanted to display the number of movies grouped by their rating in a vertical bar chart.

Procedure Code:

```
PROC CHART DATA=SASUSER.MOVIES;
  TITLE 'Chart by Movie Rating';
  VBAR RATING;
RUN;
```
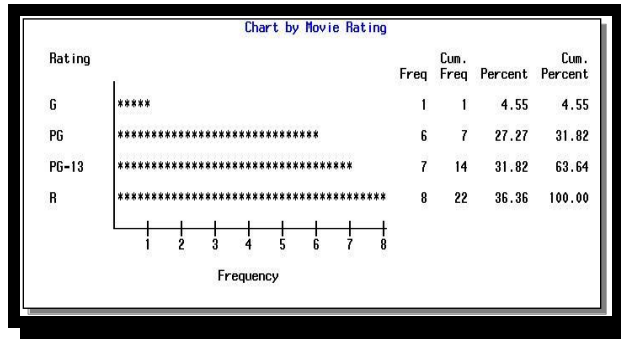
Results:
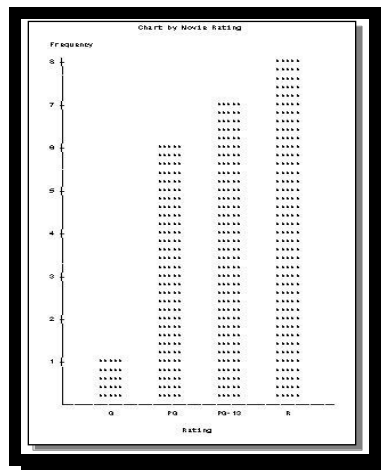
Suppose you wanted to see the number of movies grouped by their rating as a horizontal bar chart. Notice that basic-level statistics (e.g., frequency, cumulative frequency, percent, and cumulative percent) are automatically displayed with a horizontal bar chart.

Procedure Code:

```
PROC CHART DATA=SASUSER.MOVIES;
  TITLE 'Chart by Movie Rating';
  HBAR RATING;
RUN;
```

Results:


```
                          Chart by Movie Rating
Rating                                           Cum.              Cum.
                                           Freq  Freq  Percent  Percent

G        *****                               1    1     4.55     4.55

PG       ******************************      6    7    27.27    31.82

PG-13    ***********************************  7   14    31.82    63.64

R        ****************************************  8  22   36.36   100.00

             1   2   3   4   5   6   7   8
                      Frequency
```

Using PROC FREQ

The FREQ procedure produces one-way to n-way frequency and cross-tabulation tables for numeric or character variables. In it simplest form, PROC FREQ produces a one-way frequency table.

Procedure Code:

```
PROC FREQ DATA=SASUSER.MOVIES;
 TITLE 'Frequency by Movie Rating';
 TABLES RATING;
RUN;
```

Results:


```
                Frequency by Movie Rating

                   The FREQ Procedure

                                  Cumulative    Cumulative
Rating    Frequency    Percent    Frequency      Percent

G             1         4.55          1            4.55
PG            6        27.27          7           31.82
PG-13         7        31.82         14           63.64
R             8        36.36         22          100.00
```

To see a cross-tabulation table for two variables, you will need to specify two variable names separated with an asterisk '*'.

Procedure Code:

```
PROC FREQ DATA=SASUSER.MOVIES;
 TITLE '2-Way Frequency Table';
 TABLES RATING * CATEGORY;
RUN;
```

Results (Partial Output):

Using PROC MEANS

The MEANS procedure produces descriptive statistics for numeric variables only. In it simplest form, PROC MEANS produces descriptive statistics for all numeric variables in a data set.

Procedure Code:

```
PROC MEANS DATA=SASUSER.MOVIES;
 TITLE 'Descriptive Statistics';
RUN;
```

Results:

Analysis can be performed to help understand the data by using a numeric or character categorical variable in a CLASS statement. Using the CLASS statement creates descriptive statistics as subgroups. The next example illustrates descriptive statistics for each subgroup of movie by Movie Rating.

Procedure Code:

```
PROC MEANS DATA=SASUSER.MOVIES;
 TITLE 'Descriptive Statistics';
 CLASS RATING;
RUN;
```

Results:

Descriptive Statistics
The MEANS Procedure

Rating	N Obs	Variable	N	Mean	Std Dev	Minimum	Maximum
G	1	Length	1	101.0000000	.	101.0000000	101.0000000
		Year	1	1939.00	.	1939.00	1939.00
PG	6	Length	6	120.3333333	10.7641380	103.0000000	135.0000000
		Year	6	1973.50	16.2818918	1942.00	1989.00
PG-13	7	Length	7	127.2857143	33.9004144	97.0000000	194.0000000
		Year	7	1991.86	4.9809160	1983.00	1997.00
R	8	Length	8	129.2500000	28.4190580	105.0000000	177.0000000
		Year	8	1987.63	5.1806646	1980.00	1995.00

Using PROC UNIVARIATE

The UNIVARIATE procedure works similar to the MEANS procedure, except it provides a larger number of descriptive statistics. In its simplest form, PROC UNIVARIATE produces descriptive statistics for all numeric variables in a data set.

Procedure Code:

PROC UNIVARIATE DATA=SASUSER.MOVIES;
 TITLE 'Descriptive Statistics';
RUN;

Results (Partial Output):

Descriptive Statistics
The UNIVARIATE Procedure
Variable: Length

Moments

N	22	Sum Weights	22
Mean	124.909091	Sum Observations	2748
Std Deviation	25.8344714	Variance	667.419913
Skewness	1.45414494	Kurtosis	1.71453814
Uncorrected SS	357266	Corrected SS	14015.8182
Coeff Variation	20.682619	Std Error Mean	5.50792781

Basic Statistical Measures

Location		Variability	
Mean	124.9091	Std Deviation	25.83447
Median	119.0000	Variance	667.41991
Mode	127.0000	Range	97.00000
		Interquartile Range	24.00000

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	22.67806	Pr > |t|	<.0001
Sign	M	11	Pr >= |M|	<.0001
Signed Rank	S	126.5	Pr >= |S|	<.0001

As with PROC MEANS, analysis can be performed to help understand the data by using a numeric or character categorical variable in a CLASS statement. Using the CLASS statement creates descriptive statistics as subgroups. The next example illustrates descriptive statistics for each subgroup of movie by Movie Rating.

Procedure Code:

PROC UNIVARIATE DATA=SASUSER.MOVIES;
 TITLE 'Descriptive Statistics';
 CLASS RATING;
RUN;

Results (Partial Output):


```
                    Descriptive Statistics
                  The UNIVARIATE Procedure
                       Variable:  Length
                         Rating = G
                         Moments

N                            1    Sum Weights                 1
Mean                       101    Sum Observations          101
Std Deviation                .    Variance                    .
Skewness                     .    Kurtosis                    .
Uncorrected SS           10201    Corrected SS                0
Coeff Variation              .    Std Error Mean              .

                  Basic Statistical Measures

         Location                        Variability

   Mean      101.0000      Std Deviation               .
   Median    101.0000      Variance                    .
   Mode      101.0000      Range                       0
                           Interquartile Range         0

                  Tests for Location: Mu0=0

       Test             -Statistic-     -----p Value------

   Student's t      t          .      Pr > |t|          .
   Sign             M        0.5      Pr >= |M|    1.0000
   Signed Rank      S        0.5      Pr >= |S|    1.0000
```

Utility PROCs for Data Manipulation and Management

We will now look at two utility procedures that help with data manipulation and management tasks: the SORT and DATASETS procedures. Their designed purposes as utility tools permit the manipulation of SAS data sets and the management of SAS libraries. Unlike reporting procedures that generate results automatically to output, utility-oriented procedures produce and display results as informative messages on the SAS Log.

The first utility tool we will look at is known as PROC SORT. Used to rearrange one or more columns of data in either ascending or descending order, users are able to change the order of data for a more "custom" look and feel. In its most simplistic form, the syntax of PROC SORT appears below.

```
PROC SORT DATA=SAS-Dataset
    <OUT=SAS-Dataset>;
 BY <DESCENDING> variable-1;
RUN;
```

Using PROC SORT

Suppose you had to rearrange the order of data in a SAS data set to reflect some other order. The SORT procedure enables one or more columns of data to be physically ordered in a SAS data set. The name of a data set is specified in the PROC SORT DATA= option and the name of the variable to rearrange data for in a BY statement. The following example illustrates the SORT procedure rearranging the MOVIES data set by the LENGTH (Movie Length) variable so the data appears in the data set in ascending order (shortest to longest movie length).

Procedure Code:

```
PROC SORT DATA=SASUSER.MOVIES;
 BY LENGTH;
RUN;
```

The next example illustrates a two-way sort where the first variable, RATING, is ordered in ascending order and the second variable, LENGTH, is ordered in descending order as follows.

Procedure Code:

```
PROC SORT DATA=SASUSER.MOVIES;
 BY RATING DESCENDING LENGTH;
RUN;
```

The second utility procedure, PROC DATASETS, is a powerful PROC for any SAS user to know. It provides all the tools necessary to manage a SAS data library and the members within it. Table 3 below illustrates the various statements and tasks the DATASETS procedure can perform.

Since the DATASETS procedure is an interactive procedure (like the SQL procedure), it remains active even after a RUN statement is issued. To turn it off you issue a QUIT; statement. The general form looks something like the following:

```
PROC DATASETS LIBRARY=libref;
  Datasets-statement _____;
QUIT;
```

The beauty of the DATASETS procedure is that it is used to copy, save, age, rename, and delete data sets. It can also produce a contents listing containing one or more members of a data library. Finally, it can be used to create a backup and recovery data set for the process of aging important data sets.

Statement	Description
AGE	Create a backup and recovery process for important data sets.
APPEND	Concatenate one or more data set observations to the end of a "master" data set.
CONTENTS	Produce a detailed description of the members in a SAS data library.
COPY	Replicate one or more members in a SAS data library.
DELETE	Delete (remove) one or more data sets from a SAS data library.
MODIFY	Change attributes for one or more variables in a data set.
REPAIR	Restore damaged data sets or catalogs to a usable condition.
SAVE	Save specified members in a SAS data library and automatically deletes members not specified.

Table 3. PROC DATASETS Statements and Tasks

Describing Members of a Data Library

Suppose you were asked to produce a contents listing of an important SAS data library. By using PROC DATASETS, a detailed member listing of any SAS data library can be generated easily and quickly.

Procedure Code:

```
PROC DATASETS LIBRARY=SASUSER;
QUIT;
```

Results:

Directory			
Libref	SASUSER		
Engine	V9		
Physical Name	C:\Users\Kirk\Documents\My SAS Files(32)\9.3		
Filename	C:\Users\Kirk\Documents\My SAS Files(32)\9.3		

#	Name	Member Type	File Size	Last Modified
1	MOVIES	DATA	9216	20Feb14:20:08:49
2	PROFBAK	CATALOG	17408	20Feb14:20:06:36
3	PROFILE	CATALOG	17408	20Feb14:20:06:36
4	PROFILE2	CATALOG	25600	20Feb14:20:06:37
5	REGSTRY	ITEMSTOR	13312	20Feb14:18:09:20

Aging for Backup and Recovery Purposes

Being able to create a backup and recovery process for important data sets can be critical should disaster strike. One or more related data sets can be assigned an aging number corresponding to when it was last updated. Suppose you wanted to age the Movies data set by creating a safety net consisting of three versions of the data. The most recent version would be called MOVIES1, the next most recent version would be called MOVIES2, and the oldest and least recent version would be called MOVIES3.

Procedure Code:

```
PROC DATASETS LIBRARY=SASUSER;
  AGE MOVIES MOVIES1-MOVIES3;
QUIT;
```

Analysis:

When the DATASETS procedure is executed, the aging process automatically begins. Because only three data sets are specified in the AGE statement member list, a maximum of three aged data sets are retained. The process begins by first renaming the base data set MOVIES to the first member name in the list, the next most recent data set in the member list is renamed to the second name in the member list, the next most recent data set in the member list is renamed to the third name in the member list, and the oldest data set in the member list is deleted. The aging process is especially useful for important data sets that are updated frequently and a need exists for a simple and effective data recovery process to be implemented.

Repairing Damaged Data Sets

On rare instances where a system failure occurs (e.g., during a power brownout or electrical storm) during an update operation, a data set may become damaged an unusable. To fix a problem like this and restore a data set to a usable condition, it may be necessary to try to rebuild data set indexes. The PROC DATASETS REPAIR statement can be a life-saving statement (at least as it related to rescuing your damaged data set).

Suppose during an unexpected power outage our computer system experienced a problem that caused the Movies data set to become damaged. You could the PROC DATASETS REPAIR statement to attempt to restore the data set back to usability.

Procedure Code:

```
PROC DATASETS LIBRARY=SASUSER;
  REPAIR MOVIES;
QUIT;
```

Results:

```
PROC DATASETS LIBRARY=SASUSER;
  REPAIR MOVIES;
QUIT;

NOTE: Repairing SASUSER.MOVIES (memtype=DATA).
NOTE: PROCEDURE DATASETS used (Total process time):
      real time        0.05 seconds
      cpu time         0.01 seconds
```

Directory	
Libref	SASUSER
Engine	V9
Physical Name	C:\Users\Kirk\Documents\My SAS Files(32)\9.3
Filename	C:\Users\Kirk\Documents\My SAS Files(32)\9.3

#	Name	Member Type	File Size	Last Modified
1	MOVIES	DATA	17408	23Feb14:15:58:51
	MOVIES	INDEX	17408	23Feb14:15:58:51
2	PROFBAK	CATALOG	17408	23Feb14:15:56:42
3	PROFILE	CATALOG	17408	23Feb14:15:56:42
4	PROFILE2	CATALOG	25600	23Feb14:15:56:43
5	REGSTRY	ITEMSTOR	13312	20Feb14:20:56:47

Conclusion

Delivering timely and quality looking reports to management, end users, and customers is critical. With the SAS System's *"canned"* PROCedures for generating quick results, users around the world appreciate the benefits of using these "tried and proven" productivity tools. Basic SAS PROCedures such as PRINT, SQL, and FORMS are frequently used for detail reporting; CHART, FREQ, MEANS, and UNIVARIATE provide the tools for summary reporting; and SORT and DATASETS are powerful tools for data manipulation and management. Each of these PROCedures are worth their weight in gold. So learn their syntax, use them wisely, and you will be quickly and frequently rewarded. Happy computing!

References

Cody, Ron, "Learning SAS by Example: A Programmer's Guide," SAS Institute Inc, 2007.

Delwiche, Lora D. and Susan J. Slaughter, "The Little SAS Book, A Primer (Fourth Edition)," SAS Institute Inc, 2008.

Lafler, Kirk Paul (2014), *"Basic SAS® PROCedures for Quick Results,",* SAS Global Forum (SGF) Conference, Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2012), *"Basic SAS® PROCedures for Generating Quick Results,",* Western Users of SAS Software (WUSS) Conference, Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2012), *"Basic SAS® PROCedures for Generating Quick Results,",* Iowa SAS Users Group One-day Conference, Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2011), *"Basic SAS® PROCedures for Generating Quick Results,",* Pacific North West SAS Users Group (PNWSUG) Conference, Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2009), *"Exploring DICTIONARY Tables and SASHELP Views,"* South Central SAS Users Group (SCSUG) Conference (November 8th – November 10th, 2009), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2009), *"Exploring DICTIONARY Tables and SASHELP Views,"* Western Users of SAS Software (WUSS) Conference (September 1st – September 4th, 2009), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2009), *"Exploring DICTIONARY Tables and SASHELP Views,"* PharmaSUG SAS Users Group Conference (May 31st – June 3rd, 2009), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2008), *"Basic SAS® PROCedures for Generating Quick Results,",* Greater Atlanta SAS Users Group Meeting (June 11th, 2008), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2008), *"Kirk's Top Ten Best PROC SQL Tips and Techniques,"* Wisconsin Illinois SAS Users Conference (June 26th, 2008), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2008), *"Undocumented and Hard-to-find PROC SQL Features,"* Greater Atlanta SAS Users Group (GASUG) Meeting (June 11th, 2008), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2008), *"Undocumented and Hard-to-find PROC SQL Features,"* PharmaSUG SAS Users Group Conference (June 1st - 4th, 2008), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2008), *"Undocumented and Hard-to-find PROC SQL Features,"* Michigan SAS Users Group (MSUG) Meeting (May 29th, 2008), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2008), *"Undocumented and Hard-to-find PROC SQL Features,"* Vancouver SAS Users Group Meeting (April 23rd, 2008), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2008), *"Undocumented and Hard-to-find PROC SQL Features,"* PhilaSUG 2008 User Group Meeting (March 13th, 2008), Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2007), *"Undocumented and Hard-to-find PROC SQL Features,"* Proceedings of the PharmaSUG 2007 Conference, Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul (2006), "*Exploring Dictionary Tables with PROC SQL*," SAS Press Webinar Series – June 27, 2006.

Lafler, Kirk Paul (2005), "*Exploring Dictionary Tables and SASHELP Views*," Proceedings of the Thirteenth Annual Western Users of SAS Software Conference.

Lafler, Kirk Paul (2004). *PROC SQL: Beyond the Basics Using SAS*, SAS Institute Inc., Cary, NC, USA.

Lafler, Kirk Paul (2003), "*Undocumented and Hard-to-find PROC SQL Features*," Proceedings of the Eleventh Annual Western Users of SAS Software Conference.

Lafler, Kirk Paul (2002). *PROC SQL Programming Tips*; Software Intelligence Corporation, Spring Valley, CA, USA.

Lafler, Kirk Paul, "Basic SAS PROCedures for Generating Quick Results," SSU 2001 and SUGI 2004.

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