C H A P T E R   1

Writing Reports with SAS

Presenting information in a way that's understood by the audience is fundamentally important to anyone's job. Once you collect your data and understand its structure, you need to be able to report and summarize your findings effectively and efficiently.

With SAS procedures, SAS DATA steps, and SAS features such as the Output Delivery System (ODS) and the macro facility, you have the tools to succeed at writing programs that analyze your data and create reports.

Using This Book

This book presents examples of SAS programs that solve many common report-writing tasks. The examples range from simply listing the observations in a data set to computing summary statistics to creating customized reports with SAS DATA step statements to tailoring report output by including ODS features.

Each chapter in this book groups reports of a similar type as described in Table 1.1.

Table 1.1 List of Chapter Topics

Chapter	Topic	Description
2	Detail Reports	List observations.
3	Summary Reports	Summarize observations.
4	Customized Reports	Use SAS programming statements to customize the presentation of data.
5	Multipanel Reports	Place multiple rows of information side-by-side.
6	Enhancing Reports with ODS Features	Apply ODS features to enhance the formatting of reports.

Each example includes the following information in this order:

❑   a brief statement of the goal of the example

❑   the report output

❑   a table that lists the SAS code features found in the example

❑   a description of the process to solve the report-writing task and a description of the data set that the example uses

❑   the SAS program that creates the output with annotations of the code in the left margin

❑   other ways of solving the same report-writing task (optional)

❑   more detailed discussions of the special features of the example (optional)

The example data sets analyzed in this book were devised to be structurally simple so that the focus of each example is the report-writing tool rather than the unique characteristics of the data set. See Appendix A, "Creating the Example Data Sets," for details on the contents of each example data set.

As you read each example, keep in mind how you can adapt the code to report results from your data sets. You can access the data sets and programs presented in this book from the companion Web site for this book: support.sas.com/companionsites.

Understanding SAS Report-Writing Tools

Most SAS procedures produce output in a standard format. Two procedures, REPORT and TABULATE, allow some customization of output layout. DATA steps and ODS features provide the most flexibility in customizing and selecting report output. The examples in this book focus on the application of report-writing procedures, DATA steps, and ODS in producing reports.

When writing a program to create a report, you need to know which SAS procedures specialize in the kind of report you want to produce. Reports can be categorized as detail, summary, customized, and multipanel. Examples of each are shown in Figures 1.1 through 1.4.

❑ *Detail* reports list information at the observation level of a data set (see Figure 1.1).

❑ *Summary* reports summarize observations and produce output such as frequency counts and descriptive statistics (see Figure 1.2).

❑ *Customized* reports list information in a style that is different than the standard output from a SAS procedure. Often these are produced with DATA step programming (see Figure 1.3).

❑ *Multipanel* reports present multiple rows of information side-by-side (see Figure 1.4).

Some overlap does exist between the categories. For example, a detail report may include summaries, and a multipanel report may contain detail and summary information.

Figure 1.1 Example of a Detail Report

	ID	GROUP	GENDER	HT	WT	AGE
1	301	B	F	64	110	32
2	302	A	M	71	142	42
3	303	A	M	72	206	34
4	304	B	M	69	160	43
5	305	A	F	65	138	32
6	306	A	F	65	196	32
7	307	B	M	70	242	40

Study Heights and Weights

..... more rows…….

Figure 1.2 Example of a Summary Report

Study Heights and Weights

Group	Gender	Height(in)		Weight(lb)		Age at Exam	
		Mean	Std	Mean	Std	Mean	Std
A	Females	64.6	1.6	144	21.6	35.4	7.5
	Males	69.5	2.6	169	24.9	35.9	9.0
B	Females	65.9	2.6	139	21.4	36.2	7.3
	Males	69.5	2.7	169	20.0	36.6	8.5

Figure 1.3 Example of a Customized Report

Study Heights and Weights

Group A Males
Mean Weight: 169   Mean Height: 69.5
Group B Males
Mean Weight: 169   Mean Height: 69.5
TTest Results: Males Group A vs Group B Weight: No significant difference (p>0.05)
TTest Results: Males Group A vs Group B Height: No significant difference (p>0.05)

Group A Females
Mean Weight: 144   Mean Height: 64.6
Group B Females
Mean Weight: 139   Mean Height: 65.9
TTest Results: Females Group A vs Group B Weight: No significant difference (p>0.05)
TTest Results: Females Group A vs Group B Height: Significant difference (p < 0.05)

Figure 1.4 Example of a Multipanel Report

Study Heights and Weights

Group	ID	Gender	Ht	Wt	Age
B	301	F	64	110	31
A	302	M	71	142	42
A	303	M	72	206	34
B	304	M	69	160	43
A	305	F	64	138	32
A	306	F	65	196	32

Group	ID	Gender	Ht	Wt	Age
B	339	F	65	143	34
B	340	M	68	181	26
A	341	M	66	168	44
B	342	M	70	171	44
B	343	M	68	168	31
B	344	M	71	162	24

Group	ID	Gender	Ht	Wt	Age
A	377	F	66	152	33
B	378	M	69	176	53
B	379	F	64	127	41
B	380	M	66	174	52
B	381	M	69	154	39
B	382	F	66	135	41

……more rows………..

Table 1.2 presents an overview of each category of report and the SAS procedures best suited to produce reports of that type.

Table 1.2 Report Types and the Procedures Used to Produce the Different Types

Report Type	Procedure/Step	Description
Detail	PRINT	Produces data listings quickly; can supply titles, footnotes, and column sums.
	REPORT	Offers more control and customization than PROC PRINT; can produce both column and row sums; has DATA step computation abilities.
	SQL	Combines Structured Query Language and SAS features such as formats; can manipulate data and create a SAS data set in the same step that creates the report; can produce column and row statistics; does not offer as much control over output as PROC PRINT and PROC REPORT.
	MEANS, SUMMARY, UNIVARIATE	Computes descriptive statistics for numeric variables; can produce a printed report and create an output data set.
Summary	PRINT	Produces only one summary report; can sum the BY variables.
	REPORT	Combines features of the PRINT, MEANS, and TABULATE procedures with features of the DATA step in a single report-writing tool; can also create an output data set.
	SQL	Computes descriptive statistics for one or more SAS data sets or DBMS tables; can produce a printed report or create a SAS data set.
	TABULATE	Produces descriptive statistics in a tabular format; can produce multidimensional tables with descriptive statistics; can also create an output data set.
Customized	DATA Step	Produces highly customized reports of all types using SAS programming statements.
Multipanel	All procedures when sending output to a nonlisting destination; REPORT when sending output to either the LISTING or a nonlisting destination	Produces side-by-side reports.

Most examples in this book use PROC REPORT and PROC TABULATE. A few examples use PROC PRINT and a few examples use DATA steps. One example uses PROC MEANS and another uses PROC FREQ. PROC FORMAT is used throughout to add labels and other information to the reports.

Integrating ODS and Report Writing

ODS is an integral part of the report-writing process. It can be used in all categories of reports to design the layout of a report, improve the look of a report, and select the contents of a report.

The default destination of your output when you start your SAS session is LISTING. The LISTING destination is the traditional monospace SAS output. The examples in Chapters 2, 3, 4, and 5 are written to send output to the LISTING destination. Several of these examples are modified in Chapter 6 to send output to nonlisting destinations such as RTF and HTML.

Associating Types of Reports and the Examples in This Book

Appendix B, "Cross-Reference of the Examples in This Book," presents a cross-reference of the examples in this book to the type of report, procedures used, data sets used, and ODS enhanced versions of the examples.

The rows of Table B.1 in Appendix B list the examples presented in Chapters 2 through 5. A table in the introduction to each of the Chapters 2 through 5 repeats the pertinent rows from Table B.1.

The examples in Chapter 6 are derived from the examples in Chapters 2 through 5, and a table linking the examples in Chapter 6 to the original versions is presented in the introduction to Chapter 6 and repeated in Table B.2 in Appendix B.

Using PROC SQL as a Report-Writing Tool

PROC SQL can also produce reports, but none of the examples in this book apply this procedure to a report-writing task. PROC SQL is a multipurpose procedure that is the SAS implementation of Structured Query Language.

You can produce detail reports with PROC SQL, but the report formatting options in the procedure are limited. In the process of creating your report, you may find PROC SQL most useful in combining your data sets and obtaining intermediate results that are included in your final reports. For more information on PROC SQL, see "The SQL Procedure" in the "Procedures" section of *Base SAS 9.1 Procedures Guide.*

Displaying Results Graphically

The examples in this book concentrate on producing text-based tables. Some images are included in the text reports in Chapter 6, and one example in Chapter 6 includes a programmatically derived graphical report.

A picture can be invaluable in conveying results. When you combine both pictures and text in a report, you can help your audience better understand your results.

While plotting data is beyond the scope of this book, do not ignore this topic. The best reference for presenting data graphically is *SAS/GRAPH 9.1 Reference.* To get started in producing graphical reports, look for SAS Press titles and SUGI conference proceedings, as described in the "References" section of this chapter. These resources will help you combine graphs with the material you've learned in this book.

Writing a Report Program in Five Steps

Writing a report can be an iterative process. You will likely find that it takes several tries to produce the report you need. Before starting your report program, make sure you understand your data and the types of information that the report should convey. Do not concentrate on the style attributes of the report until you're sure you can produce the basic output. Then after successfully establishing the structure of the report, add the formatting features that improve the look and readability of your report.

These five steps can guide you in writing your report programs.

1. ***State the information that the report should convey.*** Write sentences that describe and explain the contents of your report.

2. ***Sketch how the report should look.*** Consider these issues in planning your report:

   ❏ What type of report is this–detail, summary, customized, multipanel, a combination of types?

   ❏ What defines the columns of the report–variables, computed variables?

   ❏ What defines the rows of the report–an observation, summaries of observations, groups of observations?

   ❏ How should the rows be ordered?

   ❏ What kind of annotation is needed in the report–customized lines, titles, footnotes?

3. ***Understand your data.*** Consider these issues when you investigate the content and structure of your analysis data sets:

   ❏ What data sets do you need to produce the report?

   ❏ How are the analysis data sets structured? Run PROC CONTENTS or view the properties to review the attributes of the variables in the data sets and the characteristics of the data sets, such as size and sorting. List a few observations with PROC PRINT to see what the values look like. When producing a summary report, run PROC FREQ on the variables that define the categories in your reports to determine the number of levels and whether values should be grouped. This will help you predict the physical size of the final report. Consider whether PROC FORMAT would be useful in grouping the data. Run PROC MEANS to determine ranges of values.

   ❏ Is the physical structure of the data set in the same orientation as the report? Do you need to reshape the data sets? What method should you use to reshape the data–DATA steps, PROC TRANSPOSE, output data set from a procedure?

   ❏ Do you need to combine data sets? How should you combine data sets–MERGE or SET statements in DATA steps, PROC APPEND, PROC SQL?

❑ Do you need to compute new variables? If so, should you do this before you execute the report-writing procedure? If you're using PROC REPORT, you may not know the answer until you test your PROC REPORT step. When writing a DATA step to produce a report, you may be able to compute the new variables and produce the report in the same step.

❑ Do you need to rearrange the order of the data for the report? You may not know the answer to this question until you select the report-writing procedure. Say, for example, that your goal is to produce a detail report with ordered rows. If you use PROC PRINT, your data set must be sorted or indexed in the proper order before you execute PROC PRINT. If you use PROC REPORT, you may not have to sort the data set before using the procedure. Options within PROC REPORT–the ORDER or GROUP option on the DEFINE statement and the ORDER= option on the PROC REPORT statement–will order the rows of your report.

4. ***Select the report-writing procedure or decide to use a DATA step and, after reshaping the data sets as explained in Step 3, write the basic statements that construct the report.*** Ensure that your program can construct the basic layout of the report, and do not dwell on formatting the report (formatting columns, adding labels, adding style options, etc.). It may take several tries to achieve the required structure, and you may need to return to Step 3 to learn more about your data sets, reshape the data sets, or compute new variables. Refer to Table 1.2 for a list of which procedures perform best at which tasks.

5. ***Add formatting features to the report.*** Consider whether to add these items to improve the look of your report:

❑ SAS defined formats and user-defined formats

❑ titles, footnotes, labels

❑ customized lines

❑ style attributes for fonts, spacing, borders, etc.

❑ customized BY lines

❑ summary lines

❑ features specific to the output destination

Your final report program will likely be a hybrid of formatting features available within the procedure and those that can be supplied with ODS specifications.

References

The focus of this book is the presentation of examples, not the explanation of syntax. Therefore, it's important to have reference documentation available when you read this book. SAS®9 documentation is available online at support.sas.com/v9doc.

Basic references used for this book include:

❑ *SAS 9.1 Language Reference: Concepts*

❑ *SAS 9.1 Language Reference: Dictionary*

❏ *Base SAS 9.1 Procedures Guide*

❏ *SAS 9.1 Output Delivery System: User's Guide*

Additional SAS examples can be found in the many books available through SAS Press. See the back of this book for a list of titles, and access the SAS Press Web site (support.sas.com/saspress) for newly released and revised publications.

Several presentations at SUGI conferences show how SAS users apply report-writing techniques. Recent conference proceedings are available online, and they provide a wealth of additional applications and examples. You can link to them through the SAS support Web site (support.sas.com).