

Data Analytics with SAS

*Explore your data and get actionable
insights with the power of SAS*

Nishant Sidana



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First published: 2024

Published by BPB Online

WeWork

119 Marylebone Road

London NW1 5PU

UK | UAE | INDIA | SINGAPORE

ISBN 978-93-55515-971

www.bpbonline.com

Dedicated to

*My wife, Nisha, my daughter, Anika
and
my parents, Suresh Sidana and Reeta Sidana*

About the Author

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Acknowledgement

I want to express my deepest gratitude to my family and friends for their unwavering support and encouragement throughout the journey. I want to especially thank, my wife Nisha who supported me with enthusiasm throughout this journey.

I am also grateful to BPB Publications for lending their guidance, support and expertise, successfully throughout the journey. I received unconditional support from the reviewers, technical experts, and editors in revising and finalizing the book.

Finally, I would also like to thank the industry as working in different domains helped me bring minute details of analytical concepts into the book.

Preface

Data Analytics has become the most sort after technology today for every industry. Competitive advantage is not possible without examining the data of business operations. This book will help readers build concepts to discover patterns from the data which can help them understand the business operation and acquire a competitive edge.

SAS is an analytical tool. It has got all the functionalities which can help us analyse data easily. This book has tried to help readers with every aspect and function of data analytics with SAS.

Readers will learn about SAS and its components, concepts and functions for data manipulation, data exploration, data visualization, etc. The book has presented examples for every topic which will help readers to be job ready.

This book is helpful for readers from any domain such as engineering, management, finance, medical etc., who want to build career in Data Analytics, Data Science, Business Intelligence roles or want to explore the power of data.

I hope that readers will find this book helpful, informative and friendly in their analytical journey:

Chapter 1: Introduction to SAS Programming - The chapter will introduce SAS Software which is an analytical software. It is used for analysing data, visualising data. The chapter will focus on the building blocks of SAS. It will help participants understand SAS. SAS Libraries are an important component while working with SAS. It is used to store data files. The chapter will focus on understanding Data and Set statements which help create new data sets after carrying out modifications on existing data sets.

Chapter 2: Overview of SAS Components - The chapter will focus on SAS components. The components are the building blocks of SAS. We can write programs in SAS with the help of these components. The chapter will also focus on importing data sets to SAS.

Chapter 3: Data Manipulation - Raw data available cannot be used directly. It needs to be clean, and noise needs to be removed before using it for further analysis. Data Manipulation is a critical step for every analyst. It basically helps shape the data. Complete data is not important to us. It helps remove unwanted data before processing it.

Chapter 4: Advanced Data Manipulation - The chapter will focus on advanced techniques for data manipulation.

Chapter 5: SAS Functions and Options - The chapter will focus on SAS Functions which is a SAS component that accepts an argument, perform an operation on data and return a value. Functions help us perform many operations such as arithmetic, text, date and time. SAS options also control SAS operations.

Chapter 6: Data Exploration-I - After cleaning the data, the first step in data analysis is Exploratory Data Analysis (EDA). It is a critical step in data analysis. It helps us understand the data. It helps us know the volume of data we are working on, data types, etc. It helps get insights from data about the business operations held in past.

Chapter 7: Data Exploration-II - The chapter will focus on advance concepts of data exploration.

Chapter 8: Importing Raw Data Files - A raw data file is an external text file whose records contain data values that are organized in fields. They can be read by a variety of software programs. This chapter focuses on concepts for importing raw data files to SAS.

Chapter 9: Advanced SAS: Proc SQL - SQL is a standardized language that is widely used to retrieve and update data in tables and in views that are based on those tables. It can be used with any SAS data set. It enables you to combine data from two or more different types of data sources and present them as a single table. It has all the functions for data analysis.

Chapter 10: Macro Programming for Faster Data Manipulation - Macros allows us to avoid repetitive sections of code and to use them again and again when needed. Used for reducing the amount of text that must be entered to do common tasks. It enables to assign of a name to character strings or groups of SAS programming statements.

Chapter 11: Data Visualization - Data Visualization is a critical element in analytics to get insights from data. Graphs and SGPLOT will help us create data visualization with Bar Charts, Pie-Charts, Histograms, Box plots etc.

Code Bundle and Coloured Images

Please follow the link to download the *Code Bundle* and the *Coloured Images* of the book:

<https://rebrand.ly/y7vclmu>

The code bundle for the book is also hosted on GitHub at

<https://github.com/bpbpublications/Data-Analytics-with-SAS>.

In case there's an update to the code, it will be updated on the existing GitHub repository.

We have code bundles from our rich catalogue of books and videos available at **<https://github.com/bpbpublications>**. Check them out!

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Table of Contents

1. Introduction to SAS Programming.....	1
Introduction.....	1
Structure.....	1
Objectives.....	2
Statistical Analysis System (SAS).....	2
Graphical User Interface (GUI)	2
SAS libraries	5
<i>Temporary library</i>	5
<i>Permanent library</i>	5
Data and set statements.....	6
<i>SAS dataset</i>	8
Data step execution	9
<i>Compilation phase</i>	9
<i>Input buffer</i>	9
<i>Program Data Vector (PDV)</i>	10
<i>Descriptor information</i>	10
<i>Execution phase</i>	12
Variable attributes	12
<i>Variable name</i>	13
<i>Type</i>	13
<i>Length</i>	13
<i>Format</i>	13
<i>Informat</i>	14
<i>Label</i>	14
Conclusion.....	14
2. Overview of SAS Components	15
Introduction.....	15
Structure.....	15
Objectives.....	15
SAS components.....	16
<i>Data step</i>	16

<i>PROC step</i>	18
Data transfer from one library to another.....	19
<i>Delete a dataset</i>	20
Import data.....	20
<i>Import a comma-delimited file with a CSV extension</i>	21
<i>Import an Excel file</i>	22
<i>Import a tab-delimited file</i>	23
Datalines/ cards	24
Conclusion.....	26
3. Data Manipulation	27
Introduction.....	27
Structure.....	27
Objectives.....	28
Formats	28
<i>Types of formats</i>	28
<i>Predefined formats</i>	28
<i>User-defined formats</i>	30
<i>Ranges</i>	31
<i>ATTRIB statement</i>	35
Appending: Adding rows	36
Sorting.....	41
Removing duplicates	44
Merging: Adding columns	47
<i>Types of merges</i>	52
Conclusion.....	54
4. Advanced Data Manipulation.....	55
Introduction.....	55
Structure.....	55
Objectives.....	56
Accumulator variable	56
By group processing.....	59
Do loops	62
Nested do loops	64
<i>Explicit OUTPUT statements</i>	65

Conditional do loops.....	66
Arrays.....	69
Conclusion.....	74
5. SAS Functions and Options.....	75
Introduction.....	75
Structure.....	75
Objectives.....	75
Introduction to SAS functions	76
Arithmetic function.....	76
Text functions	78
<i>Text function: Scan</i>	79
<i>Text functions: Substr</i>	80
<i>Text functions: Concatenate</i>	81
<i>Text functions: Find</i>	83
<i>Text functions: Concatenation operator</i>	85
<i>Text functions: Input</i>	86
<i>Text functions: Put</i>	87
Date and Time functions: INTCK.....	90
<i>Date and time functions: INTNX</i>	92
<i>Date and Time functions: DATEDIF</i>	94
<i>Date and time functions: YEARDIF</i>	95
Options.....	96
<i>Options: commonly used</i>	96
<i>Options: YEARCUTOFF</i>	97
Conclusion.....	99
6. Data Exploration-I	101
Introduction.....	101
Structure.....	101
Objectives.....	102
Expression.....	102
Operators	102
Where expression	105
IF THEN ELSE statement	107
<i>IF THEN ELSE statement with delete option</i>	108

<i>Where versus IF</i>	109
<i>SELECT</i>	112
PROC contents	114
PROC DATASETS.....	117
PROC PRINT.....	120
FIRST OBS and OBS options.....	123
<i>LABEL and RENAME</i>	124
<i>DROP= and KEEP=</i>	126
<i>DROP and KEEP statements</i>	128
Conclusion.....	129
7. Data Exploration-II.....	131
Introduction.....	131
Structure.....	131
Objectives.....	132
Proc Freq	132
<i>Proc Freq with variables</i>	132
<i>Proc Freq: Two-way tables (cross-tabulate)</i>	134
<i>Proc Freq: n-way tables(cross-tabulate)</i>	135
<i>Proc Freq: Suppress table information</i>	135
<i>Proc Freq: Crosslist</i>	137
<i>Proc Freq: Nlevels</i>	138
Proc Means	139
<i>Proc Means: Summarized data set</i>	144
Proc Summary.....	146
Proc Univariate	147
<i>Proc Corr</i>	149
Proc Rank.....	150
Proc Transpose	154
Proc Report.....	156
<i>Proc Report: BREAK/RBREAK</i>	163
Proc Tabulate.....	165
<i>Table statement</i>	166
<i>Proc Tabulate: Adding Labels</i>	170
<i>Proc Tabulate: Hiding Labels</i>	171
<i>Proc Tabulate: Adding totals and subtotals</i>	172

<i>Proc Tabulate: Adding formats and remove horizontal separators</i>	173
Exporting data	174
Output delivery system.....	175
Conclusion.....	176
8. Importing Raw Data Files	177
Introduction.....	177
Structure.....	177
Objectives.....	178
Raw data files.....	178
INFILE statement.....	180
INPUT statement.....	182
Formatted input method	188
<i>@n column pointer control</i>	189
<i>+n pointer control</i>	190
Informat	191
Recorded formats	193
PAD option.....	195
Free format raw data files.....	196
List input.....	197
<i>List input: Working with Delimiters</i>	198
Reading missing values	199
<i>Modifying list input</i>	204
Line pointer controls.....	205
Conclusion.....	212
9. Advanced SAS: Proc SQL.....	213
Introduction.....	213
Structure	213
Objectives.....	214
Proc SQL.....	214
<i>SAS vs SQL</i>	214
<i>SAS functions vs SQL functions</i>	215
Proc SQL step	215
<i>Types of Proc SQL step output</i>	218
Create output tables	218

<i>Unique values</i>	220
Creating new columns	221
CASE expression.....	223
COALESCE function.....	224
<i>Specify column attributes</i>	225
Sorting data	227
<i>Retrieving rows</i>	229
Summarizing data	231
<i>Aggregate function</i>	235
Grouping data.....	235
<i>Filtering grouped data</i>	236
<i>HAVING clause versus WHERE clause</i>	237
SQL joins	237
<i>Cartesian product of 2 tables</i>	238
<i>SQL joins: Inner joins</i>	238
<i>SQL joins: Outer joins</i>	240
<i>Right outer join</i>	241
<i>Full outer join</i>	242
<i>Using subqueries to select data</i>	243
Indexes	244
<i>Tips for creating indexes</i>	245
Conclusion.....	246
10. Macro Programming for Faster Data Manipulation	247
Introduction.....	247
Structure.....	247
Objectives.....	248
SAS macros.....	248
<i>Macro processor</i>	248
<i>Macro variable</i>	250
Defining macro	251
Calling macro	251
<i>Types of macro variables</i>	252
% PUT statement	255
Macro parameters.....	258
<i>Positional parameter</i>	258

<i>Keyword parameter</i>	259
<i>Arithmetic and logical expressions</i>	260
CALL SYMPUT.....	262
Conditional processing.....	264
<i>%IF-%THEN vs IF-THEN</i>	266
% INCLUDE statement.....	266
Conclusion.....	268
11. Data Visualization	269
Introduction.....	269
Structure.....	269
Objectives.....	269
GCHART.....	270
<i>Character chart variables</i>	270
<i>Numeric chart variables</i>	271
<i>Default statistics for charts</i>	272
<i>Specifying statistics</i>	274
<i>Summarizing a variable within categories</i>	276
<i>Selecting observations</i>	278
<i>Enhancing charts</i>	279
SGPLOT.....	280
PROC SGPLOT.....	281
Conclusion.....	289
Index	291-294

CHAPTER 1

Introduction to SAS Programming

Introduction

This chapter will introduce **Statistical Analysis System (SAS)**, an analytical software, used for analyzing and visualizing data. It will focus on the building blocks of SAS and help the readers understand SAS libraries which are an important component while working with SAS. It is used to store data files. This chapter will focus on understanding Data and Set statements which help create new data sets after carrying out modifications on existing data sets.

Structure

In this chapter we will be discussing the following topics:

- SAS
- GUI
- SAS libraries
- Data and set statements
- Executing data steps
- Variable attributes

Objectives

By the end of this chapter, you will be able to understand how SAS executes data steps. You would be able to understand the concept of SAS libraries as well as variable attributes. You will also learn the purpose of different windows of SAS will be understood.

Statistical Analysis System (SAS)

Competition in every sector is increasing rapidly and data analytics is the science which can help companies beat the competition. Companies today wants to utilize the power of analytics on data to explore new ways for increasing profits, expanding product base, dominating the competition, and so on. To perform data analysis, we require analytical tools. SAS is a tool used for data analytic activities.

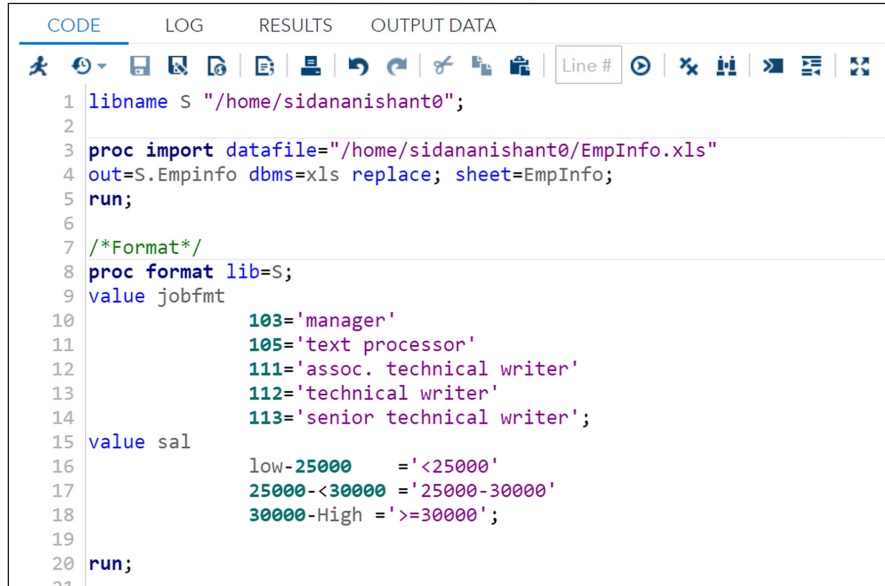
SAS is a programming language used for statistical analysis. It is developed by SAS institute. It is used for:

- Data mining
- Data management
- Business intelligence
- Exploratory Data Analysis (EDA)
- Data visualization
- Data analysis
- Predictive analytics
- Advanced analytics

Graphical User Interface (GUI)

Graphical User Interface (GUI) helps in data preparation, integration, visualization, reporting, and analytics. SAS has 4 important windows which help in easy access to data activities:

- **Code/Editor window:** It is used for writing and editing codes in SAS, as per *Figure 1.1:*



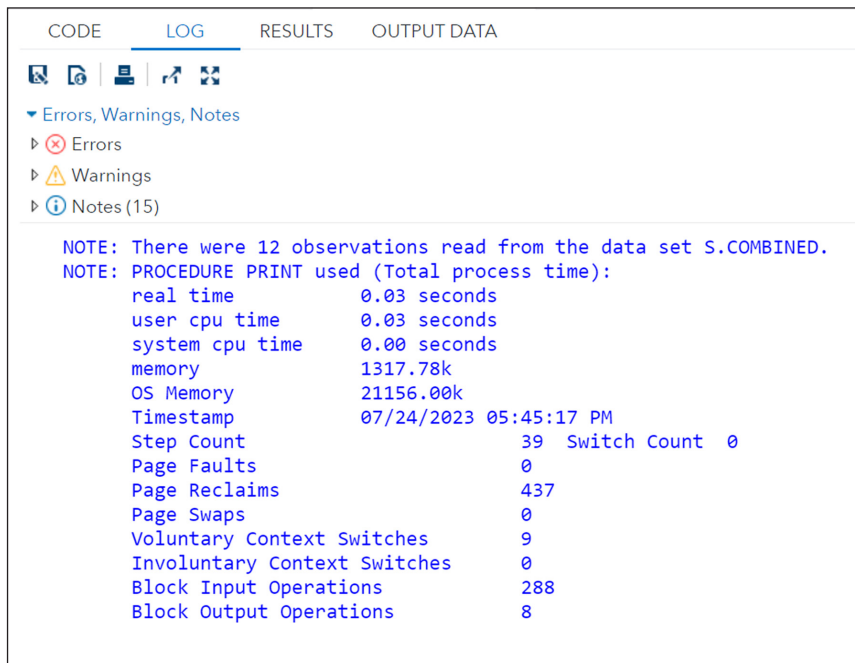
```

CODE LOG RESULTS OUTPUT DATA
1 libname s "/home/sidananishant0";
2
3 proc import datafile="/home/sidananishant0/EmpInfo.xls"
4 out=S.Empinfo dbms=xls replace; sheet=EmpInfo;
5 run;
6
7 /*Format*/
8 proc format lib=S;
9 value jobfmt
10         103='manager'
11         105='text processor'
12         111='assoc. technical writer'
13         112='technical writer'
14         113='senior technical writer';
15 value sal
16         low-25000 = '<25000'
17         25000-<30000 = '25000-30000'
18         30000-High = '>=30000';
19
20 run;
21

```

Figure 1.1: Code/Editor window

- **Log window:** It provides information about the execution of a program, and also lists the errors, warnings, or notes that come after executing the code, as per Figure 1.2:



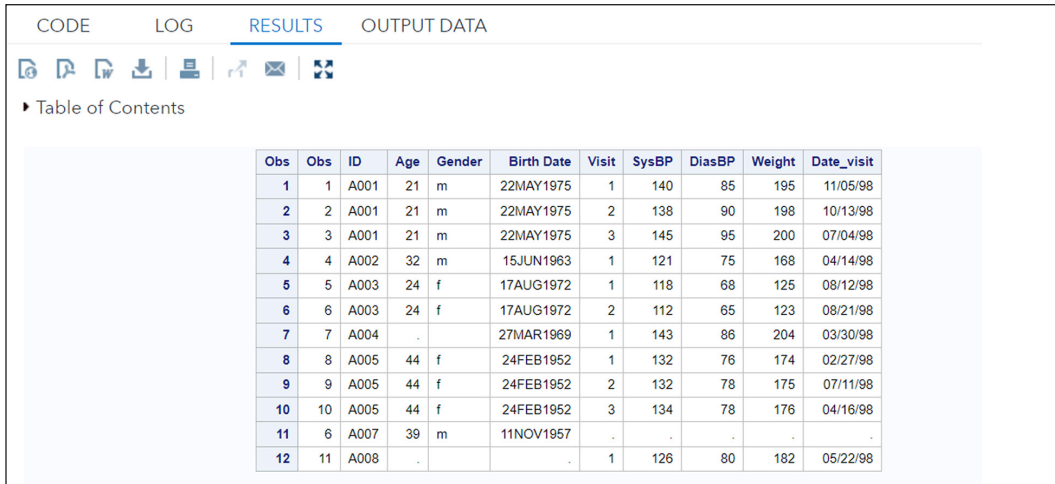
```

CODE LOG RESULTS OUTPUT DATA
Errors, Warnings, Notes
  Errors
  Warnings
  Notes (15)
NOTE: There were 12 observations read from the data set S.COMBINED.
NOTE: PROCEDURE PRINT used (Total process time):
      real time           0.03 seconds
      user cpu time       0.03 seconds
      system cpu time     0.00 seconds
      memory              1317.78k
      OS Memory           21156.00k
      Timestamp           07/24/2023 05:45:17 PM
      Step Count          39  Switch Count  0
      Page Faults         0
      Page Reclaims       437
      Page Swaps          0
      Voluntary Context Switches 9
      Involuntary Context Switches 0
      Block Input Operations 288
      Block Output Operations 8

```

Figure 1.2: Log Window

- **Results window:** It is used for displaying the output after executing the code, as per *Figure 1.3*:



The screenshot shows the SAS Results window with the 'RESULTS' tab selected. Below the navigation icons, there is a 'Table of Contents' section. The main area displays a table with 12 rows of patient data. The columns are: Obs, Obs, ID, Age, Gender, Birth Date, Visit, SysBP, DiasBP, Weight, and Date_visit.

Obs	Obs	ID	Age	Gender	Birth Date	Visit	SysBP	DiasBP	Weight	Date_visit
1	1	A001	21	m	22MAY1975	1	140	85	195	11/05/98
2	2	A001	21	m	22MAY1975	2	138	90	198	10/13/98
3	3	A001	21	m	22MAY1975	3	145	95	200	07/04/98
4	4	A002	32	m	15JUN1963	1	121	75	168	04/14/98
5	5	A003	24	f	17AUG1972	1	118	68	125	08/12/98
6	6	A003	24	f	17AUG1972	2	112	65	123	08/21/98
7	7	A004	.	.	27MAR1969	1	143	86	204	03/30/98
8	8	A005	44	f	24FEB1952	1	132	76	174	02/27/98
9	9	A005	44	f	24FEB1952	2	132	78	175	07/11/98
10	10	A005	44	f	24FEB1952	3	134	78	176	04/16/98
11	6	A007	39	m	11NOV1957
12	11	A008	.	.	.	1	126	80	182	05/22/98

Figure 1.3: Results window

- **Server files and folders:** It is used to represent the physical storage locations of data, as per *Figure 1.4*:

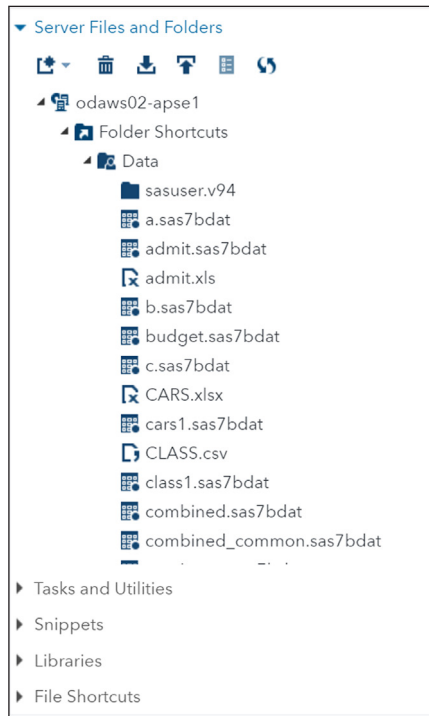


Figure 1.4: Server files and folders

SAS libraries

Output of the data pre-processing work done on data with SAS tool is stored in SAS in the form of SAS files. SAS can store data files in the form of a library.

A SAS library is defined as a collection of SAS files and SAS data sets, recognized by SAS.

The files can be stored as a unit. SAS libraries do not physically store data files. They just reference the location on computer where the files are physically stored.

Types of libraries in SAS are:

- Temporary library
- Permanent library

Temporary library

The output of data pre-processing work create many subsets of original dataset before getting the final dataset after the completion of data pre-processing. There is no requirement for storing these subsets permanently as we require them only during the working session till we get final dataset after pre-processing.

A temporary SAS library is used as a temporary storage location for data files. Important points:

- It stores data files only for the current SAS session and the data files are deleted once we end the SAS session.
- The name of the temporary library in SAS is work.

There is no specific library name that we can provide while storing a data file in a temporary library.

Permanent library

Once data pre-processing is completed, the final dataset needs to be stored permanently as we need it further for carrying out analysis to finally arrive at a solution for the problem.

A permanent SAS library is used as a permanent storage location of data files as the following:

- The data files stored here are available in every SAS session.
- We can specify a library name while creating SAS permanent library.
- The **libname** statement is used to create a permanent library.
- Permanent library creates a reference to the path where SAS files are physically stored.
- Syntax for creating a permanent library,