

**Andreas Krause
Melvin Olson**

The Basics of S and S-PLUS

With 34 Illustrations



Springer

Contents

Preface	v
List of Figures	xiii
List of Tables	xv
1. Introduction	1
1.1 The History of S and S-PLUS	1
1.2 S-PLUS on Different Operating Systems	4
1.2.1 UNIX	4
1.2.2 DOS/Windows	5
1.2.3 Data Transfer	5
1.2.4 Implementation Differences	5
1.3 Notational Conventions	5
2. System Design	7
2.1 Windows Components	7
2.1.1 Object Browser	8
2.1.2 Command Window	9
2.1.3 Toolbars	9
2.1.4 Graph Sheets	9
2.2 Working with Menus and Buttons	9
2.2.1 Importing Data	9
2.2.2 Graphs	10
2.2.3 Data and Statistics	11
2.2.4 Customizing the Toolbars	12
2.3 Learning the System	13
3. A First Session	15
3.1 General Information	15
3.1.1 Starting and Quitting	15
3.1.2 The Help System	16
3.1.3 Before Beginning	16
3.2 Simple Structures	17
3.2.1 Arithmetic Operators	17
3.2.2 Assignments	18
3.2.3 The Concatenate Command (<code>c</code>)	20
3.2.4 The Sequence Command (<code>seq</code>)	21
3.2.5 The Replicate Command (<code>rep</code>)	22
3.3 Mathematical Operations	23
3.4 Use of Brackets	25
3.5 Logical Values	26
3.6 Review	29

3.7 Exercises	32
3.8 Solutions	33
4. A Second Session	37
4.1 Constructing and Manipulating Data	37
4.1.1 Matrices	37
4.1.2 Arrays	43
4.1.3 Data Frames	45
4.1.4 Lists	47
4.2 Introduction to Missing Values	49
4.3 Putting it all Together	50
4.4 Exercises	53
4.5 Solutions	54
5. Graphics	57
5.1 Basic Graphics Commands	57
5.2 How Graphs Work	58
5.3 Graphics Devices	58
5.3.1 Working with Multiple Graphics Devices	60
5.4 Plotting Data	61
5.4.1 The <code>plot</code> Command	61
5.4.2 Modifying the Data Display	62
5.4.3 Modifying Figure Elements	64
5.5 Adding Elements to Existing Plots	65
5.5.1 Functions to Add Elements to Graphs	65
5.5.2 More About <code>abline</code>	66
5.5.3 More on Adding Axes	68
5.5.4 Adding Text to Graphs	69
5.6 Setting Options	69
5.7 Creating Fancy Graphs: The Most Important Commands	71
5.7.1 Figure Layouts	73
5.8 Exercises	77
5.9 Solutions	78
6. Exploring Data	83
6.1 Univariate Data Exploration	83
6.1.1 Descriptive Statistics	83
6.1.2 Graphical Exploration	90
6.2 Multivariate Data Exploration	93
6.2.1 Descriptive Statistics	93
6.2.2 Graphical Exploration	98
6.3 Distributions and Related Functions	112
6.3.1 Univariate Distributions	113
6.3.2 Multivariate Distributions	118
6.4 Confirmatory Statistics and Hypothesis Testing	118

6.5	Missing Values	123
6.5.1	Testing for Missing Values	124
6.5.2	Missing Values in Graphs	125
6.6	Exercises	126
6.7	Solutions	129
7.	Statistical Modeling	139
7.1	Introductory Examples	139
7.1.1	Regression	139
7.1.2	Regression Diagnostics	141
7.2	Statistical Models	143
7.3	Model Syntax	144
7.4	Regression	145
7.4.1	Linear Regression and Modeling Techniques	145
7.4.2	ANOVA	149
7.4.3	Logistic Regression	151
7.4.4	Survival Data Analysis	153
7.5	Exercises	156
7.6	Solutions	157
8.	Programming	163
8.1	Iteration	163
8.1.1	The <code>for</code> Loop	164
8.1.2	The <code>while</code> Loop	165
8.1.3	The <code>repeat</code> Loop	165
8.1.4	Vectorizing a Loop	166
8.2	Writing Functions	167
8.2.1	Scope of Variables	169
8.2.2	Parameters and Defaults	170
8.2.3	Passing an Unspecified Number of Parameters to a Function	172
8.2.4	Testing for Existence of an Argument	173
8.2.5	Using Function Arguments in Graphics Labels	173
8.3	Debugging: Searching for Errors	174
8.3.1	Syntax Errors	175
8.3.2	Invalid Arguments	175
8.3.3	Execution or Runtime Errors	176
8.3.4	Logical Errors	177
8.4	Output Using the <code>cat</code> Function	178
8.5	The <code>paste</code> Function	179
8.6	Elements of Object-Oriented Programming	180
8.7	Lists	184
8.7.1	Adding and Deleting List Elements	185
8.7.2	Naming List Elements	186
8.7.3	Applying the Same Function to List Elements	187

8.7.4	Unlisting a List	188
8.8	Exercises	189
8.9	Solutions	191
9.	Input and Output	197
9.1	Reading Data from the Terminal	197
9.2	Using the <code>scan</code> Function	197
9.3	A Comfortable Function for Reading Data	199
9.4	Editing Data	199
9.5	Transferring Data	200
9.6	Reading S-PLUS Commands from File	201
9.7	Writing Text Files	201
9.8	Writing S-PLUS Output	202
9.9	Exercises	203
9.10	Solutions	205
10.	Useful Hints and Techniques	209
10.1	How S-PLUS works	209
10.1.1	Starting the S-PLUS System	209
10.1.2	Levels of Calls	211
10.1.3	Searching for Objects	212
10.2	Tips for Programmers	213
10.2.1	Storing and Restoring Graphical Parameters	213
10.2.2	Naming of Variables and Functions	214
10.3	The Process of Developing a Function	214
10.4	Imposing a Structure	215
10.4.1	Working on Different Projects	215
10.4.2	Housekeeping-Cleaning Up Directories	216
10.5	Batch Jobs	216
10.6	Incorporating and Accessing C and Fortran Programs	217
10.7	Exercises	220
10.8	Solutions	221
11.	Special Topics	223
11.1	Libraries	223
11.2	Including Graphs in Text Processors	224
11.2.1	Copying Graphs into Windows Text Processors	225
11.2.2	Using the PostScript Format	225
11.2.3	PostScript Graphs in TeX	226
11.2.4	PostScript Graphs in MS Word	227
11.2.5	PostScript Graphs in Other Word Processors	228
11.2.6	If You Don't Have a PostScript Printer	228
11.3	S-News: Exchanging Information with Other Users	229
11.3.1	Subscribing and Unsubscribing to S-News	229
11.3.2	Asking Questions on the Mailing List	229

11.4 The Statlib Server	230
11.5 R: A Public Domain Software	230
12. References	231
12.1 Print References.....	231
12.2 Electronic References	233
12.2.1 S-PLUS Related Sources.....	233
12.2.2 TeX Related Sources.....	233
12.2.3 Other Sources.....	233
Index	235