PSPP Users' Guide

GNU PSPP Statistical Analysis Software
Release 2.0.1

This manual is for GNU PSPP version 2.0.1, software for statistical analysis.

Copyright © 1997, 1998, 2004, 2005, 2009, 2012, 2013, 2014, 2016, 2019, 2020, 2023 Free Software Foundation, Inc.

> Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.3 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation License".

Table of Contents

1 Introduction **1**

2 Your rights and obligations **2**

3 Invoking pspp **3**

3.1 Main Options 3
3.2 PDF, PostScript, SVG, and PNG Output Options 6
3.3 Plain Text Output Options 7
3.4 SPV Output Options 8
3.5 TeX Output Options 9
3.6 HTML Output Options 9
3.7 OpenDocument Output Options 9
3.8 Comma-Separated Value Output Options 9

4 Invoking psppire **11**

4.1 The graphic user interface 11

5 Using PSPP **12**

5.1 Preparation of Data Files 12
5.1.1 Defining Variables 13
5.1.2 Listing the data 13
5.1.3 Reading data from a text file 14
5.1.4 Reading data from a pre-prepared PSPP file 14
5.1.5 Saving data to a PSPP file. 15
5.1.6 Reading data from other sources 15
5.1.7 Exiting PSPP 15
5.2 Data Screening and Transformation 15
5.2.1 Identifying incorrect data 15
5.2.2 Dealing with suspicious data 16
5.2.3 Inverting negatively coded variables 17
5.2.4 Testing data consistency 18
5.2.5 Testing for normality 19
5.3 Hypothesis Testing 21
5.3.1 Testing for differences of means 21
5.3.2 Linear Regression 23

6 The PSPP language **25**

6.1 Tokens 25
6.2 Forming commands of tokens 26
6.3 Syntax Variants 27
6.4 Types of Commands 27

6.5 Order of Commands . . . 28
6.6 Handling missing observations . . . 29
6.7 Datasets . . . 29
6.7.1 Attributes of Variables . . . 29
6.7.2 Variables Automatically Defined by PSPP . . . 31
6.7.3 Lists of variable names . . . 32
6.7.4 Input and Output Formats . . . 32
6.7.4.1 Basic Numeric Formats . . . 33
6.7.4.2 Custom Currency Formats . . . 35
6.7.4.3 Legacy Numeric Formats . . . 36
6.7.4.4 Binary and Hexadecimal Numeric Formats . . . 37
6.7.4.5 Time and Date Formats . . . 38
6.7.4.6 Date Component Formats . . . 41
6.7.4.7 String Formats . . . 41
6.7.5 Scratch Variables . . . 41
6.8 Files Used by PSPP . . . 41
6.9 File Handles . . . 42
6.10 Backus-Naur Form . . . 43

7 Mathematical Expressions . . . 44

7.1 Boolean Values . . . 44
7.2 Missing Values in Expressions . . . 44
7.3 Grouping Operators . . . 44
7.4 Arithmetic Operators . . . 44
7.5 Logical Operators . . . 45
7.6 Relational Operators . . . 45
7.7 Functions . . . 46
7.7.1 Mathematical Functions . . . 46
7.7.2 Miscellaneous Mathematical Functions . . . 46
7.7.3 Trigonometric Functions . . . 47
7.7.4 Missing-Value Functions . . . 47
7.7.5 Set-Membership Functions . . . 48
7.7.6 Statistical Functions . . . 48
7.7.7 String Functions . . . 49
7.7.8 Time & Date Functions . . . 51
7.7.8.1 How times & dates are defined and represented . . . 51
7.7.8.2 Functions that Produce Times . . . 51
7.7.8.3 Functions that Examine Times . . . 51
7.7.8.4 Functions that Produce Dates . . . 52
7.7.8.5 Functions that Examine Dates . . . 53
7.7.8.6 Time and Date Arithmetic . . . 54
7.7.9 Miscellaneous Functions . . . 55
7.7.10 Statistical Distribution Functions . . . 55
7.7.10.1 Continuous Distributions . . . 56
7.7.10.2 Discrete Distributions . . . 60
7.8 Operator Precedence . . . 61

8 Data Input and Output . . . 62
8.1 BEGIN DATA . . . 62
8.2 CLOSE FILE HANDLE . . . 62
8.3 DATAFILE ATTRIBUTE . . . 62
8.4 DATASET commands . . . 63
8.5 DATA LIST . . . 64
8.5.1 DATA LIST FIXED . . . 64
Examples . . . 66
8.5.2 DATA LIST FREE . . . 67
8.5.3 DATA LIST LIST . . . 68
8.6 END CASE . . . 68
8.7 END FILE . . . 68
8.8 FILE HANDLE . . . 68
8.9 INPUT PROGRAM . . . 71
8.10 LIST . . . 74
8.11 NEW FILE . . . 74
8.12 PRINT . . . 74
8.13 PRINT EJECT . . . 75
8.14 PRINT SPACE . . . 76
8.15 REREAD . . . 76
8.16 WRITE . . . 77

9 System and Portable File I/O . . . 78
9.1 APPLY DICTIONARY . . . 78
9.2 EXPORT . . . 79
9.3 GET . . . 79
9.4 GET DATA . . . 80
9.4.1 Spreadsheet Files . . . 81
9.4.2 Postgres Database Queries . . . 81
9.4.3 Textual Data Files . . . 82
9.4.3.1 Reading Delimited Data . . . 83
9.4.3.2 Reading Fixed Columnar Data . . . 85
9.5 IMPORT . . . 86
9.6 SAVE . . . 86
9.7 SAVE DATA COLLECTION . . . 88
9.8 SAVE TRANSLATE . . . 88
9.8.1 Writing Comma- and Tab-Separated Data Files . . . 89
9.9 SYSFILE INFO . . . 90
9.10 XEXPORT . . . 91
9.11 XSAVE . . . 91

10 Combining Data Files . . . 92
10.1 Common Syntax . . . 92
10.2 ADD FILES . . . 94
10.3 MATCH FILES . . . 95
10.4 UPDATE . . . 96

11 Manipulating Variables 97
11.1 DISPLAY 97
11.2 NUMERIC 98
11.3 STRING 98
11.4 RENAME VARIABLES 98
11.5 SORT VARIABLES 99
11.6 DELETE VARIABLES 100
11.7 VARIABLE LABELS 100
11.8 PRINT FORMATS 100
11.9 WRITE FORMATS 101
11.10 FORMATS 101
11.11 VALUE LABELS 101
11.12 ADD VALUE LABELS 101
11.13 MISSING VALUES 102
11.14 VARIABLE ATTRIBUTE 102
11.15 VARIABLE ALIGNMENT 103
11.16 VARIABLE WIDTH 103
11.17 VARIABLE LEVEL 104
11.18 VARIABLE ROLE 104
11.19 VECTOR 104
11.20 MRSETS 105
11.21 LEAVE 106

12 Data transformations 107
12.1 AGGREGATE 107
12.1.1 Aggregate Example 110
12.2 AUTORECODE 110
12.2.1 Autorecode Example 111
12.3 COMPUTE 113
12.3.1 Compute Examples 114
12.4 COUNT 115
12.4.1 Count Examples 116
12.5 FLIP 118
12.5.1 Flip Examples 119
12.6 IF 120
12.7 RECODE 121
12.8 SORT CASES 123
12.8.1 Sorting Example 124

13 Selecting data for analysis 127
13.1 FILTER 127
13.2 N OF CASES 127
13.3 SAMPLE 128
13.4 SELECT IF 128
13.4.1 Example Select-If 128

13.5 SPLIT FILE . . . 129
13.5.1 Example Split . . . 130
13.6 TEMPORARY . . . 132
13.6.1 Example Temporary . . . 132
13.7 WEIGHT . . . 133
13.7.1 Example Weights . . . 133

14 Conditional and Looping Constructs . . . 135

14.1 BREAK . . . 135
14.2 DEFINE . . . 135
14.2.1 Overview . . . 135
14.2.2 Introduction . . . 136
14.2.3 Macro Bodies . . . 137
14.2.4 Macro Arguments . . . 137
14.2.5 Controlling Macro Expansion . . . 140
14.2.6 Macro Functions . . . 140
14.2.7 Macro Expressions . . . 143
14.2.8 Macro Conditional Expansion . . . 144
14.2.9 Macro Loops . . . 144
14.2.10 Macro Variable Assignment . . . 145
14.2.11 Macro Settings . . . 145
14.2.12 Additional Notes . . . 145
14.2.12.1 Calling Macros from Macros . . . 145
14.2.12.2 Command Terminators . . . 146
14.2.12.3 Expansion Contexts . . . 146
14.2.12.4 PRESERVE and RESTORE . . . 146
14.3 DO IF . . . 146
14.4 DO REPEAT . . . 147
14.5 LOOP . . . 148

15 Statistics . . . 149

15.1 DESCRIPTIVES . . . 149
15.1.1 Descriptives Example . . . 150
15.2 FREQUENCIES . . . 152
15.2.1 Frequencies Example . . . 154
15.3 EXAMINE . . . 155
15.4 GRAPH . . . 158
15.4.1 Scatterplot . . . 158
15.4.2 Histogram . . . 158
15.4.3 Bar Chart . . . 158
15.5 CORRELATIONS . . . 159
15.6 CROSSTABS . . . 160
15.6.1 Crosstabs Example . . . 163
15.7 CTABLES . . . 166
15.7.1 Basics . . . 167
15.7.1.1 Categorical Variables . . . 167

15.7.1.2 Scalar Variables . . . 169
15.7.1.3 Overriding Measurement Level . . . 170
15.7.2 Data Summarization . . . 172
15.7.2.1 Summary Functions for Individual Cells . . . 174
15.7.2.2 Summary Functions for Groups of Cells . . . 175
15.7.2.3 Summary Functions for Adjusted Weights . . . 176
15.7.2.4 Unweighted Summary Functions . . . 177
15.7.3 Statistics Positions and Labels . . . 177
15.7.4 Category Label Positions . . . 178
15.7.5 Per-Variable Category Options . . . 182
15.7.5.1 Explicit Categories . . . 182
15.7.5.2 Implicit Categories . . . 183
15.7.5.3 Totals and Subtotals . . . 184
15.7.5.4 Categories Without Values . . . 186
15.7.6 Titles . . . 186
15.7.7 Table Formatting . . . 187
15.7.8 Display of Variable Labels . . . 187
15.7.9 Missing Value Treatment . . . 188
15.7.9.1 Missing Values for Cell-Defining Variables . . . 188
15.7.9.2 Missing Values for Summary Variables . . . 189
15.7.9.3 Scale Missing Values . . . 190
15.7.10 Computed Categories . . . 191
15.7.10.1 PCOMPUTE . . . 191
15.7.10.2 PPROPERTIES . . . 193
15.7.11 Effective Weight . . . 193
15.7.12 Hiding Small Counts . . . 194
15.8 FACTOR . . . 194
15.9 GLM . . . 197
15.10 LOGISTIC REGRESSION . . . 197
15.11 MEANS . . . 199
15.11.1 Example Means . . . 200
15.12 NPAR TESTS . . . 201
15.12.1 Binomial test . . . 202
15.12.2 Chi-square Test . . . 203
15.12.2.1 Chi-square Example . . . 203
15.12.3 Cochran Q Test . . . 204
15.12.4 Friedman Test . . . 205
15.12.5 Kendall's W Test . . . 205
15.12.6 Kolmogorov-Smirnov Test . . . 205
15.12.7 Kruskal-Wallis Test . . . 206
15.12.8 Mann-Whitney U Test . . . 206
15.12.9 McNemar Test . . . 206
15.12.10 Median Test . . . 206
15.12.11 Runs Test . . . 207
15.12.12 Sign Test . . . 207
15.12.13 Wilcoxon Matched Pairs Signed Ranks Test . . . 207
15.13 T-TEST . . . 207

15.13.1 One Sample Mode . . . 208
15.13.1.1 Example - One-Sample T-test . . . 208
15.13.2 Independent Samples Mode . . . 210
15.13.2.1 Example - Independent Samples T-test . . . 210
15.13.3 Paired Samples Mode . . . 214
15.14 ONEWAY . . . 214
15.15 QUICK CLUSTER . . . 215
15.16 RANK . . . 216
15.17 REGRESSION . . . 217
15.17.1 Syntax . . . 217
15.17.2 Examples . . . 218
15.18 RELIABILITY . . . 219
15.18.1 Example - Reliability . . . 219
15.19 ROC . . . 221

16 Matrices . . . 223

16.1 Matrix Files . . . 223
16.2 MATRIX DATA . . . 224
16.2.1 With `ROWTYPE_` . . . 225
16.2.2 Without `ROWTYPE_` . . . 228
16.2.2.1 Factor variables without `ROWTYPE_` . . . 230
16.3 MCONVERT . . . 231
16.4 MATRIX . . . 232
16.4.1 Matrix Expressions . . . 234
16.4.1.1 Matrix Construction Operator `{}` . . . 234
16.4.1.2 Integer Sequence Operator '`:`' . . . 235
16.4.1.3 Index Operator `()` . . . 235
16.4.1.4 Unary Operators . . . 236
16.4.1.5 Elementwise Binary Operators . . . 236
16.4.1.6 Matrix Multiplication Operator '`*`' . . . 237
16.4.1.7 Matrix Exponentiation Operator `**` . . . 237
16.4.2 Matrix Functions . . . 238
16.4.2.1 Elementwise Functions . . . 238
16.4.2.2 Logical Functions . . . 239
16.4.2.3 Matrix Construction Functions . . . 240
16.4.2.4 Minimum, Maximum, and Sum Functions . . . 242
16.4.2.5 Matrix Property Functions . . . 243
16.4.2.6 Matrix Rank Ordering Functions . . . 243
16.4.2.7 Matrix Algebra Functions . . . 243
16.4.2.8 Matrix Statistical Distribution Functions . . . 246
16.4.2.9 EOF Function . . . 246
16.4.3 The `COMPUTE` Command . . . 247
16.4.4 The `CALL` Command . . . 247
16.4.5 The `PRINT` Command . . . 248
16.4.6 The `DO IF` Command . . . 250
16.4.7 The `LOOP` and `BREAK` Commands . . . 250

16.4.7.1 The BREAK Command . . . 251
16.4.8 The READ and WRITE Commands . . . 252
16.4.8.1 The READ Command . . . 253
16.4.8.2 The WRITE Command . . . 254
16.4.9 The GET Command . . . 255
16.4.10 The SAVE Command . . . 256
16.4.11 The MGET Command . . . 257
16.4.12 The MSAVE Command . . . 258
16.4.13 The DISPLAY Command . . . 258
16.4.14 The RELEASE Command . . . 259

17 Utilities . . . 260

17.1 ADD DOCUMENT . . . 260
17.2 CACHE . . . 260
17.3 CD . . . 260
17.4 COMMENT . . . 260
17.5 DOCUMENT . . . 261
17.6 DISPLAY DOCUMENTS . . . 261
17.7 DISPLAY FILE LABEL . . . 261
17.8 DROP DOCUMENTS . . . 261
17.9 ECHO . . . 261
17.10 ERASE . . . 261
17.11 EXECUTE . . . 262
17.12 FILE LABEL . . . 262
17.13 FINISH . . . 262
17.14 HOST . . . 262
17.15 INCLUDE . . . 263
17.16 INSERT . . . 263
17.17 OUTPUT . . . 264
17.18 PERMISSIONS . . . 265
17.19 PRESERVE and RESTORE . . . 265
17.20 SET . . . 265
17.21 SHOW . . . 273
17.22 SUBTITLE . . . 274
17.23 TITLE . . . 274

18 Invoking pspp-convert . . . 276

19 Invoking pspp-output . . . 279

19.1 The detect Command . . . 279
19.2 The dir Command . . . 279
19.3 The convert Command . . . 279
19.4 The get-table-look Command . . . 280
19.5 The convert-table-look Command . . . 280
19.6 Input Selection Options . . . 281

20 Invoking `pspp-dump-sav` 283

21 Not Implemented 284

22 Bugs 288
22.1 How to report bugs 288

23 Function Index 291

24 Command Index 294

25 Concept Index 296

Appendix A GNU Free Documentation License 302

1 Introduction

PSPP is a tool for statistical analysis of sampled data. It reads the data, analyzes the data according to commands provided, and writes the results to a listing file, to the standard output or to a window of the graphical display.

The language accepted by PSPP is similar to those accepted by SPSS statistical products. The details of PSPP's language are given later in this manual.

PSPP produces tables and charts as output, which it can produce in several formats; currently, ASCII, PostScript, PDF, HTML, DocBook and TEX are supported.

The current version of PSPP, 2.0.1, is incomplete in terms of its statistical procedure support. PSPP is a work in progress. The authors hope to fully support all features in the products that PSPP replaces, eventually. The authors welcome questions, comments, donations, and code submissions. See Chapter 22 [Submitting Bug Reports], page 288, for instructions on contacting the authors.

2 Your rights and obligations

PSPP is not in the public domain. It is copyrighted and there are restrictions on its distribution, but these restrictions are designed to permit everything that a good cooperating citizen would want to do. What is not allowed is to try to prevent others from further sharing any version of this program that they might get from you.

Specifically, we want to make sure that you have the right to give away copies of PSPP, that you receive source code or else can get it if you want it, that you can change these programs or use pieces of them in new free programs, and that you know you can do these things.

To make sure that everyone has such rights, we have to forbid you to deprive anyone else of these rights. For example, if you distribute copies of PSPP, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must tell them their rights.

Also, for our own protection, we must make certain that everyone finds out that there is no warranty for PSPP. If these programs are modified by someone else and passed on, we want their recipients to know that what they have is not what we distributed, so that any problems introduced by others will not reflect on our reputation.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise conditions of the license for PSPP are found in the GNU General Public License. You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA. This manual specifically is covered by the GNU Free Documentation License (see Appendix A [GNU Free Documentation License], page 302).

3 Invoking pspp

PSPP has two separate user interfaces. This chapter describes `pspp`, PSPP's command-line driven text-based user interface. The following chapter briefly describes PSPPIRE, the graphical user interface to PSPP.

The sections below describe the `pspp` program's command-line interface.

3.1 Main Options

Here is a summary of all the options, grouped by type, followed by explanations in the same order.

In the table, arguments to long options also apply to any corresponding short options.

Non-option arguments

syntax-file

Output options

-o, --output=*output-file*
-O *option*=*value*
-O format=*format*
-O device={terminal|listing}
--no-output
--table-look=*file*
-e, --error-file=*error-file*

Language options

-I, --include=*dir*
-I-, --no-include
-b, --batch
-i, --interactive
-r, --no-statrc
-a, --algorithm={compatible|enhanced}
-x, --syntax={compatible|enhanced}
--syntax-encoding=*encoding*

Informational options

-h, --help
-V, --version

Other options

-s, --safer
--testing-mode

syntax-file Read and execute the named syntax file. If no syntax files are specified, PSPP prompts for commands. If any syntax files are specified, PSPP by default exits after it runs them, but you may make it prompt for commands by specifying '-' as an additional syntax file.

-o *output-file*
Write output to *output-file*. PSPP has several different output drivers that support output in various formats (use `--help` to list the available formats).

Specify this option more than once to produce multiple output files, presumably in different formats.

Use '-' as *output-file* to write output to standard output.

If no -o option is used, then PSPP writes text and CSV output to standard output and other kinds of output to whose name is based on the format, *e.g.* pspp.pdf for PDF output.

-O *option=value*

Sets an option for the output file configured by a preceding -o. Most options are specific to particular output formats. A few options that apply generically are listed below.

-O format=*format*

PSPP uses the extension of the file name given on -o to select an output format. Use this option to override this choice by specifying an alternate format, *e.g.* -o pspp.out -O format=html to write HTML to a file named pspp.out. Use --help to list the available formats.

-O device={terminal|listing}

Sets whether PSPP considers the output device configured by the preceding -o to be a terminal or a listing device. This affects what output will be sent to the device, as configured by the SET command's output routing subcommands (see Section 17.20 [SET], page 265). By default, output written to standard output is considered a terminal device and other output is considered a listing device.

--no-output

Disables output entirely, if neither -o nor -O is also used. If one of those options is used, --no-output has no effect.

--table-look=*file*

Reads a table style from *file* and applies it to all PSPP table output. The file should be a TableLook .stt or .tlo file. PSPP searches for *file* in the current directory, then in .pspp/looks in the user's home directory, then in a looks subdirectory inside PSPP's data directory (usually /usr/local/share/pspp). If PSPP cannot find *file* under the given name, it also tries adding a .stt extension.

When this option is not specified, PSPP looks for default.stt using the algorithm above, and otherwise it falls back to a default built-in style.

Using SET TLOOK in PSPP syntax overrides the style set on the command line (see Section 17.20 [SET], page 265).

-e *error-file*
--error-file=*error-file*

Configures a file to receive PSPP error, warning, and note messages in plain text format. Use '-' as *error-file* to write messages to standard output. The default error file is standard output in the absence of these options, but this is suppressed if an output device writes to standard output (or another terminal), to avoid printing every message twice. Use 'none' as *error-file* to explicitly suppress the default.

`-I dir`
`--include=dir`

Appends *dir* to the set of directories searched by the `INCLUDE` (see Section 17.15 [INCLUDE], page 263) and `INSERT` (see Section 17.16 [INSERT], page 263) commands.

`-I-`
`--no-include`

Clears all directories from the include path, including directories inserted in the include path by default. The default include path is `.` (the current directory), followed by `.pspp` in the user's home directory, followed by PSPP's system configuration directory (usually `/etc/pspp` or `/usr/local/etc/pspp`).

`-b`

`--batch`

`-i`
`--interactive`

These options forces syntax files to be interpreted in batch mode or interactive mode, respectively, rather than the default "auto" mode. See Section 6.3 [Syntax Variants], page 27, for a description of the differences.

`-r`
`--no-statrc`

By default, at startup PSPP searches for a file named `rc` in the include path (described above) and, if it finds one, runs the commands in it. This option disables this behavior.

`-a {enhanced|compatible}`
`--algorithm={enhanced|compatible}`

With `enhanced`, the default, PSPP uses the best implemented algorithms for statistical procedures. With `compatible`, however, PSPP will in some cases use inferior algorithms to produce the same results as the proprietary program SPSS.

Some commands have subcommands that override this setting on a per command basis.

`-x {enhanced|compatible}`
`--syntax={enhanced|compatible}`

With `enhanced`, the default, PSPP accepts its own extensions beyond those compatible with the proprietary program SPSS. With `compatible`, PSPP rejects syntax that uses these extensions.

`--syntax-encoding=encoding`

Specifies *encoding* as the encoding for syntax files named on the command line. The *encoding* also becomes the default encoding for other syntax files read during the PSPP session by the `INCLUDE` and `INSERT` commands. See Section 17.16 [INSERT], page 263, for the accepted forms of *encoding*.

`--help` Prints a message describing PSPP command-line syntax and the available device formats, then exits.

`-V`
`--version`
: Prints a brief message listing PSPP's version, warranties you don't have, copying conditions and copyright, and e-mail address for bug reports, then exits.

`-s`
`--safer`
: Disables certain unsafe operations. This includes the `ERASE` and `HOST` commands, as well as use of pipes as input and output files.

`--testing-mode`
: Invoke heuristics to assist with testing PSPP. For use by `make check` and similar scripts.

3.2 PDF, PostScript, SVG, and PNG Output Options

To produce output in PDF, PostScript, SVG, or PNG format, specify `-o` *`file`* on the PSPP command line, optionally followed by any of the options shown in the table below to customize the output format.

PDF, PostScript, and SVG use real units: each dimension among the options listed below may have a suffix '`mm`' for millimeters, '`in`' for inches, or '`pt`' for points. Lacking a suffix, numbers below 50 are assumed to be in inches and those above 50 are assumed to be in millimeters.

PNG files are pixel-based, so dimensions in PNG output must ultimately be measured in pixels. For output to these files, PSPP translates the specified dimensions to pixels at 72 pixels per inch. For PNG output only, fonts are by default rendered larger than this, at 96 pixels per inch.

An SVG or PNG file can only hold a single page. When PSPP outputs more than one page to SVG or PNG, it creates multiple files. It outputs the second page to a file named with a `-2` suffix, the third with a `-3` suffix, and so on.

`-O format={pdf|ps|svg|png}`
: Specify the output format. This is only necessary if the file name given on `-o` does not end in `.pdf`, `.ps`, `.svg`, or `.png`.

`-O paper-size=`*`paper-size`*
: Paper size, as a name (*e.g.* `a4`, `letter`) or measurements (*e.g.* `210x297`, `8.5x11in`).

  The default paper size is taken from the `PAPERSIZE` environment variable or the file indicated by the `PAPERCONF` environment variable, if either variable is set. If not, and your system supports the `LC_PAPER` locale category, then the default paper size is taken from the locale. Otherwise, if `/etc/papersize` exists, the default paper size is read from it. As a last resort, A4 paper is assumed.

`-O foreground-color=`*`color`*
: Sets *color* as the default color for lines and text. Use a CSS color format (e.g. `#`*`rrggbb`*) or name (e.g. `black`) as *color*.

`-O orientation=`*`orientation`*
: Either `portrait` or `landscape`. Default: `portrait`.

`-O left-margin=dimension`
`-O right-margin=dimension`
`-O top-margin=dimension`
`-O bottom-margin=dimension`

Sets the margins around the page. See below for the allowed forms of *dimension*. Default: `0.5in`.

`-O object-spacing=dimension`

Sets the amount of vertical space between objects (such as headings or tables).

`-O prop-font=font-name`

Sets the default font used for ordinary text. Most systems support CSS-like font names such as "Sans Serif", but a wide range of system-specific fonts are likely to be supported as well.

Default: proportional font `Sans Serif`.

`-O font-size=font-size`

Sets the size of the default fonts, in thousandths of a point. Default: 10000 (10 point).

`-O trim=true`

This option makes PSPP trim empty space around each page of output, before adding the margins. This can make the output easier to include in other documents.

`-O outline=boolean`

For PDF output only, this option controls whether PSPP includes an outline in the output file. PDF viewers usually display the outline as a side bar that allows for easy navigation of the file. The default is true unless `-O trim=true` is also specified. (The Cairo graphics library that PSPP uses to produce PDF output has a bug that can cause a crash when outlines and trimming are used together.)

`-O font-resolution=dpi`

Sets the resolution for font rendering, in dots per inch. For PDF, PostScript, and SVG output, the default is 72 dpi, so that a 10-point font is rendered with a height of 10 points. For PNG output, the default is 96 dpi, so that a 10-point font is rendered with a height of $10/72 * 96 = 13.3$ pixels. Use a larger *dpi* to enlarge text output, or a smaller *dpi* to shrink it.

3.3 Plain Text Output Options

PSPP can produce plain text output, drawing boxes using ASCII or Unicode line drawing characters. To produce plain text output, specify `-o file` on the PSPP command line, optionally followed by options from the table below to customize the output format.

Plain text output is encoded in UTF-8.

`-O format=txt`

Specify the output format. This is only necessary if the file name given on `-o` does not end in `.txt` or `.list`.

`-O charts={template.png|none}`
: Name for chart files included in output. The value should be a file name that includes a single '#' and ends in `png`. When a chart is output, the '#' is replaced by the chart number. The default is the file name specified on `-o` with the extension stripped off and replaced by `-#.png`.

  Specify `none` to disable chart output.

`-O foreground-color=color`
`-O background-color=color`
: Sets *color* as the color to be used for the background or foreground to be used for charts. Color should be given in the format `#RRRRGGGGBBBB`, where *RRRR*, *GGGG* and *BBBB* are 4 character hexadecimal representations of the red, green and blue components respectively. If charts are disabled, this option has no effect.

`-O width=columns`
: Width of a page, in columns. If unspecified or given as `auto`, the default is the width of the terminal, for interactive output, or the WIDTH setting (see Section 17.20 [SET], page 265), for output to a file.

`-O box={ascii|unicode}`
: Sets the characters used for lines in tables. If set to `ascii`, output uses use the characters '`-`', '`|`', and '`+`' for single-width lines and '`=`' and '`#`' for double-width lines. If set to `unicode` then, output uses Unicode box drawing characters. The default is `unicode` if the locale's character encoding is `"UTF-8"` or `ascii` otherwise.

`-O emphasis={none|bold|underline}`
: How to emphasize text. Bold and underline emphasis are achieved with overstriking, which may not be supported by all the software to which you might pass the output. Default: `none`.

3.4 SPV Output Options

SPSS 16 and later write `.spv` files to represent the contents of its output editor. To produce output in `.spv` format, specify `-o file` on the PSPP command line, optionally followed by any of the options shown in the table below to customize the output format.

`-O format=spv`
: Specify the output format. This is only necessary if the file name given on `-o` does not end in `.spv`.

`-O paper-size=paper-size`
`-O left-margin=dimension`
`-O right-margin=dimension`
`-O top-margin=dimension`
`-O bottom-margin=dimension`
`-O object-spacing=dimension`
: These have the same syntax and meaning as for PDF output. See Section 3.2 [PDF PostScript SVG and PNG Output Options], page 6, for details.

3.5 TeX Output Options

If you want to publish statistical results in professional or academic journals, you will probably want to provide results in TEX format. To do this, specify `-o file` on the PSPP command line where *file* is a file name ending in `.tex`, or you can specify `-O format=tex`.

The resulting file can be directly processed using TEX or you can manually edit the file to add commentary text. Alternatively, you can cut and paste desired sections to another TEX file.

3.6 HTML Output Options

To produce output in HTML format, specify `-o file` on the PSPP command line, optionally followed by any of the options shown in the table below to customize the output format.

`-O format=html`
: Specify the output format. This is only necessary if the file name given on `-o` does not end in `.html`.

`-O charts={template.png|none}`
: Sets the name used for chart files. See Section 3.3 [Plain Text Output Options], page 7, for details.

`-O borders=boolean`
: Decorate the tables with borders. If set to false, the tables produced will have no borders. The default value is true.

`-O bare=boolean`
: The HTML output driver ordinarily outputs a complete HTML document. If set to true, the driver instead outputs only what would normally be the contents of the `body` element. The default value is false.

`-O css=boolean`
: Use cascading style sheets. Cascading style sheets give an improved appearance and can be used to produce pages which fit a certain web site's style. The default value is true.

3.7 OpenDocument Output Options

To produce output as an OpenDocument text (ODT) document, specify `-o file` on the PSPP command line. If *file* does not end in `.odt`, you must also specify `-O format=odt`.

ODT support is only available if your installation of PSPP was compiled with the libxml2 library.

The OpenDocument output format does not have any configurable options.

3.8 Comma-Separated Value Output Options

To produce output in comma-separated value (CSV) format, specify `-o file` on the PSPP command line, optionally followed by any of the options shown in the table below to customize the output format.

`-O format=csv`
: Specify the output format. This is only necessary if the file name given on `-o` does not end in `.csv`.

`-O separator=`*`field-separator`*
: Sets the character used to separate fields. Default: a comma (‘`,`’).

`-O quote=`*`qualifier`*
: Sets *qualifier* as the character used to quote fields that contain white space, the separator (or any of the characters in the separator, if it contains more than one character), or the quote character itself. If *qualifier* is longer than one character, only the first character is used; if *qualifier* is the empty string, then fields are never quoted.

`-O titles=`*`boolean`*
: Whether table titles (brief descriptions) should be printed. Default: `on`.

`-O captions=`*`boolean`*
: Whether table captions (more extensive descriptions) should be printed. Default: on.

The CSV format used is an extension to that specified in RFC 4180:

Tables
: Each table row is output on a separate line, and each column is output as a field. The contents of a cell that spans multiple rows or columns is output only for the top-left row and column; the rest are output as empty fields.

Titles
: When a table has a title and titles are enabled, the title is output just above the table as a single field prefixed by ‘`Table:`’.

Captions
: When a table has a caption and captions are enabled, the caption is output just below the table as a single field prefixed by ‘`Caption:`’.

Footnotes
: Within a table, footnote markers are output as bracketed letters following the cell’s contents, *e.g.* ‘`[a]`’, ‘`[b]`’, . . . The footnotes themselves are output following the body of the table, as a separate two-column table introduced with a line that says ‘`Footnotes:`’. Each row in the table represent one footnote: the first column is the marker, the second column is the text.

Text
: Text in output is printed as a field on a line by itself. The TITLE and SUBTITLE produce similar output, prefixed by ‘`Title:`’ or ‘`Subtitle:`’, respectively.

Messages
: Errors, warnings, and notes are printed the same way as text.

Charts
: Charts are not included in CSV output.

Successive output items are separated by a blank line.

4 Invoking `psppire`

4.1 The graphic user interface

The PSPPIRE graphic user interface for PSPP can perform all functionality of the command line interface. In addition it gives an instantaneous view of the data, variables and statistical output.

The graphic user interface can be started by typing `psppire` at a command prompt. Alternatively many systems have a system of interactive menus or buttons from which `psppire` can be started by a series of mouse clicks.

Once the principles of the PSPP system are understood, the graphic user interface is designed to be largely intuitive, and for this reason is covered only very briefly by this manual.

5 Using PSPP

PSPP is a tool for the statistical analysis of sampled data. You can use it to discover patterns in the data, to explain differences in one subset of data in terms of another subset and to find out whether certain beliefs about the data are justified. This chapter does not attempt to introduce the theory behind the statistical analysis, but it shows how such analysis can be performed using PSPP.

For the purposes of this tutorial, it is assumed that you are using PSPP in its interactive mode from the command line. However, the example commands can also be typed into a file and executed in a post-hoc mode by typing '`pspp` *`file-name`*' at a shell prompt, where *file-name* is the name of the file containing the commands. Alternatively, from the graphical interface, you can select File → New → Syntax to open a new syntax window and use the Run menu when a syntax fragment is ready to be executed. Whichever method you choose, the syntax is identical.

When using the interactive method, PSPP tells you that it's waiting for your data with a string like `PSPP>` or `data>`. In the examples of this chapter, whenever you see text like this, it indicates the prompt displayed by PSPP, *not* something that you should type.

Throughout this chapter reference is made to a number of sample data files. So that you can try the examples for yourself, you should have received these files along with your copy of PSPP.[1]

> **Please note:** Normally these files are installed in the directory `//share/pspp/examples`. If however your system administrator or operating system vendor has chosen to install them in a different location, you will have to adjust the examples accordingly.

5.1 Preparation of Data Files

Before analysis can commence, the data must be loaded into PSPP and arranged such that both PSPP and humans can understand what the data represents. There are two aspects of data:

- The variables — these are the parameters of a quantity which has been measured or estimated in some way. For example height, weight and geographic location are all variables.
- The observations (also called 'cases') of the variables — each observation represents an instance when the variables were measured or observed.

For example, a data set which has the variables **height**, **weight**, and **name**, might have the observations:

```
1881 89.2 Ahmed
1192 107.01 Frank
1230 67 Julie
```

The following sections explain how to define a dataset.

[1] These files contain purely fictitious data. They should not be used for research purposes.

5.1.1 Defining Variables

Variables come in two basic types, *viz*: *numeric* and *string*. Variables such as age, height and satisfaction are numeric, whereas name is a string variable. String variables are best reserved for commentary data to assist the human observer. However they can also be used for nominal or categorical data.

The following example defines two variables **forename** and **height**, and reads data into them by manual input:

```
PSPP> data list list /forename (A12) height.
PSPP> begin data.
data> Ahmed 188
data> Bertram 167
data> Catherine 134.231
data> David 109.1
data> end data
PSPP>
```

There are several things to note about this example.

- The words '`data list list`' are an example of the `DATA LIST` command. See Section 8.5 [DATA LIST], page 64. It tells PSPP to prepare for reading data. The word '`list`' intentionally appears twice. The first occurrence is part of the `DATA LIST` call, whilst the second tells PSPP that the data is to be read as free format data with one record per line.
- The '`/`' character is important. It marks the start of the list of variables which you wish to define.
- The text '`forename`' is the name of the first variable, and '`(A12)`' says that the variable **forename** is a string variable and that its maximum length is 12 bytes. The second variable's name is specified by the text '`height`'. Since no format is given, this variable has the default format. Normally the default format expects numeric data, which should be entered in the locale of the operating system. Thus, the example is correct for English locales and other locales which use a period ('`.`') as the decimal separator. However if you are using a system with a locale which uses the comma ('`,`') as the decimal separator, then you should in the subsequent lines substitute '`.`' with '`,`'. Alternatively, you could explicitly tell PSPP that the **height** variable is to be read using a period as its decimal separator by appending the text '`DOT8.3`' after the word '`height`'. For more information on data formats, see Section 6.7.4 [Input and Output Formats], page 32.
- Normally, PSPP displays the prompt `PSPP>` whenever it's expecting a command. However, when it's expecting data, the prompt changes to `data>` so that you know to enter data and not a command.
- At the end of every command there is a terminating '`.`' which tells PSPP that the end of a command has been encountered. You should not enter '`.`' when data is expected (*ie.* when the `data>` prompt is current) since it is appropriate only for terminating commands.

5.1.2 Listing the data

Once the data has been entered, you could type

```
PSPP> list /format=numbered.
```

to list the data. The optional text '`/format=numbered`' requests the case numbers to be shown along with the data. It should show the following output:

```
              Data List
+-----------+---------+------+
|Case Number| forename|height|
+-----------+---------+------+
|1          |Ahmed    |188.00|
|2          |Bertram  |167.00|
|3          |Catherine|134.23|
|4          |David    |109.10|
+-----------+---------+------+
```

Note that the numeric variable **height** is displayed to 2 decimal places, because the format for that variable is '`F8.2`'. For a complete description of the `LIST` command, see Section 8.10 [LIST], page 74.

5.1.3 Reading data from a text file

The previous example showed how to define a set of variables and to manually enter the data for those variables. Manual entering of data is tedious work, and often a file containing the data will be have been previously prepared. Let us assume that you have a file called `mydata.dat` containing the ascii encoded data:

```
Ahmed          188.00
Bertram        167.00
Catherine      134.23
David          109.10
               .
               .
               .
Zachariah      113.02
```

You can can tell the `DATA LIST` command to read the data directly from this file instead of by manual entry, with a command like:

```
PSPP> data list file='mydata.dat' list /forename (A12) height.
```

Notice however, that it is still necessary to specify the names of the variables and their formats, since this information is not contained in the file. It is also possible to specify the file's character encoding and other parameters. For full details refer to see Section 8.5 [DATA LIST], page 64.

5.1.4 Reading data from a pre-prepared PSPP file

When working with other PSPP users, or users of other software which uses the PSPP data format, you may be given the data in a pre-prepared PSPP file. Such files contain not only the data, but the variable definitions, along with their formats, labels and other meta-data. Conventionally, these files (sometimes called "system" files) have the suffix `.sav`, but that is not mandatory. The following syntax loads a file called `my-file.sav`.

```
PSPP> get file='my-file.sav'.
```

You will encounter several instances of this in future examples.

5.1.5 Saving data to a PSPP file.

If you want to save your data, along with the variable definitions so that you or other PSPP users can use it later, you can do this with the SAVE command.

The following syntax will save the existing data and variables to a file called my-new-file.sav.

```
PSPP> save outfile='my-new-file.sav'.
```

If my-new-file.sav already exists, then it will be overwritten. Otherwise it will be created.

5.1.6 Reading data from other sources

Sometimes it's useful to be able to read data from comma separated text, from spreadsheets, databases or other sources. In these instances you should use the GET DATA command (see Section 9.4 [GET DATA], page 80).

5.1.7 Exiting PSPP

Use the FINISH command to exit PSPP:

```
PSPP> finish.
```

5.2 Data Screening and Transformation

Once data has been entered, it is often desirable, or even necessary, to transform it in some way before performing analysis upon it. At the very least, it's good practice to check for errors.

5.2.1 Identifying incorrect data

Data from real sources is rarely error free. PSPP has a number of procedures which can be used to help identify data which might be incorrect.

The DESCRIPTIVES command (see Section 15.1 [DESCRIPTIVES], page 149) is used to generate simple linear statistics for a dataset. It is also useful for identifying potential problems in the data. The example file physiology.sav contains a number of physiological measurements of a sample of healthy adults selected at random. However, the data entry clerk made a number of mistakes when entering the data. The following example illustrates the use of DESCRIPTIVES to screen this data and identify the erroneous values:

```
PSPP> get file='//share/pspp/examples/physiology.sav'.
PSPP> descriptives sex, weight, height.
```

For this example, PSPP produces the following output:

```
                    Descriptive Statistics
+---------------------+--+-------+-------+-------+-------+
|                     | N|  Mean |Std Dev|Minimum|Maximum|
+---------------------+--+-------+-------+-------+-------+
|Sex of subject       |40|    .45|    .50|Male   |Female |
|Weight in kilograms  |40|  72.12|  26.70|  -55.6|   92.1|
|Height in millimeters|40|1677.12| 262.87|    179|   1903|
|Valid N (listwise)   |40|       |       |       |       |
|Missing N (listwise) | 0|       |       |       |       |
+---------------------+--+-------+-------+-------+-------+
```

The most interesting column in the output is the minimum value. The **weight** variable has a minimum value of less than zero, which is clearly erroneous. Similarly, the **height**

variable's minimum value seems to be very low. In fact, it is more than 5 standard deviations from the mean, and is a seemingly bizarre height for an adult person.

We can look deeper into these discrepancies by issuing an additional EXAMINE command:

```
PSPP> examine height, weight /statistics=extreme(3).
```

This command produces the following additional output (in part):

```
                    Extreme Values
+-------------------------------+-----------+-----+
|                               |Case Number|Value|
+-------------------------------+-----------+-----+
|Height in millimeters Highest 1|         14| 1903|
|                              2|         15| 1884|
|                              3|         12| 1802|
|                      ----------+-----------+-----+
|                       Lowest  1|         30|  179|
|                              2|         31| 1598|
|                              3|         28| 1601|
+-------------------------------+-----------+-----+
|Weight in kilograms   Highest 1|         13| 92.1|
|                              2|          5| 92.1|
|                              3|         17| 91.7|
|                      ----------+-----------+-----+
|                       Lowest  1|         38|-55.6|
|                              2|         39| 54.5|
|                              3|         33| 55.4|
+-------------------------------+-----------+-----+
```

From this new output, you can see that the lowest value of **height** is 179 (which we suspect to be erroneous), but the second lowest is 1598 which we know from DESCRIPTIVES is within 1 standard deviation from the mean. Similarly, the lowest value of **weight** is negative, but its second lowest value is plausible. This suggests that the two extreme values are outliers and probably represent data entry errors.

The output also identifies the case numbers for each extreme value, so we can see that cases 30 and 38 are the ones with the erroneous values.

5.2.2 Dealing with suspicious data

If possible, suspect data should be checked and re-measured. However, this may not always be feasible, in which case the researcher may decide to disregard these values. PSPP has a feature whereby data can assume the special value 'SYSMIS', and will be disregarded in future analysis. See Section 6.6 [Missing Observations], page 29. You can set the two suspect values to the 'SYSMIS' value using the RECODE command.

```
PSPP> recode height (179 = SYSMIS).
PSPP> recode weight (LOWEST THRU 0 = SYSMIS).
```

The first command says that for any observation which has a **height** value of 179, that value should be changed to the SYSMIS value. The second command says that any **weight** values of zero or less should be changed to SYSMIS. From now on, they will be ignored in analysis. For detailed information about the RECODE command see Section 12.7 [RECODE], page 121.

If you now re-run the DESCRIPTIVES or EXAMINE commands from the previous section, you will see a data summary with more plausible parameters. You will also notice that the data summaries indicate the two missing values.

5.2.3 Inverting negatively coded variables

Data entry errors are not the only reason for wanting to recode data. The sample file `hotel.sav` comprises data gathered from a customer satisfaction survey of clients at a particular hotel. The following commands load the file and display its variables and associated data:

```
PSPP> get file='//share/pspp/examples/hotel.sav'.
PSPP> display dictionary.
```

It yields the following output:

Variables

Name	Position	Label	Measurement Level	Role	Width	Alignment	Print Format	Write Format
v1	1	I am satisfied with the level of service	Ordinal	Input	8	Right	F8.0	F8.0
v2	2	The value for money was good	Ordinal	Input	8	Right	F8.0	F8.0
v3	3	The staff were slow in responding	Ordinal	Input	8	Right	F8.0	F8.0
v4	4	My concerns were dealt with in an efficient manner	Ordinal	Input	8	Right	F8.0	F8.0
v5	5	There was too much noise in the rooms	Ordinal	Input	8	Right	F8.0	F8.0

Value Labels

Variable Value		Label
I am satisfied with the level of service	1	Strongly Disagree
	2	Disagree
	3	No Opinion
	4	Agree
	5	Strongly Agree
The value for money was good	1	Strongly Disagree
	2	Disagree
	3	No Opinion
	4	Agree
	5	Strongly Agree
The staff were slow in responding	1	Strongly Disagree
	2	Disagree
	3	No Opinion
	4	Agree
	5	Strongly Agree

```
|My concerns were dealt with in an efficient manner 1|Strongly Disagree|
|                                                   2|Disagree         |
|                                                   3|No Opinion       |
|                                                   4|Agree            |
|                                                   5|Strongly Agree   |
+---------------------------------------------------+-----------------+
|There was too much noise in the rooms              1|Strongly Disagree|
|                                                   2|Disagree         |
|                                                   3|No Opinion       |
|                                                   4|Agree            |
|                                                   5|Strongly Agree   |
+---------------------------------------------------+-----------------+
```

The output shows that all of the variables **v1** through **v5** are measured on a 5 point Likert scale, with 1 meaning "Strongly disagree" and 5 meaning "Strongly agree". However, some of the questions are positively worded (**v1**, **v2**, **v4**) and others are negatively worded (**v3**, **v5**). To perform meaningful analysis, we need to recode the variables so that they all measure in the same direction. We could use the `RECODE` command, with syntax such as:

```
recode v3 (1 = 5) (2 = 4) (4 = 2) (5 = 1).
```

However an easier and more elegant way uses the `COMPUTE` command (see Section 12.3 [COMPUTE], page 113). Since the variables are Likert variables in the range (1 . . . 5), subtracting their value from 6 has the effect of inverting them:

```
compute var = 6 - var.
```

The following section uses this technique to recode the variables **v3** and **v5**. After applying `COMPUTE` for both variables, all subsequent commands will use the inverted values.

5.2.4 Testing data consistency

A sensible check to perform on survey data is the calculation of reliability. This gives the statistician some confidence that the questionnaires have been completed thoughtfully. If you examine the labels of variables **v1**, **v3** and **v4**, you will notice that they ask very similar questions. One would therefore expect the values of these variables (after recoding) to closely follow one another, and we can test that with the `RELIABILITY` command (see Section 15.18 [RELIABILITY], page 219). The following example shows a PSPP session where the user recodes negatively scaled variables and then requests reliability statistics for **v1**, **v3**, and **v4**.

```
PSPP> get file='//share/pspp/examples/hotel.sav'.
PSPP> compute v3 = 6 - v3.
PSPP> compute v5 = 6 - v5.
PSPP> reliability v1, v3, v4.
```

This yields the following output:

```
Scale: ANY

Case Processing Summary
+--------+--+-------+
|Cases   | N|Percent|
+--------+--+-------+
|Valid   |17| 100.0%|
|Excluded| 0|    .0%|
|Total   |17| 100.0%|
+--------+--+-------+
```

```
    Reliability Statistics
+----------------+----------+
|Cronbach's Alpha|N of Items|
+----------------+----------+
|             .81|         3|
+----------------+----------+
```

As a rule of thumb, many statisticians consider a value of Cronbach's Alpha of 0.7 or higher to indicate reliable data.

Here, the value is 0.81, which suggests a high degree of reliability among variables **v1**, **v3** and **v4**, so the data and the recoding that we performed are vindicated.

5.2.5 Testing for normality

Many statistical tests rely upon certain properties of the data. One common property, upon which many linear tests depend, is that of normality — the data must have been drawn from a normal distribution. It is necessary then to ensure normality before deciding upon the test procedure to use. One way to do this uses the `EXAMINE` command.

In the following example, a researcher was examining the failure rates of equipment produced by an engineering company. The file `repairs.sav` contains the mean time between failures (**mtbf**) of some items of equipment subject to the study. Before performing linear analysis on the data, the researcher wanted to ascertain that the data is normally distributed.

```
PSPP> get file='//share/pspp/examples/repairs.sav'.
PSPP> examine mtbf
                /statistics=descriptives.
```

This produces the following output:

```
                                Descriptives
+-------------------------------------------------------------+---------+--------+
|                                                             |         |  Std.  |
|                                                             |Statistic|  Error |
+-------------------------------------------------------------+---------+--------+
|Mean time between        Mean                                |     8.78|    1.10|
|failures (months)       ------------------------------------+---------+--------+
|                         95% Confidence Interval Lower       |     6.53|        |
|                         for Mean                Bound       |         |        |
|                                                 Upper       |    11.04|        |
|                                                 Bound       |         |        |
|                        ------------------------------------+---------+--------+
|                         5% Trimmed Mean                     |     8.20|        |
|                        ------------------------------------+---------+--------+
|                         Median                              |     8.29|        |
|                        ------------------------------------+---------+--------+
|                         Variance                            |    36.34|        |
|                        ------------------------------------+---------+--------+
|                         Std. Deviation                      |     6.03|        |
|                        ------------------------------------+---------+--------+
|                         Minimum                             |     1.63|        |
|                        ------------------------------------+---------+--------+
|                         Maximum                             |    26.47|        |
|                        ------------------------------------+---------+--------+
|                         Range                               |    24.84|        |
|                        ------------------------------------+---------+--------+
```

```
|                        Interquartile Range              |     6.03|        |
|                       ----------------------------------+---------+--------+
|                        Skewness                         |     1.65|     .43|
|                       ----------------------------------+---------+--------+
|                        Kurtosis                         |     3.41|     .83|
+-------------------------------------------------------+---------+--------+
```

A normal distribution has a skewness and kurtosis of zero. The skewness of **mtbf** in the output above makes it clear that the mtbf figures have a lot of positive skew and are therefore not drawn from a normally distributed variable. Positive skew can often be compensated for by applying a logarithmic transformation, as in the following continuation of the example:

```
PSPP> compute mtbf_ln = ln (mtbf).
PSPP> examine mtbf_ln
                /statistics=descriptives.
```

which produces the following additional output:

```
                                Descriptives
+---------------------------------------------------+---------+----------+
|                                                   |Statistic|Std. Error|
+---------------------------------------------------+---------+----------+
|mtbf_ln Mean                                       |     1.95|       .13|
|       ---------------------------------------------+---------+----------+
|        95% Confidence Interval for Mean Lower Bound|     1.69|          |
|                                       Upper Bound|     2.22|          |
|       ---------------------------------------------+---------+----------+
|        5% Trimmed Mean                            |     1.96|          |
|       ---------------------------------------------+---------+----------+
|        Median                                     |     2.11|          |
|       ---------------------------------------------+---------+----------+
|        Variance                                   |      .49|          |
|       ---------------------------------------------+---------+----------+
|        Std. Deviation                             |      .70|          |
|       ---------------------------------------------+---------+----------+
|        Minimum                                    |      .49|          |
|       ---------------------------------------------+---------+----------+
|        Maximum                                    |     3.28|          |
|       ---------------------------------------------+---------+----------+
|        Range                                      |     2.79|          |
|       ---------------------------------------------+---------+----------+
|        Interquartile Range                        |      .88|          |
|       ---------------------------------------------+---------+----------+
|        Skewness                                   |     -.37|       .43|
|       ---------------------------------------------+---------+----------+
|        Kurtosis                                   |      .01|       .83|
+---------------------------------------------------+---------+----------+
```

The `COMPUTE` command in the first line above performs the logarithmic transformation:

```
compute mtbf_ln = ln (mtbf).
```

Rather than redefining the existing variable, this use of `COMPUTE` defines a new variable **mtbf_ln** which is the natural logarithm of **mtbf**. The final command in this example calls `EXAMINE` on this new variable. The results show that both the skewness and kurtosis for **mtbf_ln** are very close to zero. This provides some confidence that the **mtbf_ln** variable is normally distributed and thus safe for linear analysis. In the event that no suitable transformation can be found, then it would be worth considering an appropriate non-parametric

test instead of a linear one. See Section 15.12 [NPAR TESTS], page 201, for information about non-parametric tests.

5.3 Hypothesis Testing

One of the most fundamental purposes of statistical analysis is hypothesis testing. Researchers commonly need to test hypotheses about a set of data. For example, she might want to test whether one set of data comes from the same distribution as another, or whether the mean of a dataset significantly differs from a particular value. This section presents just some of the possible tests that PSPP offers.

The researcher starts by making a *null hypothesis*. Often this is a hypothesis which he suspects to be false. For example, if he suspects that A is greater than B he will state the null hypothesis as $A = B$.[2]

The *p-value* is a recurring concept in hypothesis testing. It is the highest acceptable probability that the evidence implying a null hypothesis is false, could have been obtained when the null hypothesis is in fact true. Note that this is not the same as "the probability of making an error" nor is it the same as "the probability of rejecting a hypothesis when it is true".

5.3.1 Testing for differences of means

A common statistical test involves hypotheses about means. The `T-TEST` command is used to find out whether or not two separate subsets have the same mean.

A researcher suspected that the heights and core body temperature of persons might be different depending upon their sex. To investigate this, he posed two null hypotheses based on the data from `physiology.sav` previously encountered:

- The mean heights of males and females in the population are equal.
- The mean body temperature of males and females in the population are equal.

For the purposes of the investigation the researcher decided to use a p-value of 0.05.

In addition to the T-test, the `T-TEST` command also performs the Levene test for equal variances. If the variances are equal, then a more powerful form of the T-test can be used. However if it is unsafe to assume equal variances, then an alternative calculation is necessary. PSPP performs both calculations.

For the **height** variable, the output shows the significance of the Levene test to be 0.33 which means there is a 33% probability that the Levene test produces this outcome when the variances are equal. Had the significance been less than 0.05, then it would have been unsafe to assume that the variances were equal. However, because the value is higher than 0.05 the homogeneity of variances assumption is safe and the "Equal Variances" row (the more powerful test) can be used. Examining this row, the two tailed significance for the **height** t-test is less than 0.05, so it is safe to reject the null hypothesis and conclude that the mean heights of males and females are unequal.

For the **temperature** variable, the significance of the Levene test is 0.58 so again, it is safe to use the row for equal variances. The equal variances row indicates that the two tailed significance for **temperature** is 0.20. Since this is greater than 0.05 we must reject

[2] This example assumes that it is already proven that B is not greater than A.

the null hypothesis and conclude that there is insufficient evidence to suggest that the body temperature of male and female persons are different.

The syntax for this analysis is:

```
PSPP> get file='//share/pspp/examples/physiology.sav'.
PSPP> recode height (179 = SYSMIS).
PSPP> t-test group=sex(0,1) /variables = height temperature.
```

PSPP produces the following output for this syntax:

Group Statistics

	Group	N	Mean	Std. Deviation	S.E. Mean
Height in millimeters	Male	22	1796.49	49.71	10.60
	Female	17	1610.77	25.43	6.17
Internal body temperature in degrees Celcius	Male	22	36.68	1.95	.42
	Female	18	37.43	1.61	.38

Independent Samples Test

		Levene's Test for Equality of Variances		T-Test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Height in millimeters	Equal variances assumed	.97	.331	14.02	37.00	.000	185.72	13.24
	Equal variances not assumed			15.15	32.71	.000	185.72	12.26
Internal body temperature in degrees Celcius	Equal variances assumed	.31	.581	-1.31	38.00	.198	-.75	.57
	Equal variances not assumed			-1.33	37.99	.190	-.75	.56

```
|                     |             |
|                     |             |
|                     +-------------+
|                     |     95%     |
|                     |  Confidence |
|                     | Interval of |
|                     |     the     |
|                     |  Difference |
|                     +------+------+
|                     | Lower| Upper|
+---------------------+------+------+
|Height in   Equal    |158.88|212.55|
|millimeters variances|      |      |
|            assumed  |      |      |
|            Equal    |160.76|210.67|
|            variances|      |      |
|            not      |      |      |
|            assumed  |      |      |
+---------------------+------+------+
|Internal    Equal    | -1.91|   .41|
|body        variances|      |      |
|temperature assumed  |      |      |
|in degrees  Equal    | -1.89|   .39|
|Celcius     variances|      |      |
|            not      |      |      |
|            assumed  |      |      |
+---------------------+------+------+
```

The `T-TEST` command tests for differences of means. Here, the **height** variable's two tailed significance is less than 0.05, so the null hypothesis can be rejected. Thus, the evidence suggests there is a difference between the heights of male and female persons. However the significance of the test for the **temperature** variable is greater than 0.05 so the null hypothesis cannot be rejected, and there is insufficient evidence to suggest a difference in body temperature.

5.3.2 Linear Regression

Linear regression is a technique used to investigate if and how a variable is linearly related to others. If a variable is found to be linearly related, then this can be used to predict future values of that variable.

In the following example, the service department of the company wanted to be able to predict the time to repair equipment, in order to improve the accuracy of their quotations. It was suggested that the time to repair might be related to the time between failures and the duty cycle of the equipment. The p-value of 0.1 was chosen for this investigation. In order to investigate this hypothesis, the `REGRESSION` command was used. This command not only tests if the variables are related, but also identifies the potential linear relationship. See Section 15.17 [REGRESSION], page 217.

A first attempt includes **duty_cycle**:

```
PSPP> get file='//share/pspp/examples/repairs.sav'.
PSPP> regression /variables = mtbf duty_cycle /dependent = mttr.
```

This attempt yields the following output (in part):

```
                    Coefficients (Mean time to repair (hours) )
+-----------------------+--------------------+-------------------+-----+----+
```

```
|                        |    Unstandardized   |    Standardized   |     |    |
|                        |     Coefficients    |    Coefficients   |     |    |
|                        +---------+-----------+-------------------+     |    |
|                        |    B    | Std. Error|        Beta       |  t  |Sig.|
+------------------------+---------+-----------+-------------------+-----+----+
|(Constant)              |    10.59|       3.11|                .00| 3.40|.002|
|Mean time between       |     3.02|        .20|                .95|14.88|.000|
|failures (months)       |         |           |                   |     |    |
|Ratio of working to non-|    -1.12|       3.69|               -.02| -.30|.763|
|working time            |         |           |                   |     |    |
+------------------------+---------+-----------+-------------------+-----+----+
```

The coefficients in the above table suggest that the formula $mttr = 9.81 + 3.1 \times mtbf + 1.09 \times duty\_cycle$ can be used to predict the time to repair. However, the significance value for the *duty_cycle* coefficient is very high, which would make this an unsafe predictor. For this reason, the test was repeated, but omitting the **duty_cycle** variable:

```
PSPP> regression /variables = mtbf /dependent = mttr.
```

This second try produces the following output (in part):

```
                  Coefficients (Mean time to repair (hours) )
+-----------------------+----------------------+-------------------+-----+----+
|                       |    Unstandardized    |    Standardized   |     |    |
|                       |     Coefficients     |    Coefficients   |     |    |
|                       +---------+------------+-------------------+     |    |
|                       |    B    | Std. Error |        Beta       |  t  |Sig.|
+-----------------------+---------+------------+-------------------+-----+----+
|(Constant)             |     9.90|        2.10|                .00| 4.71|.000|
|Mean time between      |     3.01|         .20|                .94|15.21|.000|
|failures (months)      |         |            |                   |     |    |
+-----------------------+---------+------------+-------------------+-----+----+
```

This time, the significance of all coefficients is no higher than 0.06, suggesting that at the 0.06 level, the formula $mttr = 10.5 + 3.11 \times mtbf$ is a reliable predictor of the time to repair.

6 The PSPP language

This chapter discusses elements common to many PSPP commands. Later chapters describe individual commands in detail.

6.1 Tokens

PSPP divides most syntax file lines into series of short chunks called *tokens*. Tokens are then grouped to form commands, each of which tells PSPP to take some action—read in data, write out data, perform a statistical procedure, etc. Each type of token is described below.

Identifiers Identifiers are names that typically specify variables, commands, or subcommands. The first character in an identifier must be a letter, '`#`', or '`@`'. The remaining characters in the identifier must be letters, digits, or one of the following special characters:

```
. _ $ # @
```

Identifiers may be any length, but only the first 64 bytes are significant. Identifiers are not case-sensitive: `foobar`, `Foobar`, `FooBar`, `FOOBAR`, and `FoObaR` are different representations of the same identifier.

Some identifiers are reserved. Reserved identifiers may not be used in any context besides those explicitly described in this manual. The reserved identifiers are:

```
ALL AND BY EQ GE GT LE LT NE NOT OR TO WITH
```

Keywords Keywords are a subclass of identifiers that form a fixed part of command syntax. For example, command and subcommand names are keywords. Keywords may be abbreviated to their first 3 characters if this abbreviation is unambiguous. (Unique abbreviations of 3 or more characters are also accepted: '`FRE`', '`FREQ`', and '`FREQUENCIES`' are equivalent when the last is a keyword.)

Reserved identifiers are always used as keywords. Other identifiers may be used both as keywords and as user-defined identifiers, such as variable names.

Numbers Numbers are expressed in decimal. A decimal point is optional. Numbers may be expressed in scientific notation by adding '`e`' and a base-10 exponent, so that '`1.234e3`' has the value 1234. Here are some more examples of valid numbers:

```
-5  3.14159265359  1e100  -.707  8945.
```

Negative numbers are expressed with a '`-`' prefix. However, in situations where a literal '`-`' token is expected, what appears to be a negative number is treated as '`-`' followed by a positive number.

No white space is allowed within a number token, except for horizontal white space between '`-`' and the rest of the number.

The last example above, '`8945.`' is interpreted as two tokens, '`8945`' and '`.`', if it is the last token on a line. See Section 6.2 [Forming commands of tokens], page 26.

Strings Strings are literal sequences of characters enclosed in pairs of single quotes ('`'`') or double quotes ('`"`'). To include the character used for quoting in the string,

double it, *e.g.* ‘`''it''s an apostrophe''`’. White space and case of letters are significant inside strings.

Strings can be concatenated using ‘`+`’, so that ‘`"a" + 'b' + 'c'`’ is equivalent to ‘`'abc'`’. So that a long string may be broken across lines, a line break may precede or follow, or both precede and follow, the ‘`+`’. (However, an entirely blank line preceding or following the ‘`+`’ is interpreted as ending the current command.)

Strings may also be expressed as hexadecimal character values by prefixing the initial quote character by ‘`x`’ or ‘`X`’. Regardless of the syntax file or active dataset's encoding, the hexadecimal digits in the string are interpreted as Unicode characters in UTF-8 encoding.

Individual Unicode code points may also be expressed by specifying the hexadecimal code point number in single or double quotes preceded by ‘`u`’ or ‘`U`’. For example, Unicode code point U+1D11E, the musical G clef character, could be expressed as `U'1D11E'`. Invalid Unicode code points (above U+10FFFF or in between U+D800 and U+DFFF) are not allowed.

When strings are concatenated with ‘`+`’, each segment's prefix is considered individually. For example, `'The G clef symbol is:' + u"1d11e" + "."` inserts a G clef symbol in the middle of an otherwise plain text string.

Punctuators and Operators

These tokens are the punctuators and operators:

```
, / = ( ) + - * / ** < <= <> > >= ~= & | .
```

Most of these appear within the syntax of commands, but the period (‘`.`’) punctuator is used only at the end of a command. It is a punctuator only as the last character on a line (except white space). When it is the last non-space character on a line, a period is not treated as part of another token, even if it would otherwise be part of, *e.g.*, an identifier or a floating-point number.

6.2 Forming commands of tokens

Most PSPP commands share a common structure. A command begins with a command name, such as `FREQUENCIES`, `DATA LIST`, or `N OF CASES`. The command name may be abbreviated to its first word, and each word in the command name may be abbreviated to its first three or more characters, where these abbreviations are unambiguous.

The command name may be followed by one or more *subcommands*. Each subcommand begins with a subcommand name, which may be abbreviated to its first three letters. Some subcommands accept a series of one or more specifications, which follow the subcommand name, optionally separated from it by an equals sign (‘`=`’). Specifications may be separated from each other by commas or spaces. Each subcommand must be separated from the next (if any) by a forward slash (‘`/`’).

There are multiple ways to mark the end of a command. The most common way is to end the last line of the command with a period (‘`.`’) as described in the previous section (see Section 6.1 [Tokens], page 25). A blank line, or one that consists only of white space or comments, also ends a command.

6.3 Syntax Variants

There are three variants of command syntax, which vary only in how they detect the end of one command and the start of the next.

In *interactive mode*, which is the default for syntax typed at a command prompt, a period as the last non-blank character on a line ends a command. A blank line also ends a command.

In *batch mode*, an end-of-line period or a blank line also ends a command. Additionally, it treats any line that has a non-blank character in the leftmost column as beginning a new command. Thus, in batch mode the second and subsequent lines in a command must be indented.

Regardless of the syntax mode, a plus sign, minus sign, or period in the leftmost column of a line is ignored and causes that line to begin a new command. This is most useful in batch mode, in which the first line of a new command could not otherwise be indented, but it is accepted regardless of syntax mode.

The default mode for reading commands from a file is *auto mode*. It is the same as batch mode, except that a line with a non-blank in the leftmost column only starts a new command if that line begins with the name of a PSPP command. This correctly interprets most valid PSPP syntax files regardless of the syntax mode for which they are intended.

The `--interactive` (or `-i`) or `--batch` (or `-b`) options set the syntax mode for files listed on the PSPP command line. See Section 3.1 [Main Options], page 3, for more details.

6.4 Types of Commands

Commands in PSPP are divided roughly into six categories:

Utility commands
: Set or display various global options that affect PSPP operations. May appear anywhere in a syntax file. See Chapter 17 [Utility commands], page 260.

File definition commands
: Give instructions for reading data from text files or from special binary "system files". Most of these commands replace any previous data or variables with new data or variables. At least one file definition command must appear before the first command in any of the categories below. See Chapter 8 [Data Input and Output], page 62.

Input program commands
: Though rarely used, these provide tools for reading data files in arbitrary textual or binary formats. See Section 8.9 [INPUT PROGRAM], page 71.

Transformations
: Perform operations on data and write data to output files. Transformations are not carried out until a procedure is executed.

Restricted transformations
: Transformations that cannot appear in certain contexts. See Section 6.5 [Order of Commands], page 28, for details.

Procedures

Analyze data, writing results of analyses to the listing file. Cause transformations specified earlier in the file to be performed. In a more general sense, a *procedure* is any command that causes the active dataset (the data) to be read.

6.5 Order of Commands

PSPP does not place many restrictions on ordering of commands. The main restriction is that variables must be defined before they are otherwise referenced. This section describes the details of command ordering, but most users will have no need to refer to them.

PSPP possesses five internal states, called *initial*, *input-program file-type*, *transformation*, and *procedure* states. (Please note the distinction between the `INPUT PROGRAM` and `FILE TYPE` *commands* and the *input-program* and *file-type states*.)

PSPP starts in the initial state. Each successful completion of a command may cause a state transition. Each type of command has its own rules for state transitions:

Utility commands

- Valid in any state.
- Do not cause state transitions. Exception: when `N OF CASES` is executed in the procedure state, it causes a transition to the transformation state.

`DATA LIST`

- Valid in any state.
- When executed in the initial or procedure state, causes a transition to the transformation state.
- Clears the active dataset if executed in the procedure or transformation state.

`INPUT PROGRAM`

- Invalid in input-program and file-type states.
- Causes a transition to the intput-program state.
- Clears the active dataset.

`FILE TYPE`

- Invalid in intput-program and file-type states.
- Causes a transition to the file-type state.
- Clears the active dataset.

Other file definition commands

- Invalid in input-program and file-type states.
- Cause a transition to the transformation state.
- Clear the active dataset, except for `ADD FILES`, `MATCH FILES`, and `UPDATE`.

Transformations

- Invalid in initial and file-type states.
- Cause a transition to the transformation state.

Restricted transformations

- Invalid in initial, input-program, and file-type states.

- Cause a transition to the transformation state.

Procedures

- Invalid in initial, input-program, and file-type states.
- Cause a transition to the procedure state.

6.6 Handling missing observations

PSPP includes special support for unknown numeric data values. Missing observations are assigned a special value, called the *system-missing value*. This "value" actually indicates the absence of a value; it means that the actual value is unknown. Procedures automatically exclude from analyses those observations or cases that have missing values. Details of missing value exclusion depend on the procedure and can often be controlled by the user; refer to descriptions of individual procedures for details.

The system-missing value exists only for numeric variables. String variables always have a defined value, even if it is only a string of spaces.

Variables, whether numeric or string, can have designated *user-missing values*. Every user-missing value is an actual value for that variable. However, most of the time user-missing values are treated in the same way as the system-missing value.

For more information on missing values, see the following sections: Section 6.7 [Datasets], page 29, Section 11.13 [MISSING VALUES], page 102, Chapter 7 [Expressions], page 44. See also the documentation on individual procedures for information on how they handle missing values.

6.7 Datasets

PSPP works with data organized into *datasets*. A dataset consists of a set of *variables*, which taken together are said to form a *dictionary*, and one or more *cases*, each of which has one value for each variable.

At any given time PSPP has exactly one distinguished dataset, called the *active dataset*. Most PSPP commands work only with the active dataset. In addition to the active dataset, PSPP also supports any number of additional open datasets. The `DATASET` commands can choose a new active dataset from among those that are open, as well as create and destroy datasets (see Section 8.4 [DATASET], page 63).

The sections below describe variables in more detail.

6.7.1 Attributes of Variables

Each variable has a number of attributes, including:

Name An identifier, up to 64 bytes long. Each variable must have a different name. See Section 6.1 [Tokens], page 25.

Some system variable names begin with '`$`', but user-defined variables' names may not begin with '`$`'.

The final character in a variable name should not be '`.`', because such an identifier will be misinterpreted when it is the final token on a line: `FOO.` is divided into two separate tokens, '`FOO`' and '`.`', indicating end-of-command. See Section 6.1 [Tokens], page 25.

The final character in a variable name should not be '_', because some such identifiers are used for special purposes by PSPP procedures.

As with all PSPP identifiers, variable names are not case-sensitive. PSPP capitalizes variable names on output the same way they were capitalized at their point of definition in the input.

Type Numeric or string.

Width (string variables only) String variables with a width of 8 characters or fewer are called *short string variables*. Short string variables may be used in a few contexts where *long string variables* (those with widths greater than 8) are not allowed.

Position Variables in the dictionary are arranged in a specific order. `DISPLAY` can be used to show this order: see Section 11.1 [DISPLAY], page 97.

Initialization
Either reinitialized to 0 or spaces for each case, or left at its existing value. See Section 11.21 [LEAVE], page 106.

Missing values
Optionally, up to three values, or a range of values, or a specific value plus a range, can be specified as *user-missing values*. There is also a *system-missing value* that is assigned to an observation when there is no other obvious value for that observation. Observations with missing values are automatically excluded from analyses. User-missing values are actual data values, while the system-missing value is not a value at all. See Section 6.6 [Missing Observations], page 29.

Variable label
A string that describes the variable. See Section 11.7 [VARIABLE LABELS], page 100.

Value label
Optionally, these associate each possible value of the variable with a string. See Section 11.11 [VALUE LABELS], page 101.

Print format
Display width, format, and (for numeric variables) number of decimal places. This attribute does not affect how data are stored, just how they are displayed. Example: a width of 8, with 2 decimal places. See Section 6.7.4 [Input and Output Formats], page 32.

Write format
Similar to print format, but used by the `WRITE` command (see Section 8.16 [WRITE], page 77).

Measurement level
One of the following:

Nominal Each value of a nominal variable represents a distinct category. The possible categories are finite and often have value labels. The order of categories is not significant. Political parties, US states, and

yes/no choices are nominal. Numeric and string variables can be nominal.

Ordinal
: Ordinal variables also represent distinct categories, but their values are arranged according to some natural order. Likert scales, e.g. from strongly disagree to strongly agree, are ordinal. Data grouped into ranges, e.g. age groups or income groups, are ordinal. Both numeric and string variables can be ordinal. String values are ordered alphabetically, so letter grades from A to F will work as expected, but `poor`, `satisfactory`, `excellent` will not.

Scale
: Scale variables are ones for which differences and ratios are meaningful. These are often values which have a natural unit attached, such as age in years, income in dollars, or distance in miles. Only numeric variables are scalar.

Variables created by `COMPUTE` and similar transformations, obtained from external sources, etc., initially have an unknown measurement level. Any procedure that reads the data will then assign a default measurement level. PSPP can assign some defaults without reading the data:

- Nominal, if it's a string variable.
- Nominal, if the variable has a WKDAY or MONTH print format.
- Scale, if the variable has a DOLLAR, CCA through CCE, or time or date print format.

Otherwise, PSPP reads the data and decides based on its distribution:

- Nominal, if all observations are missing.
- Scale, if one or more valid observations are noninteger or negative.
- Scale, if no valid observation is less than 10.
- Scale, if the variable has 24 or more unique valid values. The value 24 is the default and can be adjusted (see [SET SCALEMIN], page 269).

Finally, if none of the above is true, PSPP assigns the variable a nominal measurement level.

Custom attributes
: User-defined associations between names and values. See Section 11.14 [VARIABLE ATTRIBUTE], page 102.

Role
: The intended role of a variable for use in dialog boxes in graphical user interfaces. See Section 11.18 [VARIABLE ROLE], page 104.

6.7.2 Variables Automatically Defined by PSPP

There are seven system variables. These are not like ordinary variables because system variables are not always stored. They can be used only in expressions. These system variables, whose values and output formats cannot be modified, are described below.

`$CASENUM`
: Case number of the case at the moment. This changes as cases are shuffled around.

`$DATE` Date the PSPP process was started, in format A9, following the pattern `DD-MMM-YY`.

`$DATE11` Date the PSPP process was started, in format A11, following the pattern `DD-MMM-YYYY`.

`$JDATE` Number of days between 15 Oct 1582 and the time the PSPP process was started.

`$LENGTH` Page length, in lines, in format F11.

`$SYSMIS` System missing value, in format F1.

`$TIME` Number of seconds between midnight 14 Oct 1582 and the time the active dataset was read, in format F20.

`$WIDTH` Page width, in characters, in format F3.

6.7.3 Lists of variable names

To refer to a set of variables, list their names one after another. Optionally, their names may be separated by commas. To include a range of variables from the dictionary in the list, write the name of the first and last variable in the range, separated by `TO`. For instance, if the dictionary contains six variables with the names `ID`, `X1`, `X2`, `GOAL`, `MET`, and `NEXTGOAL`, in that order, then `X2 TO MET` would include variables `X2`, `GOAL`, and `MET`.

Commands that define variables, such as `DATA LIST`, give `TO` an alternate meaning. With these commands, `TO` define sequences of variables whose names end in consecutive integers. The syntax is two identifiers that begin with the same root and end with numbers, separated by `TO`. The syntax `X1 TO X5` defines 5 variables, named `X1`, `X2`, `X3`, `X4`, and `X5`. The syntax `ITEM0008 TO ITEM0013` defines 6 variables, named `ITEM0008`, `ITEM0009`, `ITEM0010`, `ITEM0011`, `ITEM0012`, and `ITEM00013`. The syntaxes `QUES001 TO QUES9` and `QUES6 TO QUES3` are invalid.

After a set of variables has been defined with `DATA LIST` or another command with this method, the same set can be referenced on later commands using the same syntax.

6.7.4 Input and Output Formats

An *input format* describes how to interpret the contents of an input field as a number or a string. It might specify that the field contains an ordinary decimal number, a time or date, a number in binary or hexadecimal notation, or one of several other notations. Input formats are used by commands such as `DATA LIST` that read data or syntax files into the PSPP active dataset.

Every input format corresponds to a default *output format* that specifies the formatting used when the value is output later. It is always possible to explicitly specify an output format that resembles the input format. Usually, this is the default, but in cases where the input format is unfriendly to human readability, such as binary or hexadecimal formats, the default output format is an easier-to-read decimal format.

Every variable has two output formats, called its *print format* and *write format*. Print formats are used in most output contexts; write formats are used only by `WRITE` (see Section 8.16 [WRITE], page 77). Newly created variables have identical print and write formats, and `FORMATS`, the most commonly used command for changing formats (see Section 11.10

[FORMATS], page 101), sets both of them to the same value as well. Thus, most of the time, the distinction between print and write formats is unimportant.

Input and output formats are specified to PSPP with a *format specification* of the form *TYPEw* or TYPE*w*.*d*, where *TYPE* is one of the format types described later, *w* is a field width measured in columns, and *d* is an optional number of decimal places. If *d* is omitted, a value of 0 is assumed. Some formats do not allow a nonzero *d* to be specified.

The following sections describe the input and output formats supported by PSPP.

6.7.4.1 Basic Numeric Formats

The basic numeric formats are used for input and output of real numbers in standard or scientific notation. The following table shows an example of how each format displays positive and negative numbers with the default decimal point setting:

Format	3141.59	-3141.59
F8.2	3141.59	-3141.59
COMMA9.2	3,141.59	-3,141.59
DOT9.2	3.141,59	-3.141,59
DOLLAR10.2	$3,141.59	-$3,141.59
PCT9.2	3141.59%	-3141.59%
E8.1	3.1E+003	-3.1E+003

On output, numbers in F format are expressed in standard decimal notation with the requested number of decimal places. The other formats output some variation on this style:

- Numbers in COMMA format are additionally grouped every three digits by inserting a grouping character. The grouping character is ordinarily a comma, but it can be changed to a period (see [SET DECIMAL], page 267).
- DOT format is like COMMA format, but it interchanges the role of the decimal point and grouping characters. That is, the current grouping character is used as a decimal point and vice versa.
- DOLLAR format is like COMMA format, but it prefixes the number with '$'.
- PCT format is like F format, but adds '%' after the number.
- The E format always produces output in scientific notation.

On input, the basic numeric formats accept positive and numbers in standard decimal notation or scientific notation. Leading and trailing spaces are allowed. An empty or all-spaces field, or one that contains only a single period, is treated as the system missing value.

In scientific notation, the exponent may be introduced by a sign ('+' or '-'), or by one of the letters 'e' or 'd' (in uppercase or lowercase), or by a letter followed by a sign. A single space may follow the letter or the sign or both.

On fixed-format DATA LIST (see Section 8.5.1 [DATA LIST FIXED], page 64) and in a few other contexts, decimals are implied when the field does not contain a decimal point. In F6.5 format, for example, the field 314159 is taken as the value 3.14159 with implied decimals. Decimals are never implied if an explicit decimal point is present or if scientific notation is used.

E and F formats accept the basic syntax already described. The other formats allow some additional variations:

- COMMA, DOLLAR, and DOT formats ignore grouping characters within the integer part of the input field. The identity of the grouping character depends on the format.
- DOLLAR format allows a dollar sign to precede the number. In a negative number, the dollar sign may precede or follow the minus sign.
- PCT format allows a percent sign to follow the number.

All of the basic number formats have a maximum field width of 40 and accept no more than 16 decimal places, on both input and output. Some additional restrictions apply:

- As input formats, the basic numeric formats allow no more decimal places than the field width. As output formats, the field width must be greater than the number of decimal places; that is, large enough to allow for a decimal point and the number of requested decimal places. DOLLAR and PCT formats must allow an additional column for '`$`' or '`%`'.
- The default output format for a given input format increases the field width enough to make room for optional input characters. If an input format calls for decimal places, the width is increased by 1 to make room for an implied decimal point. COMMA, DOT, and DOLLAR formats also increase the output width to make room for grouping characters. DOLLAR and PCT further increase the output field width by 1 to make room for '`$`' or '`%`'. The increased output width is capped at 40, the maximum field width.
- The E format is exceptional. For output, E format has a minimum width of 7 plus the number of decimal places. The default output format for an E input format is an E format with at least 3 decimal places and thus a minimum width of 10.

More details of basic numeric output formatting are given below:

- Output rounds to nearest, with ties rounded away from zero. Thus, 2.5 is output as `3` in F1.0 format, and -1.125 as `-1.13` in F5.1 format.
- The system-missing value is output as a period in a field of spaces, placed in the decimal point's position, or in the rightmost column if no decimal places are requested. A period is used even if the decimal point character is a comma.
- A number that does not fill its field is right-justified within the field.
- A number is too large for its field causes decimal places to be dropped to make room. If dropping decimals does not make enough room, scientific notation is used if the field is wide enough. If a number does not fit in the field, even in scientific notation, the overflow is indicated by filling the field with asterisks ('`*`').
- COMMA, DOT, and DOLLAR formats insert grouping characters only if space is available for all of them. Grouping characters are never inserted when all decimal places must be dropped. Thus, 1234.56 in COMMA5.2 format is output as '` 1235`' without a comma, even though there is room for one, because all decimal places were dropped.
- DOLLAR or PCT format drop the '`$`' or '`%`' only if the number would not fit at all without it. Scientific notation with '`$`' or '`%`' is preferred to ordinary decimal notation without it.

- Except in scientific notation, a decimal point is included only when it is followed by a digit. If the integer part of the number being output is 0, and a decimal point is included, then PSPP ordinarily drops the zero before the decimal point. However, in `F`, `COMMA`, or `DOT` formats, PSPP keeps the zero if `SET LEADZERO` is set to `ON` (see [SET LEADZERO], page 269).

  In scientific notation, the number always includes a decimal point, even if it is not followed by a digit.
- A negative number includes a minus sign only in the presence of a nonzero digit: -0.01 is output as '`-.01`' in F4.2 format but as ' `.0`' in F4.1 format. Thus, a "negative zero" never includes a minus sign.
- In negative numbers output in DOLLAR format, the dollar sign follows the negative sign. Thus, -9.99 in DOLLAR6.2 format is output as `-$9.99`.
- In scientific notation, the exponent is output as '`E`' followed by '`+`' or '`-`' and exactly three digits. Numbers with magnitude less than 10**-999 or larger than 10**999 are not supported by most computers, but if they are supported then their output is considered to overflow the field and they are output as asterisks.
- On most computers, no more than 15 decimal digits are significant in output, even if more are printed. In any case, output precision cannot be any higher than input precision; few data sets are accurate to 15 digits of precision. Unavoidable loss of precision in intermediate calculations may also reduce precision of output.
- Special values such as infinities and "not a number" values are usually converted to the system-missing value before printing. In a few circumstances, these values are output directly. In fields of width 3 or greater, special values are output as however many characters fit from `+Infinity` or `-Infinity` for infinities, from `NaN` for "not a number," or from `Unknown` for other values (if any are supported by the system). In fields under 3 columns wide, special values are output as asterisks.

6.7.4.2 Custom Currency Formats

The custom currency formats are closely related to the basic numeric formats, but they allow users to customize the output format. The SET command configures custom currency formats, using the syntax

SET CC*x*="*string*".

where *x* is A, B, C, D, or E, and *string* is no more than 16 characters long.

string must contain exactly three commas or exactly three periods (but not both), except that a single quote character may be used to "escape" a following comma, period, or single quote. If three commas are used, commas are used for grouping in output, and a period is used as the decimal point. Uses of periods reverses these roles.

The commas or periods divide *string* into four fields, called the *negative prefix*, *prefix*, *suffix*, and *negative suffix*, respectively. The prefix and suffix are added to output whenever space is available. The negative prefix and negative suffix are always added to a negative number when the output includes a nonzero digit.

The following syntax shows how custom currency formats could be used to reproduce basic numeric formats:

```
SET CCA="-,,,".  /* Same as COMMA.
SET CCB="-...".  /* Same as DOT.
SET CCC="-,$,,". /* Same as DOLLAR.
SET CCD="-,,%,". /* Like PCT, but groups with commas.
```

Here are some more examples of custom currency formats. The final example shows how to use a single quote to escape a delimiter:

```
SET CCA=",EUR,,-".   /* Euro.
SET CCB="(,USD ,,)". /* US dollar.
SET CCC="-.R$..".    /* Brazilian real.
SET CCD="-,, NIS,".  /* Israel shekel.
SET CCE="-.Rp'. ..". /* Indonesia Rupiah.
```

These formats would yield the following output:

Format	3145.59	-3145.59
CCA12.2	EUR3,145.59	EUR3,145.59-
CCB14.2	USD 3,145.59	(USD 3,145.59)
CCC11.2	R$3.145,59	-R$3.145,59
CCD13.2	3,145.59 NIS	-3,145.59 NIS
CCE10.0	Rp. 3.146	-Rp. 3.146

The default for all the custom currency formats is '`-,,,`', equivalent to COMMA format.

6.7.4.3 Legacy Numeric Formats

The N and Z numeric formats provide compatibility with legacy file formats. They have much in common:

- Output is rounded to the nearest representable value, with ties rounded away from zero.
- Numbers too large to display are output as a field filled with asterisks ('`*`').
- The decimal point is always implicitly the specified number of digits from the right edge of the field, except that Z format input allows an explicit decimal point.
- Scientific notation may not be used.
- The system-missing value is output as a period in a field of spaces. The period is placed just to the right of the implied decimal point in Z format, or at the right end in N format or in Z format if no decimal places are requested. A period is used even if the decimal point character is a comma.
- Field width may range from 1 to 40. Decimal places may range from 0 up to the field width, to a maximum of 16.
- When a legacy numeric format used for input is converted to an output format, it is changed into the equivalent F format. The field width is increased by 1 if any decimal places are specified, to make room for a decimal point. For Z format, the field width is increased by 1 more column, to make room for a negative sign. The output field width is capped at 40 columns.

N Format

The N format supports input and output of fields that contain only digits. On input, leading or trailing spaces, a decimal point, or any other non-digit character causes the field to be

read as the system-missing value. As a special exception, an N format used on `DATA LIST FREE` or `DATA LIST LIST` is treated as the equivalent F format.

On output, N pads the field on the left with zeros. Negative numbers are output like the system-missing value.

Z Format

The Z format is a "zoned decimal" format used on IBM mainframes. Z format encodes the sign as part of the final digit, which must be one of the following:

```
0123456789
{ABCDEFGHI
}JKLMNOPQR
```

where the characters in each row represent digits 0 through 9 in order. Characters in the first two rows indicate a positive sign; those in the third indicate a negative sign.

On output, Z fields are padded on the left with spaces. On input, leading and trailing spaces are ignored. Any character in an input field other than spaces, the digit characters above, and '`.`' causes the field to be read as system-missing.

The decimal point character for input and output is always '`.`', even if the decimal point character is a comma (see [SET DECIMAL], page 267).

Nonzero, negative values output in Z format are marked as negative even when no nonzero digits are output. For example, -0.2 is output in Z1.0 format as '`J`'. The "negative zero" value supported by most machines is output as positive.

6.7.4.4 Binary and Hexadecimal Numeric Formats

The binary and hexadecimal formats are primarily designed for compatibility with existing machine formats, not for human readability. All of them therefore have a F format as default output format. Some of these formats are only portable between machines with compatible byte ordering (endianness) or floating-point format.

Binary formats use byte values that in text files are interpreted as special control functions, such as carriage return and line feed. Thus, data in binary formats should not be included in syntax files or read from data files with variable-length records, such as ordinary text files. They may be read from or written to data files with fixed-length records. See Section 8.8 [FILE HANDLE], page 68, for information on working with fixed-length records.

P and PK Formats

These are binary-coded decimal formats, in which every byte (except the last, in P format) represents two decimal digits. The most-significant 4 bits of the first byte is the most-significant decimal digit, the least-significant 4 bits of the first byte is the next decimal digit, and so on.

In P format, the most-significant 4 bits of the last byte are the least-significant decimal digit. The least-significant 4 bits represent the sign: decimal 15 indicates a negative value, decimal 13 indicates a positive value.

Numbers are rounded downward on output. The system-missing value and numbers outside representable range are output as zero.

The maximum field width is 16. Decimal places may range from 0 up to the number of decimal digits represented by the field.

The default output format is an F format with twice the input field width, plus one column for a decimal point (if decimal places were requested).

IB and PIB Formats

These are integer binary formats. IB reads and writes 2's complement binary integers, and PIB reads and writes unsigned binary integers. The byte ordering is by default the host machine's, but SET RIB may be used to select a specific byte ordering for reading (see [SET RIB], page 267) and SET WIB, similarly, for writing (see [SET WIB], page 270).

The maximum field width is 8. Decimal places may range from 0 up to the number of decimal digits in the largest value representable in the field width.

The default output format is an F format whose width is the number of decimal digits in the largest value representable in the field width, plus 1 if the format has decimal places.

RB Format

This is a binary format for real numbers. By default it reads and writes the host machine's floating-point format, but SET RRB may be used to select an alternate floating-point format for reading (see [SET RRB], page 267) and SET WRB, similarly, for writing (see [SET WRB], page 270).

The recommended field width depends on the floating-point format. NATIVE (the default format), IDL, IDB, VD, VG, and ZL formats should use a field width of 8. ISL, ISB, VF, and ZS formats should use a field width of 4. Other field widths do not produce useful results. The maximum field width is 8. No decimal places may be specified.

The default output format is F8.2.

PIBHEX and RBHEX Formats

These are hexadecimal formats, for reading and writing binary formats where each byte has been recoded as a pair of hexadecimal digits.

A hexadecimal field consists solely of hexadecimal digits '`0`'...'`9`' and '`A`'...'`F`'. Uppercase and lowercase are accepted on input; output is in uppercase.

Other than the hexadecimal representation, these formats are equivalent to PIB and RB formats, respectively. However, bytes in PIBHEX format are always ordered with the most-significant byte first (big-endian order), regardless of the host machine's native byte order or PSPP settings.

Field widths must be even and between 2 and 16. RBHEX format allows no decimal places; PIBHEX allows as many decimal places as a PIB format with half the given width.

6.7.4.5 Time and Date Formats

In PSPP, a *time* is an interval. The time formats translate between human-friendly descriptions of time intervals and PSPP's internal representation of time intervals, which is simply the number of seconds in the interval. PSPP has three time formats:

Time Format	Template	Example
MTIME	`MM:SS.ss`	`91:17.01`
TIME	`hh:MM:SS.ss`	`01:31:17.01`
DTIME	`DD HH:MM:SS.ss`	`00 04:31:17.01`

A *date* is a moment in the past or the future. Internally, PSPP represents a date as the number of seconds since the *epoch*, midnight, Oct. 14, 1582. The date formats translate between human-readable dates and PSPP's numeric representation of dates and times. PSPP has several date formats:

Date Format	**Template**	**Example**
DATE	`dd-mmm-yyyy`	`01-OCT-1978`
ADATE	`mm/dd/yyyy`	`10/01/1978`
EDATE	`dd.mm.yyyy`	`01.10.1978`
JDATE	`yyyyjjj`	`1978274`
SDATE	`yyyy/mm/dd`	`1978/10/01`
QYR	`q Q yyyy`	`3 Q 1978`
MOYR	`mmm yyyy`	`OCT 1978`
WKYR	`ww WK yyyy`	`40 WK 1978`
DATETIME	`dd-mmm-yyyy HH:MM:SS.ss`	`01-OCT-1978 04:31:17.01`
YMDHMS	`yyyy-mm-dd HH:MM:SS.ss`	`1978-01-OCT 04:31:17.01`

The templates in the preceding tables describe how the time and date formats are input and output:

`dd` Day of month, from 1 to 31. Always output as two digits.

`mm`
`mmm` Month. In output, `mm` is output as two digits, `mmm` as the first three letters of an English month name (January, February, . . .). In input, both of these formats, plus Roman numerals, are accepted.

`yyyy` Year. In output, DATETIME and YMDHMS always produce 4-digit years; other formats can produce a 2- or 4-digit year. The century assumed for 2-digit years depends on the EPOCH setting (see [SET EPOCH], page 267). In output, a year outside the epoch causes the whole field to be filled with asterisks ('`*`').

`jjj` Day of year (Julian day), from 1 to 366. This is exactly three digits giving the count of days from the start of the year. January 1 is considered day 1.

`q` Quarter of year, from 1 to 4. Quarters start on January 1, April 1, July 1, and October 1.

`ww` Week of year, from 1 to 53. Output as exactly two digits. January 1 is the first day of week 1.

`DD` Count of days, which may be positive or negative. Output as at least two digits.

`hh` Count of hours, which may be positive or negative. Output as at least two digits.

`HH` Hour of day, from 0 to 23. Output as exactly two digits.

`MM` In MTIME, count of minutes, which may be positive or negative. Output as at least two digits.

In other formats, minute of hour, from 0 to 59. Output as exactly two digits.

`SS.ss` Seconds within minute, from 0 to 59. The integer part is output as exactly two digits. On output, seconds and fractional seconds may or may not be included,

depending on field width and decimal places. On input, seconds and fractional seconds are optional. The DECIMAL setting controls the character accepted and displayed as the decimal point (see [SET DECIMAL], page 267).

For output, the date and time formats use the delimiters indicated in the table. For input, date components may be separated by spaces or by one of the characters '`-`', '`/`', '`.`', or '`,`', and time components may be separated by spaces or '`:`'. On input, the '`Q`' separating quarter from year and the '`WK`' separating week from year may be uppercase or lowercase, and the spaces around them are optional.

On input, all time and date formats accept any amount of leading and trailing white space.

The maximum width for time and date formats is 40 columns. Minimum input and output width for each of the time and date formats is shown below:

Format	**Min. Input Width**	**Min. Output Width**	**Option**
DATE	8	9	4-digit year
ADATE	8	8	4-digit year
EDATE	8	8	4-digit year
JDATE	5	5	4-digit year
SDATE	8	8	4-digit year
QYR	4	6	4-digit year
MOYR	6	6	4-digit year
WKYR	6	8	4-digit year
DATETIME	17	17	seconds
YMDHMS	12	16	seconds
MTIME	4	5	
TIME	5	5	seconds
DTIME	8	8	seconds

In the table, "Option" describes what increased output width enables:

4-digit year
: A field 2 columns wider than the minimum includes a 4-digit year. (DATETIME and YMDHMS formats always include a 4-digit year.)

seconds
: A field 3 columns wider than the minimum includes seconds as well as minutes. A field 5 columns wider than minimum, or more, can also include a decimal point and fractional seconds (but no more than allowed by the format's decimal places).

For the time and date formats, the default output format is the same as the input format, except that PSPP increases the field width, if necessary, to the minimum allowed for output.

Time or dates narrower than the field width are right-justified within the field.

When a time or date exceeds the field width, characters are trimmed from the end until it fits. This can occur in an unusual situation, *e.g.* with a year greater than 9999 (which adds an extra digit), or for a negative value on MTIME, TIME, or DTIME (which adds a leading minus sign).

The system-missing value is output as a period at the right end of the field.

6.7.4.6 Date Component Formats

The WKDAY and MONTH formats provide input and output for the names of weekdays and months, respectively.

On output, these formats convert a number between 1 and 7, for WKDAY, or between 1 and 12, for MONTH, into the English name of a day or month, respectively. If the name is longer than the field, it is trimmed to fit. If the name is shorter than the field, it is padded on the right with spaces. Values outside the valid range, and the system-missing value, are output as all spaces.

On input, English weekday or month names (in uppercase or lowercase) are converted back to their corresponding numbers. Weekday and month names may be abbreviated to their first 2 or 3 letters, respectively.

The field width may range from 2 to 40, for WKDAY, or from 3 to 40, for MONTH. No decimal places are allowed.

The default output format is the same as the input format.

6.7.4.7 String Formats

The A and AHEX formats are the only ones that may be assigned to string variables. Neither format allows any decimal places.

In A format, the entire field is treated as a string value. The field width may range from 1 to 32,767, the maximum string width. The default output format is the same as the input format.

In AHEX format, the field is composed of characters in a string encoded as hex digit pairs. On output, hex digits are output in uppercase; on input, uppercase and lowercase are both accepted. The default output format is A format with half the input width.

6.7.5 Scratch Variables

Most of the time, variables don't retain their values between cases. Instead, either they're being read from a data file or the active dataset, in which case they assume the value read, or, if created with `COMPUTE` or another transformation, they're initialized to the system-missing value or to blanks, depending on type.

However, sometimes it's useful to have a variable that keeps its value between cases. You can do this with `LEAVE` (see Section 11.21 [LEAVE], page 106), or you can use a *scratch variable*. Scratch variables are variables whose names begin with an octothorpe ('`#`').

Scratch variables have the same properties as variables left with `LEAVE`: they retain their values between cases, and for the first case they are initialized to 0 or blanks. They have the additional property that they are deleted before the execution of any procedure. For this reason, scratch variables can't be used for analysis. To use a scratch variable in an analysis, use `COMPUTE` (see Section 12.3 [COMPUTE], page 113) to copy its value into an ordinary variable, then use that ordinary variable in the analysis.

6.8 Files Used by PSPP

PSPP makes use of many files each time it runs. Some of these it reads, some it writes, some it creates. Here is a table listing the most important of these files:

command file
syntax file These names (synonyms) refer to the file that contains instructions that tell PSPP what to do. The syntax file's name is specified on the PSPP command line. Syntax files can also be read with `INCLUDE` (see Section 17.15 [INCLUDE], page 263).

data file Data files contain raw data in text or binary format. Data can also be embedded in a syntax file with `BEGIN DATA` and `END DATA`.

listing file One or more output files are created by PSPP each time it is run. The output files receive the tables and charts produced by statistical procedures. The output files may be in any number of formats, depending on how PSPP is configured.

system file
System files are binary files that store a dictionary and a set of cases. `GET` and `SAVE` read and write system files.

portable file
Portable files are files in a text-based format that store a dictionary and a set of cases. `IMPORT` and `EXPORT` read and write portable files.

6.9 File Handles

A *file handle* is a reference to a data file, system file, or portable file. Most often, a file handle is specified as the name of a file as a string, that is, enclosed within '`'`' or '`"`'.

A file name string that begins or ends with '`|`' is treated as the name of a command to pipe data to or from. You can use this feature to read data over the network using a program such as '`curl`' (*e.g.* `GET '|curl -s -S http://example.com/mydata.sav'`), to read compressed data from a file using a program such as '`zcat`' (*e.g.* `GET '|zcat mydata.sav.gz'`), and for many other purposes.

PSPP also supports declaring named file handles with the `FILE HANDLE` command. This command associates an identifier of your choice (the file handle's name) with a file. Later, the file handle name can be substituted for the name of the file. When PSPP syntax accesses a file multiple times, declaring a named file handle simplifies updating the syntax later to use a different file. Use of `FILE HANDLE` is also required to read data files in binary formats. See Section 8.8 [FILE HANDLE], page 68, for more information.

In some circumstances, PSPP must distinguish whether a file handle refers to a system file or a portable file. When this is necessary to read a file, *e.g.* as an input file for `GET` or `MATCH FILES`, PSPP uses the file's contents to decide. In the context of writing a file, *e.g.* as an output file for `SAVE` or `AGGREGATE`, PSPP decides based on the file's name: if it ends in '`.por`' (with any capitalization), then PSPP writes a portable file; otherwise, PSPP writes a system file.

INLINE is reserved as a file handle name. It refers to the "data file" embedded into the syntax file between `BEGIN DATA` and `END DATA`. See Section 8.1 [BEGIN DATA], page 62, for more information.

The file to which a file handle refers may be reassigned on a later `FILE HANDLE` command if it is first closed using `CLOSE FILE HANDLE`. See Section 8.2 [CLOSE FILE HANDLE], page 62, for more information.

6.10 Backus-Naur Form

The syntax of some parts of the PSPP language is presented in this manual using the formalism known as *Backus-Naur Form*, or BNF. The following table describes BNF:

- Words in all-uppercase are PSPP keyword tokens. In BNF, these are often called *terminals*. There are some special terminals, which are written in lowercase for clarity:

  `number` A real number.

  `integer` An integer number.

  `string` A string.

  `var-name` A single variable name.

  `=`, `/`, `+`, `-`, etc.
  Operators and punctuators.

  `.` The end of the command. This is not necessarily an actual dot in the syntax file (see Section 6.2 [Commands], page 26).

- Other words in all lowercase refer to BNF definitions, called *productions*. These productions are also known as *nonterminals*. Some nonterminals are very common, so they are defined here in English for clarity:

  `var-list` A list of one or more variable names or the keyword `ALL`.

  `expression`
  An expression. See Chapter 7 [Expressions], page 44, for details.

- '`::=`' means "is defined as". The left side of '`::=`' gives the name of the nonterminal being defined. The right side of '`::=`' gives the definition of that nonterminal. If the right side is empty, then one possible expansion of that nonterminal is nothing. A BNF definition is called a *production*.
- So, the key difference between a terminal and a nonterminal is that a terminal cannot be broken into smaller parts—in fact, every terminal is a single token (see Section 6.1 [Tokens], page 25). On the other hand, nonterminals are composed of a (possibly empty) sequence of terminals and nonterminals. Thus, terminals indicate the deepest level of syntax description. (In parsing theory, terminals are the leaves of the parse tree; nonterminals form the branches.)
- The first nonterminal defined in a set of productions is called the *start symbol*. The start symbol defines the entire syntax for that command.

7 Mathematical Expressions

Expressions share a common syntax each place they appear in PSPP commands. Expressions are made up of *operands*, which can be numbers, strings, or variable names, separated by *operators*. There are five types of operators: grouping, arithmetic, logical, relational, and functions.

Every operator takes one or more operands as input and yields exactly one result as output. Depending on the operator, operands accept strings or numbers as operands. With few exceptions, operands may be full-fledged expressions in themselves.

7.1 Boolean Values

Some PSPP operators and expressions work with Boolean values, which represent true/false conditions. Booleans have only three possible values: 0 (false), 1 (true), and system-missing (unknown). System-missing is neither true nor false and indicates that the true value is unknown.

Boolean-typed operands or function arguments must take on one of these three values. Other values are considered false, but provoke a warning when the expression is evaluated.

Strings and Booleans are not compatible, and neither may be used in place of the other.

7.2 Missing Values in Expressions

Most numeric operators yield system-missing when given any system-missing operand. A string operator given any system-missing operand typically results in the empty string. Exceptions are listed under particular operator descriptions.

String user-missing values are not treated specially in expressions.

User-missing values for numeric variables are always transformed into the system-missing value, except inside the arguments to the `VALUE` and `SYSMIS` functions.

The missing-value functions can be used to precisely control how missing values are treated in expressions. See Section 7.7.4 [Missing Value Functions], page 47, for more details.

7.3 Grouping Operators

Parentheses (‘`()`’) are the grouping operators. Surround an expression with parentheses to force early evaluation.

Parentheses also surround the arguments to functions, but in that situation they act as punctuators, not as operators.

7.4 Arithmetic Operators

The arithmetic operators take numeric operands and produce numeric results.

`a + b` Yields the sum of *a* and *b*.

`a - b` Subtracts *b* from *a* and yields the difference.

`a * b` Yields the product of *a* and *b*. If either *a* or *b* is 0, then the result is 0, even if the other operand is missing.

`a / b` Divides *a* by *b* and yields the quotient. If *a* is 0, then the result is 0, even if *b* is missing. If *b* is zero, the result is system-missing.

`a ** b` Yields the result of raising *a* to the power *b*. If *a* is negative and *b* is not an integer, the result is system-missing. The result of `0**0` is system-missing as well.

`- a` Reverses the sign of *a*.

7.5 Logical Operators

The logical operators take logical operands and produce logical results, meaning "true or false." Logical operators are not true Boolean operators because they may also result in a system-missing value. See Section 7.1 [Boolean Values], page 44, for more information.

`a AND b`
`a & b` True if both *a* and *b* are true, false otherwise. If one operand is false, the result is false even if the other is missing. If both operands are missing, the result is missing.

`a OR b`
`a | b` True if at least one of *a* and *b* is true. If one operand is true, the result is true even if the other operand is missing. If both operands are missing, the result is missing.

`NOT a`
`~ a` True if *a* is false. If the operand is missing, then the result is missing.

7.6 Relational Operators

The relational operators take numeric or string operands and produce Boolean results.

Strings cannot be compared to numbers. When strings of different lengths are compared, the shorter string is right-padded with spaces to match the length of the longer string.

The results of string comparisons, other than tests for equality or inequality, depend on the character set in use. String comparisons are case-sensitive.

`a EQ b`
`a = b` True if *a* is equal to *b*.

`a LE b`
`a <= b` True if *a* is less than or equal to *b*.

`a LT b`
`a < b` True if *a* is less than *b*.

`a GE b`
`a >= b` True if *a* is greater than or equal to *b*.

`a GT b`
`a > b` True if *a* is greater than *b*.

`a NE b`
`a ~= b`
`a <> b` True if *a* is not equal to *b*.

7.7 Functions

PSPP functions provide mathematical abilities above and beyond those possible using simple operators. Functions have a common syntax: each is composed of a function name followed by a left parenthesis, one or more arguments, and a right parenthesis.

Function names are not reserved. Their names are specially treated only when followed by a left parenthesis, so that '`EXP(10)`' refers to the constant value *e* raised to the 10th power, but '`EXP`' by itself refers to the value of a variable called `EXP`.

The sections below describe each function in detail.

7.7.1 Mathematical Functions

Advanced mathematical functions take numeric arguments and produce numeric results.

`EXP (`*`exponent`*`)` [Function]

Returns *e* (approximately 2.71828) raised to power *exponent*.

`LG10 (`*`number`*`)` [Function]

Takes the base-10 logarithm of *number*. If *number* is not positive, the result is system-missing.

`LN (`*`number`*`)` [Function]

Takes the base-*e* logarithm of *number*. If *number* is not positive, the result is system-missing.

`LNGAMMA (`*`number`*`)` [Function]

Yields the base-*e* logarithm of the complete gamma of *number*. If *number* is a negative integer, the result is system-missing.

`SQRT (`*`number`*`)` [Function]

Takes the square root of *number*. If *number* is negative, the result is system-missing.

7.7.2 Miscellaneous Mathematical Functions

Miscellaneous mathematical functions take numeric arguments and produce numeric results.

`ABS (`*`number`*`)` [Function]

Results in the absolute value of *number*.

`MOD (`*`numerator, denominator`*`)` [Function]

Returns the remainder (modulus) of *numerator* divided by *denominator*. If *numerator* is 0, then the result is 0, even if *denominator* is missing. If *denominator* is 0, the result is system-missing.

`MOD10 (`*`number`*`)` [Function]

Returns the remainder when *number* is divided by 10. If *number* is negative, MOD10(*number*) is negative or zero.

`RND (`*`number`* `[, `*`mult`*`[, `*`fuzzbits`*`]])` [Function]

Rounds *number* and rounds it to a multiple of *mult* (by default 1). Halves are rounded away from zero, as are values that fall short of halves by less than *fuzzbits* of errors in the least-significant bits of *number*. If *fuzzbits* is not specified then the default is taken from SET FUZZBITS (see [SET FUZZBITS], page 269), which is 6 unless overridden.

`TRUNC (number [, mult[, fuzzbits]])` [Function]

Rounds *number* to a multiple of *mult*, toward zero. For the default *mult* of 1, this is equivalent to discarding the fractional part of *number*. Values that fall short of a multiple of *mult* by less than *fuzzbits* of errors in the least-significant bits of *number* are rounded away from zero. If *fuzzbits* is not specified then the default is taken from SET FUZZBITS (see [SET FUZZBITS], page 269), which is 6 unless overridden.

7.7.3 Trigonometric Functions

Trigonometric functions take numeric arguments and produce numeric results.

`ARCOS (number)` [Function]
`ACOS (number)` [Function]

Takes the arccosine, in radians, of *number*. Results in system-missing if *number* is not between -1 and 1 inclusive. This function is a PSPP extension.

`ARSIN (number)` [Function]
`ASIN (number)` [Function]

Takes the arcsine, in radians, of *number*. Results in system-missing if *number* is not between -1 and 1 inclusive.

`ARTAN (number)` [Function]
`ATAN (number)` [Function]

Takes the arctangent, in radians, of *number*.

`COS (angle)` [Function]

Takes the cosine of *angle* which should be in radians.

`SIN (angle)` [Function]

Takes the sine of *angle* which should be in radians.

`TAN (angle)` [Function]

Takes the tangent of *angle* which should be in radians. Results in system-missing at values of *angle* that are too close to odd multiples of $\pi/2$. Portability: none.

7.7.4 Missing-Value Functions

Missing-value functions take various numeric arguments and yield various types of results. Except where otherwise stated below, the normal rules of evaluation apply within expression arguments to these functions. In particular, user-missing values for numeric variables are converted to system-missing values.

`MISSING (expr)` [Function]

When *expr* is simply the name of a numeric variable, returns 1 if the variable has the system-missing value or if it is user-missing. For any other value 0 is returned. If *expr* takes another form, the function returns 1 if the value is system-missing, 0 otherwise.

`NMISS (expr [, expr]...)` [Function]

Each argument must be a numeric expression. Returns the number of system-missing values in the list, which may include variable ranges using the `var1 TO var2` syntax.

`NVALID (expr [, expr]...)` [Function]

Each argument must be a numeric expression. Returns the number of values in the list that are not system-missing. The list may include variable ranges using the *var1* `TO` *var2* syntax.

`SYSMIS (expr)` [Function]

Returns 1 if *expr* has the system-missing value, 0 otherwise.

`VALUE (variable)` [Function]
`VALUE (vector(index))` [Function]

Prevents the user-missing values of the variable or vector element from being transformed into system-missing values, and always results in its actual value, whether it is valid, user-missing, or system-missing.

7.7.5 Set-Membership Functions

Set membership functions determine whether a value is a member of a set. They take a set of numeric arguments or a set of string arguments, and produce Boolean results.

String comparisons are performed according to the rules given in Section 7.6 [Relational Operators], page 45. User-missing string values are treated as valid values.

`ANY (value, set [, set]...)` [Function]

Returns true if *value* is equal to any of the *set* values, and false otherwise. For numeric arguments, returns system-missing if *value* is system-missing or if all the values in *set* are system-missing. If *value*

`RANGE (value, low, high [, low, high]...)` [Function]

Returns true if *value* is in any of the intervals bounded by *low* and *high* inclusive, and false otherwise. *low* and *high* must be given in pairs. Returns system-missing if any *high* is less than its *low* or, for numeric arguments, if *value* is system-missing or if all the *low*-*high* pairs contain one (or two) system-missing values. A pair does not match *value* if either *low* or *high* is missing, even if *value* equals the non-missing endpoint.

7.7.6 Statistical Functions

Statistical functions compute descriptive statistics on a list of values. Some statistics can be computed on numeric or string values; other can only be computed on numeric values. Their results have the same type as their arguments. The current case's weighting factor (see Section 13.7 [WEIGHT], page 133) has no effect on statistical functions.

These functions' argument lists may include entire ranges of variables using the *var1* `TO` *var2* syntax.

Unlike most functions, statistical functions can return non-missing values even when some of their arguments are missing. Most statistical functions, by default, require only 1 non-missing value to have a non-missing return, but `CFVAR`, `SD`, and `VARIANCE` require 2. These defaults can be increased (but not decreased) by appending a dot and the minimum number of valid arguments to the function name. For example, `MEAN.3(X, Y, Z)` would only return non-missing if all of '`X`', '`Y`', and '`Z`' were valid.

`CFVAR (number, number[, ...])` [Function]
Results in the coefficient of variation of the values of *number*. (The coefficient of variation is the standard deviation divided by the mean.)

`MAX (value, value[, ...])` [Function]
Results in the value of the greatest *value*. The *value*s may be numeric or string.

`MEAN (number, number[, ...])` [Function]
Results in the mean of the values of *number*.

`MEDIAN (number, number[, ...])` [Function]
Results in the median of the values of *number*. Given an even number of nonmissing arguments, yields the mean of the two middle values.

`MIN (number, number[, ...])` [Function]
Results in the value of the least *value*. The *value*s may be numeric or string.

`SD (number, number[, ...])` [Function]
Results in the standard deviation of the values of *number*.

`SUM (number, number[, ...])` [Function]
Results in the sum of the values of *number*.

`VARIANCE (number, number[, ...])` [Function]
Results in the variance of the values of *number*.

7.7.7 String Functions

String functions take various arguments and return various results.

`CONCAT (string, string[, ...])` [Function]
Returns a string consisting of each *string* in sequence. `CONCAT("abc", "def", "ghi")` has a value of `"abcdefghi"`. The resultant string is truncated to a maximum of 32767 bytes.

`INDEX (haystack, needle)` [Function]
`RINDEX (haystack, needle)` [Function]
Returns a positive integer indicating the position of the first (for `INDEX`) or last (for `RINDEX`) occurrence of *needle* in *haystack*. Returns 0 if *haystack* does not contain *needle*. Returns 1 if *needle* is the empty string.

`INDEX (haystack, needles, needle_len)` [Function]
`RINDEX (haystack, needle, needle_len)` [Function]
Divides *needles* into multiple needles, each with length *needle_len*, which must be a positive integer that evenly divides the length of *needles*. Searches *haystack* for the occurrences of each needle and returns a positive integer indicating the byte index of the beginning of the first (for `INDEX`) or last (for `RINDEX`) needle it finds. Returns 0 if *haystack* does not contain any of the needles, or if *needles* is the empty string.

`LENGTH (string)` [Function]
Returns the number of bytes in *string*.

`LOWER (string)` [Function]

Returns a string identical to *string* except that all uppercase letters are changed to lowercase letters. The definitions of "uppercase" and "lowercase" are system-dependent.

`LPAD (string, length[, padding])` [Function]
`RPAD (string, length[, padding])` [Function]

If *string* is at least *length* bytes long, these functions return *string* unchanged. Otherwise, they return *string* padded with *padding* on the left side (for `LPAD`) or right side (for `RPAD`) to *length* bytes. These functions report an error and return *string* unchanged if *length* is missing or bigger than 32767.

The *padding* argument must not be an empty string and defaults to a space if not specified. If its length does not evenly fit the amount of space needed for padding, the returned string will be shorter than *length*.

`LTRIM (string[, padding])` [Function]
`RTRIM (string[, padding])` [Function]

These functions return *string*, after removing leading (for `LTRIM`) or trailing (for `RTRIM`) copies of *padding*. If *padding* is omitted, these functions remove spaces (but not tabs or other white space). These functions return *string* unchanged if *padding* is the empty string.

`NUMBER (string, format)` [Function]

Returns the number produced when *string* is interpreted according to format specifier *format*. If the format width *w* is less than the length of *string*, then only the first *w* bytes in *string* are used, *e.g.* `NUMBER("123", F3.0)` and `NUMBER("1234", F3.0)` both have value 123. If *w* is greater than *string*'s length, then it is treated as if it were right-padded with spaces. If *string* is not in the correct format for *format*, system-missing is returned.

`REPLACE (haystack, needle, replacement[, n])` [Function]

Returns string *haystack* with instances of *needle* replaced by *replacement*. If nonnegative integer *n* is specified, it limits the maximum number of replacements; otherwise, all instances of *needle* are replaced.

`STRING (number, format)` [Function]

Returns a string corresponding to *number* in the format given by format specifier *format*. For example, `STRING(123.56, F5.1)` has the value `"123.6"`.

`STRUNC (string, n)` [Function]

Returns *string*, first trimming it to at most *n* bytes, then removing trailing spaces (but not tabs or other white space). Returns an empty string if *n* is zero or negative, or *string* unchanged if *n* is missing.

`SUBSTR (string, start)` [Function]

Returns a string consisting of the value of *string* from position *start* onward. Returns an empty string if *start* is system-missing, less than 1, or greater than the length of *string*.

`SUBSTR (string, start, count)` [Function]

Returns a string consisting of the first *count* bytes from *string* beginning at position *start*. Returns an empty string if *start* or *count* is system-missing, if *start* is less than 1 or greater than the number of bytes in *string*, or if *count* is less than 1. Returns a string shorter than *count* bytes if *start* + *count* - 1 is greater than the number of bytes in *string*. Examples: `SUBSTR("abcdefg", 3, 2)` has value `"cd"`; `SUBSTR("nonsense", 4, 10)` has the value `"sense"`.

`UPCASE (string)` [Function]

Returns *string*, changing lowercase letters to uppercase letters.

7.7.8 Time & Date Functions

For compatibility, PSPP considers dates before 15 Oct 1582 invalid. Most time and date functions will not accept earlier dates.

7.7.8.1 How times & dates are defined and represented

Times and dates are handled by PSPP as single numbers. A *time* is an interval. PSPP measures times in seconds. Thus, the following intervals correspond with the numeric values given:

10 minutes	600
1 hour	3,600
1 day, 3 hours, 10 seconds	97,210
40 days	3,456,000

A *date*, on the other hand, is a particular instant in the past or the future. PSPP represents a date as a number of seconds since midnight preceding 14 Oct 1582. Because midnight preceding the dates given below correspond with the numeric PSPP dates given:

15 Oct 1582	86,400
4 Jul 1776	6,113,318,400
1 Jan 1900	10,010,390,400
1 Oct 1978	12,495,427,200
24 Aug 1995	13,028,601,600

7.7.8.2 Functions that Produce Times

These functions take numeric arguments and return numeric values that represent times.

`TIME.DAYS (ndays)` [Function]

Returns a time corresponding to *ndays* days.

`TIME.HMS (nhours, nmins, nsecs)` [Function]

Returns a time corresponding to *nhours* hours, *nmins* minutes, and *nsecs* seconds. The arguments may not have mixed signs: if any of them are positive, then none may be negative, and vice versa.

7.7.8.3 Functions that Examine Times

These functions take numeric arguments in PSPP time format and give numeric results.

`CTIME.DAYS (time)` [Function]

Results in the number of days and fractional days in *time*.

`CTIME.HOURS (time)` [Function]

Results in the number of hours and fractional hours in *time*.

`CTIME.MINUTES (time)` [Function]

Results in the number of minutes and fractional minutes in *time*.

`CTIME.SECONDS (time)` [Function]

Results in the number of seconds and fractional seconds in *time*. (`CTIME.SECONDS` does nothing; `CTIME.SECONDS(x)` is equivalent to `x`.)

7.7.8.4 Functions that Produce Dates

These functions take numeric arguments and give numeric results that represent dates. Arguments taken by these functions are:

day Refers to a day of the month between 1 and 31. Day 0 is also accepted and refers to the final day of the previous month. Days 29, 30, and 31 are accepted even in months that have fewer days and refer to a day near the beginning of the following month.

month Refers to a month of the year between 1 and 12. Months 0 and 13 are also accepted and refer to the last month of the preceding year and the first month of the following year, respectively.

quarter Refers to a quarter of the year between 1 and 4. The quarters of the year begin on the first day of months 1, 4, 7, and 10.

week Refers to a week of the year between 1 and 53.

yday Refers to a day of the year between 1 and 366.

year Refers to a year, 1582 or greater. Years between 0 and 99 are treated according to the epoch set on SET EPOCH, by default beginning 69 years before the current date (see [SET EPOCH], page 267).

If these functions' arguments are out-of-range, they are correctly normalized before conversion to date format. Non-integers are rounded toward zero.

`DATE.DMY (day, month, year)` [Function]
`DATE.MDY (month, day, year)` [Function]

Results in a date value corresponding to the midnight before day *day* of month *month* of year *year*.

`DATE.MOYR (month, year)` [Function]

Results in a date value corresponding to the midnight before the first day of month *month* of year *year*.

`DATE.QYR (quarter, year)` [Function]

Results in a date value corresponding to the midnight before the first day of quarter *quarter* of year *year*.

`DATE.WKYR (week, year)` [Function]

Results in a date value corresponding to the midnight before the first day of week *week* of year *year*.

`DATE.YRDAY (year, yday)` [Function]

Results in a date value corresponding to the day *yday* of year *year*.

7.7.8.5 Functions that Examine Dates

These functions take numeric arguments in PSPP date or time format and give numeric results. These names are used for arguments:

date A numeric value in PSPP date format.

time A numeric value in PSPP time format.

time-or-date
A numeric value in PSPP time or date format.

`XDATE.DATE (time-or-date)` [Function]

For a time, results in the time corresponding to the number of whole days *date-or-time* includes. For a date, results in the date corresponding to the latest midnight at or before *date-or-time*; that is, gives the date that *date-or-time* is in.

`XDATE.HOUR (time-or-date)` [Function]

For a time, results in the number of whole hours beyond the number of whole days represented by *date-or-time*. For a date, results in the hour (as an integer between 0 and 23) corresponding to *date-or-time*.

`XDATE.JDAY (date)` [Function]

Results in the day of the year (as an integer between 1 and 366) corresponding to *date*.

`XDATE.MDAY (date)` [Function]

Results in the day of the month (as an integer between 1 and 31) corresponding to *date*.

`XDATE.MINUTE (time-or-date)` [Function]

Results in the number of minutes (as an integer between 0 and 59) after the last hour in *time-or-date*.

`XDATE.MONTH (date)` [Function]

Results in the month of the year (as an integer between 1 and 12) corresponding to *date*.

`XDATE.QUARTER (date)` [Function]

Results in the quarter of the year (as an integer between 1 and 4) corresponding to *date*.

`XDATE.SECOND (time-or-date)` [Function]

Results in the number of whole seconds after the last whole minute (as an integer between 0 and 59) in *time-or-date*.

`XDATE.TDAY (date)` [Function]

Results in the number of whole days from 14 Oct 1582 to *date*.

`XDATE.TIME (date)` [Function]

Results in the time of day at the instant corresponding to *date*, as a time value. This is the number of seconds since midnight on the day corresponding to *date*.

`XDATE.WEEK (date)` [Function]

Results in the week of the year (as an integer between 1 and 53) corresponding to *date*.

`XDATE.WKDAY (date)` [Function]

Results in the day of week (as an integer between 1 and 7) corresponding to *date*, where 1 represents Sunday.

`XDATE.YEAR (date)` [Function]

Returns the year (as an integer 1582 or greater) corresponding to *date*.

7.7.8.6 Time and Date Arithmetic

Ordinary arithmetic operations on dates and times often produce sensible results. Adding a time to, or subtracting one from, a date produces a new date that much earlier or later. The difference of two dates yields the time between those dates. Adding two times produces the combined time. Multiplying a time by a scalar produces a time that many times longer. Since times and dates are just numbers, the ordinary addition and subtraction operators are employed for these purposes.

Adding two dates does not produce a useful result.

Dates and times may have very large values. Thus, it is not a good idea to take powers of these values; also, the accuracy of some procedures may be affected. If necessary, convert times or dates in seconds to some other unit, like days or years, before performing analysis.

PSPP supplies a few functions for date arithmetic:

`DATEDIFF (date2, date1, unit)` [Function]

Returns the span of time from *date1* to *date2* in terms of *unit*, which must be a quoted string, one of '`years`', '`quarters`', '`months`', '`weeks`', '`days`', '`hours`', '`minutes`', and '`seconds`'. The result is an integer, truncated toward zero.

One year is considered to span from a given date to the same month, day, and time of day the next year. Thus, from Jan. 1 of one year to Jan. 1 the next year is considered to be a full year, but Feb. 29 of a leap year to the following Feb. 28 is not. Similarly, one month spans from a given day of the month to the same day of the following month. Thus, there is never a full month from Jan. 31 of a given year to any day in the following February.

`DATESUM (date, quantity, unit[, method])` [Function]

Returns *date* advanced by the given *quantity* of the specified *unit*, which must be one of the strings '`years`', '`quarters`', '`months`', '`weeks`', '`days`', '`hours`', '`minutes`', and '`seconds`'.

When *unit* is '`years`', '`quarters`', or '`months`', only the integer part of *quantity* is considered. Adding one of these units can cause the day of the month to exceed the number of days in the month. In this case, the *method* comes into play: if it is omitted or specified as '`closest`' (as a quoted string), then the resulting day is the

last day of the month; otherwise, if it is specified as '`rollover`', then the extra days roll over into the following month.

When *unit* is '`weeks`', '`days`', '`hours`', '`minutes`', or '`seconds`', the *quantity* is not rounded to an integer and *method*, if specified, is ignored.

7.7.9 Miscellaneous Functions

`LAG (variable[, n])` [Function]

variable must be a numeric or string variable name. `LAG` yields the value of that variable for the case *n* before the current one. Results in system-missing (for numeric variables) or blanks (for string variables) for the first *n* cases.

`LAG` obtains values from the cases that become the new active dataset after a procedure executes. Thus, `LAG` will not return values from cases dropped by transformations such as `SELECT IF`, and transformations like `COMPUTE` that modify data will change the values returned by `LAG`. These are both the case whether these transformations precede or follow the use of `LAG`.

If `LAG` is used before `TEMPORARY`, then the values it returns are those in cases just before `TEMPORARY`. `LAG` may not be used after `TEMPORARY`.

If omitted, *ncases* defaults to 1. Otherwise, *ncases* must be a small positive constant integer. There is no explicit limit, but use of a large value will increase memory consumption.

`YRMODA (year, month, day)` [Function]

year is a year, either between 0 and 99 or at least 1582. Unlike other PSPP date functions, years between 0 and 99 always correspond to 1900 through 1999. *month* is a month between 1 and 13. *day* is a day between 0 and 31. A *day* of 0 refers to the last day of the previous month, and a *month* of 13 refers to the first month of the next year. *year* must be in range. *year*, *month*, and *day* must all be integers.

`YRMODA` results in the number of days between 15 Oct 1582 and the date specified, plus one. The date passed to `YRMODA` must be on or after 15 Oct 1582. 15 Oct 1582 has a value of 1.

`VALUELABEL (variable)` [Function]

Returns a string matching the label associated with the current value of *variable*. If the current value of *variable* has no associated label, then this function returns the empty string. *variable* may be a numeric or string variable.

7.7.10 Statistical Distribution Functions

PSPP can calculate several functions of standard statistical distributions. These functions are named systematically based on the function and the distribution. The table below describes the statistical distribution functions in general:

PDF.*dist* (*x*[, *param*. . .])

Probability density function for *dist*. The domain of *x* depends on *dist*. For continuous distributions, the result is the density of the probability function at *x*, and the range is nonnegative real numbers. For discrete distributions, the result is the probability of *x*.

CDF.*dist* (*x*[, *param*. . .])
: Cumulative distribution function for *dist*, that is, the probability that a random variate drawn from the distribution is less than *x*. The domain of *x* depends *dist*. The result is a probability.

SIG.*dist* (*x*[, *param*. . .)
: Tail probability function for *dist*, that is, the probability that a random variate drawn from the distribution is greater than *x*. The domain of *x* depends *dist*. The result is a probability. Only a few distributions include an `SIG` function.

IDF.*dist* (*p*[, *param*. . .])
: Inverse distribution function for *dist*, the value of *x* for which the CDF would yield *p*. The value of *p* is a probability. The range depends on *dist* and is identical to the domain for the corresponding CDF.

RV.*dist* ([*param*. . .])
: Random variate function for *dist*. The range depends on the distribution.

NPDF.*dist* (*x*[, *param*. . .])
: Noncentral probability density function. The result is the density of the given noncentral distribution at *x*. The domain of *x* depends on *dist*. The range is nonnegative real numbers. Only a few distributions include an `NPDF` function.

NCDF.*dist* (*x*[, *param*. . .])
: Noncentral cumulative distribution function for *dist*, that is, the probability that a random variate drawn from the given noncentral distribution is less than *x*. The domain of *x* depends *dist*. The result is a probability. Only a few distributions include an NCDF function.

The individual distributions are described individually below.

7.7.10.1 Continuous Distributions

The following continuous distributions are available:

`PDF.BETA` (*x*) [Function]
`CDF.BETA` (*x*, *a*, *b*) [Function]
`IDF.BETA` (*p*, *a*, *b*) [Function]
`RV.BETA` (*a*, *b*) [Function]
`NPDF.BETA` (*x*, *a*, *b*, *lambda*) [Function]
`NCDF.BETA` (*x*, *a*, *b*, *lambda*) [Function]

Beta distribution with shape parameters *a* and *b*. The noncentral distribution takes an additional parameter *lambda*. Constraints: *a* > 0, *b* > 0, *lambda* >= 0, 0 <= *x* <= 1, 0 <= *p* <= 1.

`PDF.BVNOR` (*x0*, *x1*, *rho*) [Function]
`CDF.BVNOR` (*x0*, *x1*, *rho*) [Function]

Bivariate normal distribution of two standard normal variables with correlation coefficient *rho*. Two variates *x0* and *x1* must be provided. Constraints: 0 <= *rho* <= 1, 0 <= *p* <= 1.

`PDF.CAUCHY (x, a, b)` [Function]
`CDF.CAUCHY (x, a, b)` [Function]
`IDF.CAUCHY (p, a, b)` [Function]
`RV.CAUCHY (a, b)` [Function]

Cauchy distribution with location parameter *a* and scale parameter *b*. Constraints: *b* > 0, 0 < *p* < 1.

`CDF.CHISQ (x, df)` [Function]
`SIG.CHISQ (x, df)` [Function]
`IDF.CHISQ (p, df)` [Function]
`RV.CHISQ (df)` [Function]
`NCDF.CHISQ (x, df, lambda)` [Function]

Chi-squared distribution with *df* degrees of freedom. The noncentral distribution takes an additional parameter *lambda*. Constraints: *df* > 0, *lambda* > 0, *x* >= 0, 0 <= *p* < 1.

`PDF.EXP (x, a)` [Function]
`CDF.EXP (x, a)` [Function]
`IDF.EXP (p, a)` [Function]
`RV.EXP (a)` [Function]

Exponential distribution with scale parameter *a*. The inverse of *a* represents the rate of decay. Constraints: *a* > 0, *x* >= 0, 0 <= *p* < 1.

`PDF.XPOWER (x, a, b)` [Function]
`RV.XPOWER (a, b)` [Function]

Exponential power distribution with positive scale parameter *a* and nonnegative power parameter *b*. Constraints: *a* > 0, *b* >= 0, *x* >= 0, 0 <= *p* <= 1. This distribution is a PSPP extension.

`PDF.F (x, df1, df2)` [Function]
`CDF.F (x, df1, df2)` [Function]
`SIG.F (x, df1, df2)` [Function]
`IDF.F (p, df1, df2)` [Function]
`RV.F (df1, df2)` [Function]

F-distribution of two chi-squared deviates with *df1* and *df2* degrees of freedom. The noncentral distribution takes an additional parameter *lambda*. Constraints: *df1* > 0, *df2* > 0, *lambda* >= 0, *x* >= 0, 0 <= *p* < 1.

`PDF.GAMMA (x, a, b)` [Function]
`CDF.GAMMA (x, a, b)` [Function]
`IDF.GAMMA (p, a, b)` [Function]
`RV.GAMMA (a, b)` [Function]

Gamma distribution with shape parameter *a* and scale parameter *b*. Constraints: *a* > 0, *b* > 0, *x* >= 0, 0 <= *p* < 1.

`PDF.LANDAU (x)` [Function]
`RV.LANDAU ()` [Function]

Landau distribution.

`PDF.LAPLACE (x, a, b)` [Function]
`CDF.LAPLACE (x, a, b)` [Function]
`IDF.LAPLACE (p, a, b)` [Function]
`RV.LAPLACE (a, b)` [Function]

Laplace distribution with location parameter a and scale parameter b. Constraints: $b > 0$, $0 < p < 1$.

`RV.LEVY (c, alpha)` [Function]

Levy symmetric alpha-stable distribution with scale c and exponent *alpha*. Constraints: $0 <$ *alpha* $<= 2$.

`RV.LVSKEW (c, alpha, beta)` [Function]

Levy skew alpha-stable distribution with scale c, exponent *alpha*, and skewness parameter *beta*. Constraints: $0 <$ *alpha* $<= 2$, $-1 <=$ *beta* $<= 1$.

`PDF.LOGISTIC (x, a, b)` [Function]
`CDF.LOGISTIC (x, a, b)` [Function]
`IDF.LOGISTIC (p, a, b)` [Function]
`RV.LOGISTIC (a, b)` [Function]

Logistic distribution with location parameter a and scale parameter b. Constraints: $b > 0$, $0 < p < 1$.

`PDF.LNORMAL (x, a, b)` [Function]
`CDF.LNORMAL (x, a, b)` [Function]
`IDF.LNORMAL (p, a, b)` [Function]
`RV.LNORMAL (a, b)` [Function]

Lognormal distribution with parameters a and b. Constraints: $a > 0$, $b > 0$, $x >= 0$, $0 <= p < 1$.

`PDF.NORMAL (x, mu, sigma)` [Function]
`CDF.NORMAL (x, mu, sigma)` [Function]
`IDF.NORMAL (p, mu, sigma)` [Function]
`RV.NORMAL (mu, sigma)` [Function]

Normal distribution with mean *mu* and standard deviation *sigma*. Constraints: $b > 0$, $0 < p < 1$. Three additional functions are available as shorthand:

`CDFNORM (x)` [Function]

Equivalent to CDF.NORMAL(x, 0, 1).

`PROBIT (p)` [Function]

Equivalent to IDF.NORMAL(p, 0, 1).

`NORMAL (sigma)` [Function]

Equivalent to RV.NORMAL(0, *sigma*).

`PDF.NTAIL (x, a, sigma)` [Function]
`RV.NTAIL (a, sigma)` [Function]

Normal tail distribution with lower limit a and standard deviation *sigma*. This distribution is a PSPP extension. Constraints: $a > 0$, $x > a$, $0 < p < 1$.

`PDF.PARETO (x, a, b)` [Function]
`CDF.PARETO (x, a, b)` [Function]
`IDF.PARETO (p, a, b)` [Function]
`RV.PARETO (a, b)` [Function]

Pareto distribution with threshold parameter a and shape parameter b. Constraints: $a > 0$, $b > 0$, $x >= a$, $0 <= p < 1$.

`PDF.RAYLEIGH (x, sigma)` [Function]
`CDF.RAYLEIGH (x, sigma)` [Function]
`IDF.RAYLEIGH (p, sigma)` [Function]
`RV.RAYLEIGH (sigma)` [Function]

Rayleigh distribution with scale parameter *sigma*. This distribution is a PSPP extension. Constraints: *sigma* > 0, $x > 0$.

`PDF.RTAIL (x, a, sigma)` [Function]
`RV.RTAIL (a, sigma)` [Function]

Rayleigh tail distribution with lower limit a and scale parameter *sigma*. This distribution is a PSPP extension. Constraints: $a > 0$, *sigma* > 0, $x > a$.

`PDF.T (x, df)` [Function]
`CDF.T (x, df)` [Function]
`IDF.T (p, df)` [Function]
`RV.T (df)` [Function]

T-distribution with *df* degrees of freedom. The noncentral distribution takes an additional parameter *lambda*. Constraints: *df* > 0, $0 < p < 1$.

`PDF.T1G (x, a, b)` [Function]
`CDF.T1G (x, a, b)` [Function]
`IDF.T1G (p, a, b)` [Function]

Type-1 Gumbel distribution with parameters a and b. This distribution is a PSPP extension. Constraints: $0 < p < 1$.

`PDF.T2G (x, a, b)` [Function]
`CDF.T2G (x, a, b)` [Function]
`IDF.T2G (p, a, b)` [Function]

Type-2 Gumbel distribution with parameters a and b. This distribution is a PSPP extension. Constraints: $x > 0$, $0 < p < 1$.

`PDF.UNIFORM (x, a, b)` [Function]
`CDF.UNIFORM (x, a, b)` [Function]
`IDF.UNIFORM (p, a, b)` [Function]
`RV.UNIFORM (a, b)` [Function]

Uniform distribution with parameters a and b. Constraints: $a <= x <= b$, $0 <= p <= 1$. An additional function is available as shorthand:

`UNIFORM (b)` [Function]

Equivalent to RV.UNIFORM(0, b).

`PDF.WEIBULL (x, a, b)` [Function]
`CDF.WEIBULL (x, a, b)` [Function]

`IDF.WEIBULL (p, a, b)` [Function]
`RV.WEIBULL (a, b)` [Function]

Weibull distribution with parameters a and b. Constraints: $a > 0$, $b > 0$, $x >= 0$, $0 <= p < 1$.

7.7.10.2 Discrete Distributions

The following discrete distributions are available:

`PDF.BERNOULLI (x)` [Function]
`CDF.BERNOULLI (x, p)` [Function]
`RV.BERNOULLI (p)` [Function]

Bernoulli distribution with probability of success p. Constraints: $x = 0$ or 1, $0 <= p <= 1$.

`PDF.BINOM (x, n, p)` [Function]
`CDF.BINOM (x, n, p)` [Function]
`RV.BINOM (n, p)` [Function]

Binomial distribution with n trials and probability of success p. Constraints: integer $n > 0$, $0 <= p <= 1$, integer $x <= n$.

`PDF.GEOM (x, n, p)` [Function]
`CDF.GEOM (x, n, p)` [Function]
`RV.GEOM (n, p)` [Function]

Geometric distribution with probability of success p. Constraints: $0 <= p <= 1$, integer $x > 0$.

`PDF.HYPER (x, a, b, c)` [Function]
`CDF.HYPER (x, a, b, c)` [Function]
`RV.HYPER (a, b, c)` [Function]

Hypergeometric distribution when b objects out of a are drawn and c of the available objects are distinctive. Constraints: integer $a > 0$, integer $b <= a$, integer $c <= a$, integer $x >= 0$.

`PDF.LOG (x, p)` [Function]
`RV.LOG (p)` [Function]

Logarithmic distribution with probability parameter p. Constraints: $0 <= p < 1$, $x >= 1$.

`PDF.NEGBIN (x, n, p)` [Function]
`CDF.NEGBIN (x, n, p)` [Function]
`RV.NEGBIN (n, p)` [Function]

Negative binomial distribution with number of successes parameter n and probability of success parameter p. Constraints: integer $n >= 0$, $0 < p <= 1$, integer $x >= 1$.

`PDF.POISSON (x, mu)` [Function]
`CDF.POISSON (x, mu)` [Function]
`RV.POISSON (mu)` [Function]

Poisson distribution with mean mu. Constraints: $mu > 0$, integer $x >= 0$.

7.8 Operator Precedence

The following table describes operator precedence. Smaller-numbered levels in the table have higher precedence. Within a level, operations are always performed from left to right. The first occurrence of '`-`' represents unary negation, the second binary subtraction.

1. `()`
2. `**`
3. `-`
4. `* /`
5. `+ -`
6. `= >= > <= < <>`
7. `NOT`
8. `AND`
9. `OR`

8 Data Input and Output

Data are the focus of the PSPP language. Each datum belongs to a *case* (also called an *observation*). Each case represents an individual or "experimental unit". For example, in the results of a survey, the names of the respondents, their sex, age, etc. and their responses are all data and the data pertaining to single respondent is a case. This chapter examines the PSPP commands for defining variables and reading and writing data. There are alternative commands to read data from predefined sources such as system files or databases (See Section 9.3 [GET], page 79.)

> **Note:** These commands tell PSPP how to read data, but the data will not actually be read until a procedure is executed.

8.1 BEGIN DATA

BEGIN DATA.
. . .
END DATA.

`BEGIN DATA` and `END DATA` can be used to embed raw ASCII data in a PSPP syntax file. `DATA LIST` or another input procedure must be used before `BEGIN DATA` (see Section 8.5 [DATA LIST], page 64). `BEGIN DATA` and `END DATA` must be used together. `END DATA` must appear by itself on a single line, with no leading white space and exactly one space between the words `END` and `DATA`, like this:

```
END DATA.
```

8.2 CLOSE FILE HANDLE

CLOSE FILE HANDLE *handle_name*.

`CLOSE FILE HANDLE` disassociates the name of a file handle with a given file. The only specification is the name of the handle to close. Afterward `FILE HANDLE`.

The file named INLINE, which represents data entered between `BEGIN DATA` and `END DATA`, cannot be closed. Attempts to close it with `CLOSE FILE HANDLE` have no effect.

`CLOSE FILE HANDLE` is a PSPP extension.

8.3 DATAFILE ATTRIBUTE

DATAFILE ATTRIBUTE
  ATTRIBUTE=*name*('*value*') [*name*('*value*')]. . .
  ATTRIBUTE=*name*[*index*]('*value*') [*name*[*index*]('*value*')]. . .
  DELETE=*name* [*name*]. . .
  DELETE=*name*[*index*] [*name*[*index*]]. . .

`DATAFILE ATTRIBUTE` adds, modifies, or removes user-defined attributes associated with the active dataset. Custom data file attributes are not interpreted by PSPP, but they are saved as part of system files and may be used by other software that reads them.

Use the `ATTRIBUTE` subcommand to add or modify a custom data file attribute. Specify the name of the attribute as an identifier (see Section 6.1 [Tokens], page 25), followed by the desired value, in parentheses, as a quoted string. Attribute names that begin with `$`

are reserved for PSPP's internal use, and attribute names that begin with `@` or `$@` are not displayed by most PSPP commands that display other attributes. Other attribute names are not treated specially.

Attributes may also be organized into arrays. To assign to an array element, add an integer array index enclosed in square brackets (`[` and `]`) between the attribute name and value. Array indexes start at 1, not 0. An attribute array that has a single element (number 1) is not distinguished from a non-array attribute.

Use the `DELETE` subcommand to delete an attribute. Specify an attribute name by itself to delete an entire attribute, including all array elements for attribute arrays. Specify an attribute name followed by an array index in square brackets to delete a single element of an attribute array. In the latter case, all the array elements numbered higher than the deleted element are shifted down, filling the vacated position.

To associate custom attributes with particular variables, instead of with the entire active dataset, use `VARIABLE ATTRIBUTE` (see Section 11.14 [VARIABLE ATTRIBUTE], page 102) instead.

`DATAFILE ATTRIBUTE` takes effect immediately. It is not affected by conditional and looping structures such as `DO IF` or `LOOP`.

8.4 DATASET commands

DATASET NAME *name* [WINDOW={ASIS,FRONT}].
DATASET ACTIVATE *name* [WINDOW={ASIS,FRONT}].
DATASET COPY *name* [WINDOW={MINIMIZED,HIDDEN,FRONT}].
DATASET DECLARE *name* [WINDOW={MINIMIZED,HIDDEN,FRONT}].
DATASET CLOSE {*name*,*,ALL}.
DATASET DISPLAY.

The `DATASET` commands simplify use of multiple datasets within a PSPP session. They allow datasets to be created and destroyed. At any given time, most PSPP commands work with a single dataset, called the active dataset.

The DATASET NAME command gives the active dataset the specified name, or if it already had a name, it renames it. If another dataset already had the given name, that dataset is deleted.

The DATASET ACTIVATE command selects the named dataset, which must already exist, as the active dataset. Before switching the active dataset, any pending transformations are executed, as if `EXECUTE` had been specified. If the active dataset is unnamed before switching, then it is deleted and becomes unavailable after switching.

The DATASET COPY command creates a new dataset with the specified name, whose contents are a copy of the active dataset. Any pending transformations are executed, as if `EXECUTE` had been specified, before making the copy. If a dataset with the given name already exists, it is replaced. If the name is the name of the active dataset, then the active dataset becomes unnamed.

The DATASET DECLARE command creates a new dataset that is initially "empty," that is, it has no dictionary or data. If a dataset with the given name already exists, this has no effect. The new dataset can be used with commands that support output to a dataset, *e.g.* AGGREGATE (see Section 12.1 [AGGREGATE], page 107).

The DATASET CLOSE command deletes a dataset. If the active dataset is specified by name, or if '*' is specified, then the active dataset becomes unnamed. If a different dataset is specified by name, then it is deleted and becomes unavailable. Specifying ALL deletes all datasets except for the active dataset, which becomes unnamed.

The DATASET DISPLAY command lists all the currently defined datasets.

Many DATASET commands accept an optional `WINDOW` subcommand. In the PSPPIRE GUI, the value given for this subcommand influences how the dataset's window is displayed. Outside the GUI, the `WINDOW` subcommand has no effect. The valid values are:

ASIS
: Do not change how the window is displayed. This is the default for DATASET NAME and DATASET ACTIVATE.

FRONT
: Raise the dataset's window to the top. Make it the default dataset for running syntax.

MINIMIZED
: Display the window "minimized" to an icon. Prefer other datasets for running syntax. This is the default for DATASET COPY and DATASET DECLARE.

HIDDEN
: Hide the dataset's window. Prefer other datasets for running syntax.

8.5 DATA LIST

Used to read text or binary data, `DATA LIST` is the most fundamental data-reading command. Even the more sophisticated input methods use `DATA LIST` commands as a building block. Understanding `DATA LIST` is important to understanding how to use PSPP to read your data files.

There are two major variants of `DATA LIST`, which are fixed format and free format. In addition, free format has a minor variant, list format, which is discussed in terms of its differences from vanilla free format.

Each form of `DATA LIST` is described in detail below.

See Section 9.4 [GET DATA], page 80, for a command that offers a few enhancements over DATA LIST and that may be substituted for DATA LIST in many situations.

8.5.1 DATA LIST FIXED

DATA LIST [FIXED]
{TABLE,NOTABLE}
[FILE='*file_name*' [ENCODING='*encoding*']]
[RECORDS=*record_count*]
[END=*end_var*]
[SKIP=*record_count*]
/[line_no] *var_spec*...

where each *var_spec* takes one of the forms
var_list start-end [*type_spec*]
var_list (*fortran_spec*)

`DATA LIST FIXED` is used to read data files that have values at fixed positions on each line of single-line or multiline records. The keyword FIXED is optional.

The `FILE` subcommand must be used if input is to be taken from an external file. It may be used to specify a file name as a string or a file handle (see Section 6.9 [File Handles], page 42). If the `FILE` subcommand is not used, then input is assumed to be specified within the command file using `BEGIN DATA...END DATA` (see Section 8.1 [BEGIN DATA], page 62). The `ENCODING` subcommand may only be used if the `FILE` subcommand is also used. It specifies the character encoding of the file. See Section 17.16 [INSERT], page 263, for information on supported encodings.

The optional `RECORDS` subcommand, which takes a single integer as an argument, is used to specify the number of lines per record. If `RECORDS` is not specified, then the number of lines per record is calculated from the list of variable specifications later in `DATA LIST`.

The `END` subcommand is only useful in conjunction with `INPUT PROGRAM`. See Section 8.9 [INPUT PROGRAM], page 71, for details.

The optional `SKIP` subcommand specifies a number of records to skip at the beginning of an input file. It can be used to skip over a row that contains variable names, for example.

`DATA LIST` can optionally output a table describing how the data file is read. The `TABLE` subcommand enables this output, and `NOTABLE` disables it. The default is to output the table.

The list of variables to be read from the data list must come last. Each line in the data record is introduced by a slash ('`/`'). Optionally, a line number may follow the slash. Following, any number of variable specifications may be present.

Each variable specification consists of a list of variable names followed by a description of their location on the input line. Sets of variables may be specified using the `DATA LIST TO` convention (see Section 6.7.3 [Sets of Variables], page 32). There are two ways to specify the location of the variable on the line: columnar style and FORTRAN style.

In columnar style, the starting column and ending column for the field are specified after the variable name, separated by a dash ('`-`'). For instance, the third through fifth columns on a line would be specified '`3-5`'. By default, variables are considered to be in '`F`' format (see Section 6.7.4 [Input and Output Formats], page 32). (This default can be changed; see Section 17.20 [SET], page 265, for more information.)

In columnar style, to use a variable format other than the default, specify the format type in parentheses after the column numbers. For instance, for alphanumeric '`A`' format, use '`(A)`'.

In addition, implied decimal places can be specified in parentheses after the column numbers. As an example, suppose that a data file has a field in which the characters '`1234`' should be interpreted as having the value 12.34. Then this field has two implied decimal places, and the corresponding specification would be '`(2)`'. If a field that has implied decimal places contains a decimal point, then the implied decimal places are not applied.

Changing the variable format and adding implied decimal places can be done together; for instance, '`(N,5)`'.

When using columnar style, the input and output width of each variable is computed from the field width. The field width must be evenly divisible into the number of variables specified.

FORTRAN style is an altogether different approach to specifying field locations. With this approach, a list of variable input format specifications, separated by commas, are

placed after the variable names inside parentheses. Each format specifier advances as many characters into the input line as it uses.

Implied decimal places also exist in FORTRAN style. A format specification with *d* decimal places also has *d* implied decimal places.

In addition to the standard format specifiers (see Section 6.7.4 [Input and Output Formats], page 32), FORTRAN style defines some extensions:

`X` Advance the current column on this line by one character position.

`T`*x* Set the current column on this line to column *x*, with column numbers considered to begin with 1 at the left margin.

`NEWREC`*x* Skip forward *x* lines in the current record, resetting the active column to the left margin.

Repeat count
: Any format specifier may be preceded by a number. This causes the action of that format specifier to be repeated the specified number of times.

(*spec1*, . . . , *specN*)
: Group the given specifiers together. This is most useful when preceded by a repeat count. Groups may be nested arbitrarily.

FORTRAN and columnar styles may be freely intermixed. Columnar style leaves the active column immediately after the ending column specified. Record motion using `NEWREC` in FORTRAN style also applies to later FORTRAN and columnar specifiers.

Examples

1.

```
DATA LIST TABLE /NAME 1-10 (A) INFO1 TO INFO3 12-17 (1).

BEGIN DATA.
John Smith 102311
Bob Arnold 122015
Bill Yates  918 6
END DATA.
```

Defines the following variables:

- `NAME`, a 10-character-wide string variable, in columns 1 through 10.
- `INFO1`, a numeric variable, in columns 12 through 13.
- `INFO2`, a numeric variable, in columns 14 through 15.
- `INFO3`, a numeric variable, in columns 16 through 17.

The `BEGIN DATA`/`END DATA` commands cause three cases to be defined:

Case	NAME	INFO1	INFO2	INFO3
1	John Smith	10	23	11
2	Bob Arnold	12	20	15
3	Bill Yates	9	18	6

The `TABLE` keyword causes PSPP to print out a table describing the four variables defined.

2.

```
DATA LIST FILE="survey.dat"
        /ID 1-5 NAME 7-36 (A) SURNAME 38-67 (A) MINITIAL 69 (A)
        /Q01 TO Q50 7-56
        /.
```

Defines the following variables:

- `ID`, a numeric variable, in columns 1-5 of the first record.
- `NAME`, a 30-character string variable, in columns 7-36 of the first record.
- `SURNAME`, a 30-character string variable, in columns 38-67 of the first record.
- `MINITIAL`, a 1-character string variable, in column 69 of the first record.
- Fifty variables `Q01`, `Q02`, `Q03`, . . . , `Q49`, `Q50`, all numeric, `Q01` in column 7, `Q02` in column 8, . . . , `Q49` in column 55, `Q50` in column 56, all in the second record.

Cases are separated by a blank record.

Data is read from file `survey.dat` in the current directory.

8.5.2 DATA LIST FREE

DATA LIST FREE
  [({TAB,'*c*'}, . . .)]
  [{NOTABLE,TABLE}]
  [FILE='*file_name*' [ENCODING='*encoding*']]
  [SKIP=*n_records*]
  /*var_spec*. . .

where each *var_spec* takes one of the forms
  var_list [(*type_spec*)]
  var_list *

In free format, the input data is, by default, structured as a series of fields separated by spaces, tabs, or line breaks. If the current `DECIMAL` separator is `DOT` (see Section 17.20 [SET], page 265), then commas are also treated as field separators. Each field's content may be unquoted, or it may be quoted with a pairs of apostrophes (`'`) or double quotes (`"`). Unquoted white space separates fields but is not part of any field. Any mix of spaces, tabs, and line breaks is equivalent to a single space for the purpose of separating fields, but consecutive commas will skip a field.

Alternatively, delimiters can be specified explicitly, as a parenthesized, comma-separated list of single-character strings immediately following FREE. The word TAB may also be used to specify a tab character as a delimiter. When delimiters are specified explicitly, only the given characters, plus line breaks, separate fields. Furthermore, leading spaces at the beginnings of fields are not trimmed, consecutive delimiters define empty fields, and no form of quoting is allowed.

The `NOTABLE` and `TABLE` subcommands are as in `DATA LIST FIXED` above. `NOTABLE` is the default.

The `FILE`, `SKIP`, and `ENCODING` subcommands are as in `DATA LIST FIXED` above.

The variables to be parsed are given as a single list of variable names. This list must be introduced by a single slash (`/`). The set of variable names may contain format spec-

ifications in parentheses (see Section 6.7.4 [Input and Output Formats], page 32). Format specifications apply to all variables back to the previous parenthesized format specification.

In addition, an asterisk may be used to indicate that all variables preceding it are to have input/output format '`F8.0`'.

Specified field widths are ignored on input, although all normal limits on field width apply, but they are honored on output.

8.5.3 DATA LIST LIST

DATA LIST LIST
[({TAB,'*c*'}, . . .)]
[{NOTABLE,TABLE}]
[FILE='*file_name*' [ENCODING='*encoding*']]
[SKIP=*record_count*]
/*var_spec*. . .

where each *var_spec* takes one of the forms
var_list [(*type_spec*)]
var_list *

With one exception, `DATA LIST LIST` is syntactically and semantically equivalent to `DATA LIST FREE`. The exception is that each input line is expected to correspond to exactly one input record. If more or fewer fields are found on an input line than expected, an appropriate diagnostic is issued.

8.6 END CASE

END CASE.

`END CASE` is used only within `INPUT PROGRAM` to output the current case. See Section 8.9 [INPUT PROGRAM], page 71, for details.

8.7 END FILE

END FILE.

`END FILE` is used only within `INPUT PROGRAM` to terminate the current input program. See Section 8.9 [INPUT PROGRAM], page 71.

8.8 FILE HANDLE

For text files:
FILE HANDLE *handle_name*
/NAME='*file_name*
[/MODE=CHARACTER]
[/ENDS={CR,CRLF}]
/TABWIDTH=*tab_width*
[ENCODING='*encoding*']

For binary files in native encoding with fixed-length records:
FILE HANDLE *handle_name*

/NAME='*file_name*'
/MODE=IMAGE
[/LRECL=*rec_len*]
[ENCODING='*encoding*']

For binary files in native encoding with variable-length records:

FILE HANDLE *handle_name*
/NAME='*file_name*'
/MODE=BINARY
[/LRECL=*rec_len*]
[ENCODING='*encoding*']

For binary files encoded in EBCDIC:

FILE HANDLE *handle_name*
/NAME='*file_name*'
/MODE=360
/RECFORM={FIXED,VARIABLE,SPANNED}
[/LRECL=*rec_len*]
[ENCODING='*encoding*']

Use `FILE HANDLE` to associate a file handle name with a file and its attributes, so that later commands can refer to the file by its handle name. Names of text files can be specified directly on commands that access files, so that `FILE HANDLE` is only needed when a file is not an ordinary file containing lines of text. However, `FILE HANDLE` may be used even for text files, and it may be easier to specify a file's name once and later refer to it by an abstract handle.

Specify the file handle name as the identifier immediately following the `FILE HANDLE` command name. The identifier INLINE is reserved for representing data embedded in the syntax file (see Section 8.1 [BEGIN DATA], page 62) The file handle name must not already have been used in a previous invocation of `FILE HANDLE`, unless it has been closed by an intervening command (see Section 8.2 [CLOSE FILE HANDLE], page 62).

The effect and syntax of `FILE HANDLE` depends on the selected MODE:

- In CHARACTER mode, the default, the data file is read as a text file. Each text line is read as one record.

  In CHARACTER mode only, tabs are expanded to spaces by input programs, except by `DATA LIST FREE` with explicitly specified delimiters. Each tab is 4 characters wide by default, but TABWIDTH (a PSPP extension) may be used to specify an alternate width. Use a TABWIDTH of 0 to suppress tab expansion.

  A file written in CHARACTER mode by default uses the line ends of the system on which PSPP is running, that is, on Windows, the default is CR LF line ends, and on other systems the default is LF only. Specify ENDS as CR or CRLF to override the default. PSPP reads files using either convention on any kind of system, regardless of ENDS.

- In IMAGE mode, the data file is treated as a series of fixed-length binary records. LRECL should be used to specify the record length in bytes, with a default of 1024. On input, it is an error if an IMAGE file's length is not an integer multiple of the

record length. On output, each record is padded with spaces or truncated, if necessary, to make it exactly the correct length.

- In BINARY mode, the data file is treated as a series of variable-length binary records. LRECL may be specified, but its value is ignored. The data for each record is both preceded and followed by a 32-bit signed integer in little-endian byte order that specifies the length of the record. (This redundancy permits records in these files to be efficiently read in reverse order, although PSPP always reads them in forward order.) The length does not include either integer.
- Mode 360 reads and writes files in formats first used for tapes in the 1960s on IBM mainframe operating systems and still supported today by the modern successors of those operating systems. For more information, see *OS/400 Tape and Diskette Device Programming*, available on IBM's website.

  Alphanumeric data in mode 360 files are encoded in EBCDIC. PSPP translates EBCDIC to or from the host's native format as necessary on input or output, using an ASCII/EBCDIC translation that is one-to-one, so that a "round trip" from ASCII to EBCDIC back to ASCII, or vice versa, always yields exactly the original data.

  The `RECFORM` subcommand is required in mode 360. The precise file format depends on its setting:

  F
  FIXED
  : This record format is equivalent to IMAGE mode, except for EBCDIC translation.

    IBM documentation calls this `*F` (fixed-length, deblocked) format.

  V
  VARIABLE
  : The file comprises a sequence of zero or more variable-length blocks. Each block begins with a 4-byte *block descriptor word* (BDW). The first two bytes of the BDW are an unsigned integer in big-endian byte order that specifies the length of the block, including the BDW itself. The other two bytes of the BDW are ignored on input and written as zeros on output.

    Following the BDW, the remainder of each block is a sequence of one or more variable-length records, each of which in turn begins with a 4-byte *record descriptor word* (RDW) that has the same format as the BDW. Following the RDW, the remainder of each record is the record data.

    The maximum length of a record in VARIABLE mode is 65,527 bytes: 65,535 bytes (the maximum value of a 16-bit unsigned integer), minus 4 bytes for the BDW, minus 4 bytes for the RDW.

    In mode VARIABLE, LRECL specifies a maximum, not a fixed, record length, in bytes. The default is 8,192.

    IBM documentation calls this `*VB` (variable-length, blocked, unspanned) format.

  VS
  SPANNED
  : The file format is like that of VARIABLE mode, except that logical records may be split among multiple physical records (called *segments*) or blocks.

In SPANNED mode, the third byte of each RDW is called the segment control character (SCC). Odd SCC values cause the segment to be appended to a record buffer maintained in memory; even values also append the segment and then flush its contents to the input procedure. Canonically, SCC value 0 designates a record not spanned among multiple segments, and values 1 through 3 designate the first segment, the last segment, or an intermediate segment, respectively, within a multi-segment record. The record buffer is also flushed at end of file regardless of the final record's SCC.

The maximum length of a logical record in VARIABLE mode is limited only by memory available to PSPP. Segments are limited to 65,527 bytes, as in VARIABLE mode.

This format is similar to what IBM documentation call `*VS` (variable-length, deblocked, spanned) format.

In mode 360, fields of type A that extend beyond the end of a record read from disk are padded with spaces in the host's native character set, which are then translated from EBCDIC to the native character set. Thus, when the host's native character set is based on ASCII, these fields are effectively padded with character `X'80'`. This wart is implemented for compatibility.

The `NAME` subcommand specifies the name of the file associated with the handle. It is required in all modes but SCRATCH mode, in which its use is forbidden.

The ENCODING subcommand specifies the encoding of text in the file. For reading text files in CHARACTER mode, all of the forms described for ENCODING on the INSERT command are supported (see Section 17.16 [INSERT], page 263). For reading in other file-based modes, encoding autodetection is not supported; if the specified encoding requests autodetection then the default encoding is used. This is also true when a file handle is used for writing a file in any mode.

8.9 INPUT PROGRAM

INPUT PROGRAM.
. . . input commands . . .
END INPUT PROGRAM.

`INPUT PROGRAM...END INPUT PROGRAM` specifies a complex input program. By placing data input commands within `INPUT PROGRAM`, PSPP programs can take advantage of more complex file structures than available with only `DATA LIST`.

The first sort of extended input program is to simply put multiple `DATA LIST` commands within the `INPUT PROGRAM`. This will cause all of the data files to be read in parallel. Input will stop when end of file is reached on any of the data files.

Transformations, such as conditional and looping constructs, can also be included within `INPUT PROGRAM`. These can be used to combine input from several data files in more complex ways. However, input will still stop when end of file is reached on any of the data files.

To prevent `INPUT PROGRAM` from terminating at the first end of file, use the `END` subcommand on `DATA LIST`. This subcommand takes a variable name, which should be a numeric scratch variable (see Section 6.7.5 [Scratch Variables], page 41). (It need not be a scratch

variable but otherwise the results can be surprising.) The value of this variable is set to 0 when reading the data file, or 1 when end of file is encountered.

Two additional commands are useful in conjunction with `INPUT PROGRAM`. `END CASE` is the first. Normally each loop through the `INPUT PROGRAM` structure produces one case. `END CASE` controls exactly when cases are output. When `END CASE` is used, looping from the end of `INPUT PROGRAM` to the beginning does not cause a case to be output.

`END FILE` is the second. When the `END` subcommand is used on `DATA LIST`, there is no way for the `INPUT PROGRAM` construct to stop looping, so an infinite loop results. `END FILE`, when executed, stops the flow of input data and passes out of the `INPUT PROGRAM` structure.

`INPUT PROGRAM` must contain at least one `DATA LIST` or `END FILE` command.

Example 1: Read two files in parallel to the end of the shorter

The following example reads variable X from file `a.txt` and variable Y from file `b.txt`. If one file is shorter than the other then the extra data in the longer file is ignored.

```
INPUT PROGRAM.
    DATA LIST NOTABLE FILE='a.txt'/X 1-10.
    DATA LIST NOTABLE FILE='b.txt'/Y 1-10.
END INPUT PROGRAM.
LIST.
```

Example 2: Read two files in parallel, supplementing the shorter

The following example also reads variable X from `a.txt` and variable Y from `b.txt`. If one file is shorter than the other then it continues reading the longer to its end, setting the other variable to system-missing.

```
INPUT PROGRAM.
    NUMERIC #A #B.

    DO IF NOT #A.
        DATA LIST NOTABLE END=#A FILE='a.txt'/X 1-10.
    END IF.
    DO IF NOT #B.
        DATA LIST NOTABLE END=#B FILE='b.txt'/Y 1-10.
    END IF.
    DO IF #A AND #B.
        END FILE.
    END IF.
    END CASE.
END INPUT PROGRAM.
LIST.
```

Example 3: Concatenate two files (version 1)

The following example reads data from file `a.txt`, then from `b.txt`, and concatenates them into a single active dataset.

```
INPUT PROGRAM.
    NUMERIC #A #B.
```

```
    DO IF #A.
        DATA LIST NOTABLE END=#B FILE='b.txt'/X 1-10.
        DO IF #B.
            END FILE.
        ELSE.
            END CASE.
        END IF.
    ELSE.
        DATA LIST NOTABLE END=#A FILE='a.txt'/X 1-10.
        DO IF NOT #A.
            END CASE.
        END IF.
    END IF.
END INPUT PROGRAM.
LIST.
```

Example 4: Concatenate two files (version 2)

This is another way to do the same thing as Example 3.

```
INPUT PROGRAM.
    NUMERIC #EOF.

    LOOP IF NOT #EOF.
        DATA LIST NOTABLE END=#EOF FILE='a.txt'/X 1-10.
        DO IF NOT #EOF.
            END CASE.
        END IF.
    END LOOP.

    COMPUTE #EOF = 0.
    LOOP IF NOT #EOF.
        DATA LIST NOTABLE END=#EOF FILE='b.txt'/X 1-10.
        DO IF NOT #EOF.
            END CASE.
        END IF.
    END LOOP.

    END FILE.
END INPUT PROGRAM.
LIST.
```

Example 5: Generate random variates

The follows example creates a dataset that consists of 50 random variates between 0 and 10.

```
INPUT PROGRAM.
    LOOP #I=1 TO 50.
```

```
        COMPUTE X=UNIFORM(10).
        END CASE.
    END LOOP.
    END FILE.
END INPUT PROGRAM.
LIST /FORMAT=NUMBERED.
```

8.10 LIST

LIST
  /VARIABLES=*var_list*
  /CASES=FROM *start_index* TO *end_index* BY *incr_index*
  /FORMAT={UNNUMBERED,NUMBERED} {WRAP,SINGLE}

The `LIST` procedure prints the values of specified variables to the listing file.

The `VARIABLES` subcommand specifies the variables whose values are to be printed. Keyword VARIABLES is optional. If `VARIABLES` subcommand is not specified then all variables in the active dataset are printed.

The `CASES` subcommand can be used to specify a subset of cases to be printed. Specify `FROM` and the case number of the first case to print, `TO` and the case number of the last case to print, and `BY` and the number of cases to advance between printing cases, or any subset of those settings. If `CASES` is not specified then all cases are printed.

The `FORMAT` subcommand can be used to change the output format. `NUMBERED` will print case numbers along with each case; `UNNUMBERED`, the default, causes the case numbers to be omitted. The `WRAP` and `SINGLE` settings are currently not used.

Case numbers start from 1. They are counted after all transformations have been considered.

`LIST` is a procedure. It causes the data to be read.

8.11 NEW FILE

NEW FILE.

`NEW FILE` command clears the dictionary and data from the current active dataset.

8.12 PRINT

PRINT
  [OUTFILE='*file_name*']
  [RECORDS=*n_lines*]
  [{NOTABLE,TABLE}]
  [ENCODING='*encoding*']
  [/[*line_no*] *arg*...]

arg takes one of the following forms:
  '*string*' [*start*]
  var_list start-end [*type_spec*]
  var_list (*fortran_spec*)

var_list *

The PRINT transformation writes variable data to the listing file or an output file. PRINT is executed when a procedure causes the data to be read. Follow PRINT by EXECUTE to print variable data without invoking a procedure (see Section 17.11 [EXECUTE], page 262).

All PRINT subcommands are optional. If no strings or variables are specified, PRINT outputs a single blank line.

The OUTFILE subcommand specifies the file to receive the output. The file may be a file name as a string or a file handle (see Section 6.9 [File Handles], page 42). If OUTFILE is not present then output is sent to PSPP's output listing file. When OUTFILE is present, the output is written to *file_name* in a plain text format, with a space inserted at beginning of each output line, even lines that otherwise would be blank.

The ENCODING subcommand may only be used if the OUTFILE subcommand is also used. It specifies the character encoding of the file. See Section 17.16 [INSERT], page 263, for information on supported encodings.

The RECORDS subcommand specifies the number of lines to be output. The number of lines may optionally be surrounded by parentheses.

TABLE will cause the PRINT command to output a table to the listing file that describes what it will print to the output file. NOTABLE, the default, suppresses this output table.

Introduce the strings and variables to be printed with a slash ('/'). Optionally, the slash may be followed by a number indicating which output line is specified. In the absence of this line number, the next line number is specified. Multiple lines may be specified using multiple slashes with the intended output for a line following its respective slash.

Literal strings may be printed. Specify the string itself. Optionally the string may be followed by a column number, specifying the column on the line where the string should start. Otherwise, the string is printed at the current position on the line.

Variables to be printed can be specified in the same ways as available for DATA LIST FIXED (see Section 8.5.1 [DATA LIST FIXED], page 64). In addition, a variable list may be followed by an asterisk ('*'), which indicates that the variables should be printed in their dictionary print formats, separated by spaces. A variable list followed by a slash or the end of command is interpreted in the same way.

If a FORTRAN type specification is used to move backwards on the current line, then text is written at that point on the line, the line is truncated to that length, although additional text being added will again extend the line to that length.

8.13 PRINT EJECT

PRINT EJECT
  OUTFILE='*file_name*'
  RECORDS=*n_lines*
  {NOTABLE,TABLE}
  /[*line_no*] *arg*...

arg takes one of the following forms:
  '*string*' [*start-end*]
  var_list start-end [*type_spec*]

var_list (*fortran_spec*)
var_list *

`PRINT EJECT` advances to the beginning of a new output page in the listing file or output file. It can also output data in the same way as `PRINT`.

All `PRINT EJECT` subcommands are optional.

Without `OUTFILE`, `PRINT EJECT` ejects the current page in the listing file, then it produces other output, if any is specified.

With `OUTFILE`, `PRINT EJECT` writes its output to the specified file. The first line of output is written with '`1`' inserted in the first column. Commonly, this is the only line of output. If additional lines of output are specified, these additional lines are written with a space inserted in the first column, as with `PRINT`.

See Section 8.12 [PRINT], page 74, for more information on syntax and usage.

8.14 PRINT SPACE

PRINT SPACE [OUTFILE='file_name'] [ENCODING='*encoding*'] [n_lines].

`PRINT SPACE` prints one or more blank lines to an output file.

The `OUTFILE` subcommand is optional. It may be used to direct output to a file specified by file name as a string or file handle (see Section 6.9 [File Handles], page 42). If OUTFILE is not specified then output is directed to the listing file.

The `ENCODING` subcommand may only be used if `OUTFILE` is also used. It specifies the character encoding of the file. See Section 17.16 [INSERT], page 263, for information on supported encodings.

n_lines is also optional. If present, it is an expression (see Chapter 7 [Expressions], page 44) specifying the number of blank lines to be printed. The expression must evaluate to a nonnegative value.

8.15 REREAD

REREAD [FILE=handle] [COLUMN=column] [ENCODING='*encoding*'].

The `REREAD` transformation allows the previous input line in a data file already processed by `DATA LIST` or another input command to be re-read for further processing.

The `FILE` subcommand, which is optional, is used to specify the file to have its line re-read. The file must be specified as the name of a file handle (see Section 6.9 [File Handles], page 42). If FILE is not specified then the last file specified on `DATA LIST` is assumed (last file specified lexically, not in terms of flow-of-control).

By default, the line re-read is re-read in its entirety. With the `COLUMN` subcommand, a prefix of the line can be exempted from re-reading. Specify an expression (see Chapter 7 [Expressions], page 44) evaluating to the first column that should be included in the re-read line. Columns are numbered from 1 at the left margin.

The `ENCODING` subcommand may only be used if the `FILE` subcommand is also used. It specifies the character encoding of the file. See Section 17.16 [INSERT], page 263, for information on supported encodings.

Issuing `REREAD` multiple times will not back up in the data file. Instead, it will re-read the same line multiple times.

8.16 WRITE

WRITE
OUTFILE='*file_name*'
RECORDS=*n_lines*
{NOTABLE,TABLE}
/[*line_no*] *arg*...

arg takes one of the following forms:
'*string*' [*start-end*]
var_list start-end [*type_spec*]
var_list (*fortran_spec*)
var_list *

`WRITE` writes text or binary data to an output file.

See Section 8.12 [PRINT], page 74, for more information on syntax and usage. `PRINT` and `WRITE` differ in only a few ways:

- `WRITE` uses write formats by default, whereas `PRINT` uses print formats.
- `PRINT` inserts a space between variables unless a format is explicitly specified, but `WRITE` never inserts space between variables in output.
- `PRINT` inserts a space at the beginning of each line that it writes to an output file (and `PRINT EJECT` inserts '`1`' at the beginning of each line that should begin a new page), but `WRITE` does not.
- `PRINT` outputs the system-missing value according to its specified output format, whereas `WRITE` outputs the system-missing value as a field filled with spaces. Binary formats are an exception.

9 System and Portable File I/O

The commands in this chapter read, write, and examine system files and portable files.

9.1 APPLY DICTIONARY

APPLY DICTIONARY FROM={'*file_name*',*file_handle*}.

`APPLY DICTIONARY` applies the variable labels, value labels, and missing values taken from a file to corresponding variables in the active dataset. In some cases it also updates the weighting variable.

The `FROM` clause is mandatory. Use it to specify a system file or portable file's name in single quotes, a data set name (see Section 6.7 [Datasets], page 29), or a file handle name (see Section 6.9 [File Handles], page 42). The dictionary in the file is be read, but it does not replace the active dataset's dictionary. The file's data is not read.

Only variables with names that exist in both the active dataset and the system file are considered. Variables with the same name but different types (numeric, string) cause an error message. Otherwise, the system file variables' attributes replace those in their matching active dataset variables:

- If a system file variable has a variable label, then it replaces the variable label of the active dataset variable. If the system file variable does not have a variable label, then the active dataset variable's variable label, if any, is retained.
- If the system file variable has custom attributes (see Section 11.14 [VARIABLE ATTRIBUTE], page 102), then those attributes replace the active dataset variable's custom attributes. If the system file variable does not have custom attributes, then the active dataset variable's custom attributes, if any, is retained.
- If the active dataset variable is numeric or short string, then value labels and missing values, if any, are copied to the active dataset variable. If the system file variable does not have value labels or missing values, then those in the active dataset variable, if any, are not disturbed.

In addition to properties of variables, some properties of the active file dictionary as a whole are updated:

- If the system file has custom attributes (see Section 8.3 [DATAFILE ATTRIBUTE], page 62), then those attributes replace the active dataset variable's custom attributes.
- If the active dataset has a weighting variable (see Section 13.7 [WEIGHT], page 133), and the system file does not, or if the weighting variable in the system file does not exist in the active dataset, then the active dataset weighting variable, if any, is retained. Otherwise, the weighting variable in the system file becomes the active dataset weighting variable.

`APPLY DICTIONARY` takes effect immediately. It does not read the active dataset. The system file is not modified.

9.2 EXPORT

EXPORT
/OUTFILE='*file_name*'
/UNSELECTED={RETAIN,DELETE}
/DIGITS=*n*
/DROP=*var_list*
/KEEP=*var_list*
/RENAME=(*src_names*=*target_names*)...
/TYPE={COMM,TAPE}
/MAP

The `EXPORT` procedure writes the active dataset's dictionary and data to a specified portable file.

By default, cases excluded with FILTER are written to the file. These can be excluded by specifying DELETE on the `UNSELECTED` subcommand. Specifying RETAIN makes the default explicit.

Portable files express real numbers in base 30. Integers are always expressed to the maximum precision needed to make them exact. Non-integers are, by default, expressed to the machine's maximum natural precision (approximately 15 decimal digits on many machines). If many numbers require this many digits, the portable file may significantly increase in size. As an alternative, the `DIGITS` subcommand may be used to specify the number of decimal digits of precision to write. `DIGITS` applies only to non-integers.

The `OUTFILE` subcommand, which is the only required subcommand, specifies the portable file to be written as a file name string or a file handle (see Section 6.9 [File Handles], page 42).

`DROP`, `KEEP`, and `RENAME` follow the same format as the `SAVE` procedure (see Section 9.6 [SAVE], page 86).

The `TYPE` subcommand specifies the character set for use in the portable file. Its value is currently not used.

The `MAP` subcommand is currently ignored.

`EXPORT` is a procedure. It causes the active dataset to be read.

9.3 GET

GET
/FILE={'*file_name*',*file_handle*}
/DROP=*var_list*
/KEEP=*var_list*
/RENAME=(*src_names*=*target_names*)...
/ENCODING='*encoding*'

`GET` clears the current dictionary and active dataset and replaces them with the dictionary and data from a specified file.

The `FILE` subcommand is the only required subcommand. Specify the SPSS system file, SPSS/PC+ system file, or SPSS portable file to be read as a string file name or a file handle (see Section 6.9 [File Handles], page 42).

By default, all the variables in a file are read. The DROP subcommand can be used to specify a list of variables that are not to be read. By contrast, the `KEEP` subcommand can be used to specify variable that are to be read, with all other variables not read.

Normally variables in a file retain the names that they were saved under. Use the `RENAME` subcommand to change these names. Specify, within parentheses, a list of variable names followed by an equals sign ('`=`') and the names that they should be renamed to. Multiple parenthesized groups of variable names can be included on a single `RENAME` subcommand. Variables' names may be swapped using a `RENAME` subcommand of the form `/RENAME=(`*A B=B A*`)`.

Alternate syntax for the `RENAME` subcommand allows the parentheses to be eliminated. When this is done, only a single variable may be renamed at once. For instance, `/RENAME=`*A=B*. This alternate syntax is deprecated.

`DROP`, `KEEP`, and `RENAME` are executed in left-to-right order. Each may be present any number of times. `GET` never modifies a file on disk. Only the active dataset read from the file is affected by these subcommands.

PSPP automatically detects the encoding of string data in the file, when possible. The character encoding of old SPSS system files cannot always be guessed correctly, and SPSS/PC+ system files do not include any indication of their encoding. Specify the `ENCODING` subcommand with an IANA character set name as its string argument to override the default. Use `SYSFILE INFO` to analyze the encodings that might be valid for a system file. The `ENCODING` subcommand is a PSPP extension.

`GET` does not cause the data to be read, only the dictionary. The data is read later, when a procedure is executed.

Use of `GET` to read a portable file is a PSPP extension.

9.4 GET DATA

GET DATA
    /TYPE={GNM,ODS,PSQL,TXT}
    . . .additional subcommands depending on TYPE. . .

The `GET DATA` command is used to read files and other data sources created by other applications. When this command is executed, the current dictionary and active dataset are replaced with variables and data read from the specified source.

The `TYPE` subcommand is mandatory and must be the first subcommand specified. It determines the type of the file or source to read. PSPP currently supports the following file types:

GNM — Spreadsheet files created by Gnumeric (`http://gnumeric.org`).

ODS — Spreadsheet files in OpenDocument format (`http://opendocumentformat.org`).

PSQL — Relations from PostgreSQL databases (`http://postgresql.org`).

TXT — Textual data files in columnar and delimited formats.

Each supported file type has additional subcommands, explained in separate sections below.

9.4.1 Spreadsheet Files

GET DATA /TYPE={GNM, ODS}
/FILE={'*file_name*'}
/SHEET={NAME '*sheet_name*', INDEX *n*}
/CELLRANGE={RANGE '*range*', FULL}
/READNAMES={ON, OFF}
/ASSUMEDSTRWIDTH=*n*.

Gnumeric spreadsheets (`http://gnumeric.org`), and spreadsheets in OpenDocument format (`http://libreplanet.org/wiki/Group:OpenDocument/Software`) can be read using the `GET DATA` command. Use the `TYPE` subcommand to indicate the file's format. /TYPE=GNM indicates Gnumeric files, /TYPE=ODS indicates OpenDocument. The `FILE` subcommand is mandatory. Use it to specify the name file to be read. All other subcommands are optional.

The format of each variable is determined by the format of the spreadsheet cell containing the first datum for the variable. If this cell is of string (text) format, then the width of the variable is determined from the length of the string it contains, unless the `ASSUMEDSTRWIDTH` subcommand is given.

The `SHEET` subcommand specifies the sheet within the spreadsheet file to read. There are two forms of the `SHEET` subcommand. In the first form, `/SHEET=name` *`sheet_name`*, the string *sheet_name* is the name of the sheet to read. In the second form, `/SHEET=index` *`idx`*, *idx* is a integer which is the index of the sheet to read. The first sheet has the index 1. If the `SHEET` subcommand is omitted, then the command reads the first sheet in the file.

The `CELLRANGE` subcommand specifies the range of cells within the sheet to read. If the subcommand is given as `/CELLRANGE=FULL`, then the entire sheet is read. To read only part of a sheet, use the form `/CELLRANGE=range '`*`top_left_cell`*`:`*`bottom_right_cell`*`'`. For example, the subcommand `/CELLRANGE=range 'C3:P19'` reads columns C–P, and rows 3–19 inclusive. If no `CELLRANGE` subcommand is given, then the entire sheet is read.

If `/READNAMES=ON` is specified, then the contents of cells of the first row are used as the names of the variables in which to store the data from subsequent rows. This is the default. If `/READNAMES=OFF` is used, then the variables receive automatically assigned names.

The `ASSUMEDSTRWIDTH` subcommand specifies the maximum width of string variables read from the file. If omitted, the default value is determined from the length of the string in the first spreadsheet cell for each variable.

9.4.2 Postgres Database Queries

GET DATA /TYPE=PSQL
/CONNECT={*connection info*}
/SQL={*query*}
[/ASSUMEDSTRWIDTH=*w*]
[/UNENCRYPTED]
[/BSIZE=*n*].

`GET DATA /TYPE=PSQL` imports data from a local or remote Postgres database server. It automatically creates variables based on the table column names or the names specified in the SQL query. PSPP cannot support the full precision of some Postgres data types, so data of those types will lose some precision when PSPP imports them. PSPP does not support

all Postgres data types. If PSPP cannot support a datum, GET DATA issues a warning and substitutes the system-missing value.

The CONNECT subcommand is mandatory. It is a string specifying the parameters of the database server from which the data should be fetched. The format of the string is given in the postgres manual http://www.postgresql.org/docs/8.0/static/libpq.html#LIBPQ-CONNECT.

The SQL subcommand is mandatory. It must be a valid SQL string to retrieve data from the database.

The ASSUMEDSTRWIDTH subcommand specifies the maximum width of string variables read from the database. If omitted, the default value is determined from the length of the string in the first value read for each variable.

The UNENCRYPTED subcommand allows data to be retrieved over an insecure connection. If the connection is not encrypted, and the UNENCRYPTED subcommand is not given, then an error occurs. Whether or not the connection is encrypted depends upon the underlying psql library and the capabilities of the database server.

The BSIZE subcommand serves only to optimise the speed of data transfer. It specifies an upper limit on number of cases to fetch from the database at once. The default value is 4096. If your SQL statement fetches a large number of cases but only a small number of variables, then the data transfer may be faster if you increase this value. Conversely, if the number of variables is large, or if the machine on which PSPP is running has only a small amount of memory, then a smaller value is probably better.

The following syntax is an example:

```
GET DATA /TYPE=PSQL
     /CONNECT='host=example.com port=5432 dbname=product user=fred passwd=xxxx'
     /SQL='select * from manufacturer'.
```

9.4.3 Textual Data Files

GET DATA /TYPE=TXT
/FILE={'*file_name*',*file_handle*}
[ENCODING='*encoding*']
[/ARRANGEMENT={DELIMITED,FIXED}]
[/FIRSTCASE={*first_case*}]
[/IMPORTCASES=...]
. . . additional subcommands depending on ARRANGEMENT. . .

When TYPE=TXT is specified, GET DATA reads data in a delimited or fixed columnar format, much like DATA LIST (see Section 8.5 [DATA LIST], page 64).

The FILE subcommand is mandatory. Specify the file to be read as a string file name or (for textual data only) a file handle (see Section 6.9 [File Handles], page 42).

The ENCODING subcommand specifies the character encoding of the file to be read. See Section 17.16 [INSERT], page 263, for information on supported encodings.

The ARRANGEMENT subcommand determines the file's basic format. DELIMITED, the default setting, specifies that fields in the input data are separated by spaces, tabs, or other user-specified delimiters. FIXED specifies that fields in the input data appear at particular fixed column positions within records of a case.

By default, cases are read from the input file starting from the first line. To skip lines at the beginning of an input file, set `FIRSTCASE` to the number of the first line to read: 2 to skip the first line, 3 to skip the first two lines, and so on.

`IMPORTCASES` is ignored, for compatibility. Use `N OF CASES` to limit the number of cases read from a file (see Section 13.2 [N OF CASES], page 127), or `SAMPLE` to obtain a random sample of cases (see Section 13.3 [SAMPLE], page 128).

The remaining subcommands apply only to one of the two file arrangements, described below.

9.4.3.1 Reading Delimited Data

GET DATA /TYPE=TXT
  /FILE={'*file_name*',*file_handle*}
  [/ARRANGEMENT={DELIMITED,FIXED}]
  [/FIRSTCASE={*first_case*}]
  [/IMPORTCASE={ALL,FIRST *max_cases*,PERCENT *percent*}]

  /DELIMITERS="*delimiters*"
  [/QUALIFIER="*quotes*"
  [/DELCASE={LINE,VARIABLES *n_variables*}]
  /VARIABLES=*del_var1* [*del_var2*]...
where each *del_var* takes the form:
  variable format

The GET DATA command with TYPE=TXT and ARRANGEMENT=DELIMITED reads input data from text files in delimited format, where fields are separated by a set of user-specified delimiters. Its capabilities are similar to those of DATA LIST FREE (see Section 8.5.2 [DATA LIST FREE], page 67), with a few enhancements.

The required `FILE` subcommand and optional `FIRSTCASE` and `IMPORTCASE` subcommands are described above (see Section 9.4.3 [GET DATA /TYPE=TXT], page 82).

`DELIMITERS`, which is required, specifies the set of characters that may separate fields. Each character in the string specified on `DELIMITERS` separates one field from the next. The end of a line also separates fields, regardless of `DELIMITERS`. Two consecutive delimiters in the input yield an empty field, as does a delimiter at the end of a line. A space character as a delimiter is an exception: consecutive spaces do not yield an empty field and neither does any number of spaces at the end of a line.

To use a tab as a delimiter, specify '`\t`' at the beginning of the `DELIMITERS` string. To use a backslash as a delimiter, specify '`\\`' as the first delimiter or, if a tab should also be a delimiter, immediately following '`\t`'. To read a data file in which each field appears on a separate line, specify the empty string for `DELIMITERS`.

The optional `QUALIFIER` subcommand names one or more characters that can be used to quote values within fields in the input. A field that begins with one of the specified quote characters ends at the next matching quote. Intervening delimiters become part of the field, instead of terminating it. The ability to specify more than one quote character is a PSPP extension.

The character specified on `QUALIFIER` can be embedded within a field that it quotes by doubling the qualifier. For example, if '`'` is specified on `QUALIFIER`, then `'a''b'` specifies a field that contains '`a'b`'.

The `DELCASE` subcommand controls how data may be broken across lines in the data file. With LINE, the default setting, each line must contain all the data for exactly one case. For additional flexibility, to allow a single case to be split among lines or multiple cases to be contained on a single line, specify VARIABLES *n_variables*, where *n_variables* is the number of variables per case.

The `VARIABLES` subcommand is required and must be the last subcommand. Specify the name of each variable and its input format (see Section 6.7.4 [Input and Output Formats], page 32) in the order they should be read from the input file.

Examples

On a Unix-like system, the '`/etc/passwd`' file has a format similar to this:

```
root:$1$nyeSP5gD$pDq/:0:0:,,,:/root:/bin/bash
blp:$1$BrP/pFg4$g7OG:1000:1000:Ben Pfaff,,,:/home/blp:/bin/bash
john:$1$JBuq/Fioq$g4A:1001:1001:John Darrington,,,:/home/john:/bin/bash
jhs:$1$D3li4hPL$88X1:1002:1002:Jason Stover,,,:/home/jhs:/bin/csh
```

The following syntax reads a file in the format used by '`/etc/passwd`':

```
GET DATA /TYPE=TXT /FILE='/etc/passwd' /DELIMITERS=':'
        /VARIABLES=username A20
                   password A40
                   uid F10
                   gid F10
                   gecos A40
                   home A40
                   shell A40.
```

Consider the following data on used cars:

```
model   year    mileage price   type    age
Civic   2002    29883   15900   Si      2
Civic   2003    13415   15900   EX      1
Civic   1992    107000  3800    n/a     12
Accord  2002    26613   17900   EX      1
```

The following syntax can be used to read the used car data:

```
GET DATA /TYPE=TXT /FILE='cars.data' /DELIMITERS=' ' /FIRSTCASE=2
        /VARIABLES=model A8
                   year F4
                   mileage F6
                   price F5
                   type A4
                   age F2.
```

Consider the following information on animals in a pet store:

```
'Pet''s Name', "Age", "Color", "Date Received", "Price", "Height", "Type"
, (Years), , , (Dollars), ,
```

```
"Rover", 4.5, Brown, "12 Feb 2004", 80, '1''4"', "Dog"
"Charlie", , Gold, "5 Apr 2007", 12.3, "3""", "Fish"
"Molly", 2, Black, "12 Dec 2006", 25, '5"', "Cat"
"Gilly", , White, "10 Apr 2007", 10, "3""", "Guinea Pig"
```

The following syntax can be used to read the pet store data:

```
GET DATA /TYPE=TXT /FILE='pets.data' /DELIMITERS=', ' /QUALIFIER='''"' /ESCAPE
        /FIRSTCASE=3
        /VARIABLES=name A10
                   age F3.1
                   color A5
                   received EDATE10
                   price F5.2
                   height a5
                   type a10.
```

9.4.3.2 Reading Fixed Columnar Data

GET DATA /TYPE=TXT
  /FILE={'file_name',*file_handle*}
  [/ARRANGEMENT={DELIMITED,FIXED}]
  [/FIRSTCASE={*first_case*}]
  [/IMPORTCASE={ALL,FIRST *max_cases*,PERCENT *percent*}]

  [/FIXCASE=*n*]
  /VARIABLES *fixed_var* [*fixed_var*]...
    [/rec# *fixed_var* [*fixed_var*]...]...
where each *fixed_var* takes the form:
  variable start-end format

The `GET DATA` command with TYPE=TXT and ARRANGEMENT=FIXED reads input data from text files in fixed format, where each field is located in particular fixed column positions within records of a case. Its capabilities are similar to those of DATA LIST FIXED (see Section 8.5.1 [DATA LIST FIXED], page 64), with a few enhancements.

The required `FILE` subcommand and optional `FIRSTCASE` and `IMPORTCASE` subcommands are described above (see Section 9.4.3 [GET DATA /TYPE=TXT], page 82).

The optional `FIXCASE` subcommand may be used to specify the positive integer number of input lines that make up each case. The default value is 1.

The `VARIABLES` subcommand, which is required, specifies the positions at which each variable can be found. For each variable, specify its name, followed by its start and end column separated by '`-`' (*e.g.* '`0-9`'), followed by an input format type (*e.g.* '`F`') or a full format specification (*e.g.* '`DOLLAR12.2`'). For this command, columns are numbered starting from 0 at the left column. Introduce the variables in the second and later lines of a case by a slash followed by the number of the line within the case, *e.g.* '`/2`' for the second line.

Examples

Consider the following data on used cars:

```
model   year    mileage price   type    age
```

```
Civic   2002    29883   15900   Si      2
Civic   2003    13415   15900   EX      1
Civic   1992    107000  3800    n/a     12
Accord  2002    26613   17900   EX      1
```

The following syntax can be used to read the used car data:

```
GET DATA /TYPE=TXT /FILE='cars.data' /ARRANGEMENT=FIXED /FIRSTCASE=2
        /VARIABLES=model 0-7 A
                   year 8-15 F
                   mileage 16-23 F
                   price 24-31 F
                   type 32-40 A
                   age 40-47 F.
```

9.5 IMPORT

IMPORT
  /FILE='*file_name*'
  /TYPE={COMM,TAPE}
  /DROP=*var_list*
  /KEEP=*var_list*
  /RENAME=(*src_names*=*target_names*)...

The `IMPORT` transformation clears the active dataset dictionary and data and replaces them with a dictionary and data from a system file or portable file.

The `FILE` subcommand, which is the only required subcommand, specifies the portable file to be read as a file name string or a file handle (see Section 6.9 [File Handles], page 42).

The `TYPE` subcommand is currently not used.

`DROP`, `KEEP`, and `RENAME` follow the syntax used by `GET` (see Section 9.3 [GET], page 79).

`IMPORT` does not cause the data to be read; only the dictionary. The data is read later, when a procedure is executed.

Use of `IMPORT` to read a system file is a PSPP extension.

9.6 SAVE

SAVE
  /OUTFILE={'*file_name*',*file_handle*}
  /UNSELECTED={RETAIN,DELETE}
  /{UNCOMPRESSED,COMPRESSED,ZCOMPRESSED}
  /PERMISSIONS={WRITEABLE,READONLY}
  /DROP=*var_list*
  /KEEP=*var_list*
  /VERSION=*version*
  /RENAME=(*src_names*=*target_names*)...
  /NAMES
  /MAP

The `SAVE` procedure causes the dictionary and data in the active dataset to be written to a system file.

OUTFILE is the only required subcommand. Specify the system file to be written as a string file name or a file handle (see Section 6.9 [File Handles], page 42).

By default, cases excluded with FILTER are written to the system file. These can be excluded by specifying `DELETE` on the `UNSELECTED` subcommand. Specifying `RETAIN` makes the default explicit.

The `UNCOMPRESSED`, `COMPRESSED`, and `ZCOMPRESSED` subcommand determine the system file's compression level:

`UNCOMPRESSED`
: Data is not compressed. Each numeric value uses 8 bytes of disk space. Each string value uses one byte per column width, rounded up to a multiple of 8 bytes.

`COMPRESSED`
: Data is compressed with a simple algorithm. Each integer numeric value between −99 and 151, inclusive, or system missing value uses one byte of disk space. Each 8-byte segment of a string that consists only of spaces uses 1 byte. Any other numeric value or 8-byte string segment uses 9 bytes of disk space.

`ZCOMPRESSED`
: Data is compressed with the "deflate" compression algorithm specified in RFC 1951 (the same algorithm used by `gzip`). Files written with this compression level cannot be read by PSPP 0.8.1 or earlier or by SPSS 20 or earlier.

`COMPRESSED` is the default compression level. The SET command (see Section 17.20 [SET], page 265) can change this default.

The `PERMISSIONS` subcommand specifies permissions for the new system file. WRITEABLE, the default, creates the file with read and write permission. READONLY creates the file for read-only access.

By default, all the variables in the active dataset dictionary are written to the system file. The `DROP` subcommand can be used to specify a list of variables not to be written. In contrast, KEEP specifies variables to be written, with all variables not specified not written.

Normally variables are saved to a system file under the same names they have in the active dataset. Use the `RENAME` subcommand to change these names. Specify, within parentheses, a list of variable names followed by an equals sign ('`=`') and the names that they should be renamed to. Multiple parenthesized groups of variable names can be included on a single `RENAME` subcommand. Variables' names may be swapped using a `RENAME` subcommand of the form `/RENAME=(`*A B*`=`*B A*`)`.

Alternate syntax for the `RENAME` subcommand allows the parentheses to be eliminated. When this is done, only a single variable may be renamed at once. For instance, `/RENAME=`*A*`=`*B*. This alternate syntax is deprecated.

`DROP`, `KEEP`, and `RENAME` are performed in left-to-right order. They each may be present any number of times. `SAVE` never modifies the active dataset. `DROP`, `KEEP`, and `RENAME` only affect the system file written to disk.

The `VERSION` subcommand specifies the version of the file format. Valid versions are 2 and 3. The default version is 3. In version 2 system files, variable names longer than 8 bytes are truncated. The two versions are otherwise identical.

The `NAMES` and `MAP` subcommands are currently ignored.

`SAVE` causes the data to be read. It is a procedure.

9.7 SAVE DATA COLLECTION

SAVE DATA COLLECTION
/OUTFILE={'*file_name*',*file_handle*}
/METADATA={'*file_name*',*file_handle*}
/{UNCOMPRESSED,COMPRESSED,ZCOMPRESSED}
/PERMISSIONS={WRITEABLE,READONLY}
/DROP=*var_list*
/KEEP=*var_list*
/VERSION=*version*
/RENAME=(*src_names*=*target_names*)...
/NAMES
/MAP

Like `SAVE`, `SAVE DATA COLLECTION` writes the dictionary and data in the active dataset to a system file. In addition, it writes metadata to an additional XML metadata file.

OUTFILE is required. Specify the system file to be written as a string file name or a file handle (see Section 6.9 [File Handles], page 42).

METADATA is also required. Specify the metadata file to be written as a string file name or a file handle. Metadata files customarily use a `.mdd` extension.

The current implementation of this command is experimental. It only outputs an approximation of the metadata file format. Please report bugs.

Other subcommands are optional. They have the same meanings as in the `SAVE` command.

`SAVE DATA COLLECTION` causes the data to be read. It is a procedure.

9.8 SAVE TRANSLATE

SAVE TRANSLATE
/OUTFILE={'*file_name*',*file_handle*}
/TYPE={CSV,TAB}
[/REPLACE]
[/MISSING={IGNORE,RECODE}]

[/DROP=*var_list*]
[/KEEP=*var_list*]
[/RENAME=(*src_names*=*target_names*)...]
[/UNSELECTED={RETAIN,DELETE}]
[/MAP]

...additional subcommands depending on TYPE...

The `SAVE TRANSLATE` command is used to save data into various formats understood by other applications.

The `OUTFILE` and `TYPE` subcommands are mandatory. `OUTFILE` specifies the file to be written, as a string file name or a file handle (see Section 6.9 [File Handles], page 42). `TYPE` determines the type of the file or source to read. It must be one of the following:

CSV Comma-separated value format,

TAB Tab-delimited format.

By default, `SAVE TRANSLATE` does not overwrite an existing file. Use `REPLACE` to force an existing file to be overwritten.

With MISSING=IGNORE, the default, `SAVE TRANSLATE` treats user-missing values as if they were not missing. Specify MISSING=RECODE to output numeric user-missing values like system-missing values and string user-missing values as all spaces.

By default, all the variables in the active dataset dictionary are saved to the system file, but `DROP` or `KEEP` can select a subset of variable to save. The `RENAME` subcommand can also be used to change the names under which variables are saved; because they are used only in the output, these names do not have to conform to the usual PSPP variable naming rules. `UNSELECTED` determines whether cases filtered out by the `FILTER` command are written to the output file. These subcommands have the same syntax and meaning as on the `SAVE` command (see Section 9.6 [SAVE], page 86).

Each supported file type has additional subcommands, explained in separate sections below.

`SAVE TRANSLATE` causes the data to be read. It is a procedure.

9.8.1 Writing Comma- and Tab-Separated Data Files

SAVE TRANSLATE
/OUTFILE={'*file_name*',*file_handle*}
/TYPE=CSV
[/REPLACE]
[/MISSING={IGNORE,RECODE}]

[/DROP=*var_list*]
[/KEEP=*var_list*]
[/RENAME=(*src_names*=*target_names*)...]
[/UNSELECTED={RETAIN,DELETE}]

[/FIELDNAMES]
[/CELLS={VALUES,LABELS}]
[/TEXTOPTIONS DELIMITER='*delimiter*']
[/TEXTOPTIONS QUALIFIER='*qualifier*']
[/TEXTOPTIONS DECIMAL={DOT,COMMA}]
[/TEXTOPTIONS FORMAT={PLAIN,VARIABLE}]

The SAVE TRANSLATE command with TYPE=CSV or TYPE=TAB writes data in a comma- or tab-separated value format similar to that described by RFC 4180. Each variable becomes one output column, and each case becomes one line of output. If FIELDNAMES is specified, an additional line at the top of the output file lists variable names.

The CELLS and TEXTOPTIONS FORMAT settings determine how values are written to the output file:

CELLS=VALUES FORMAT=PLAIN (the default settings)

Writes variables to the output in "plain" formats that ignore the details of variable formats. Numeric values are written as plain decimal numbers with enough digits to indicate their exact values in machine representation. Numeric values include '`e`' followed by an exponent if the exponent value would be less than -4 or greater than 16. Dates are written in MM/DD/YYYY format and times in HH:MM:SS format. WKDAY and MONTH values are written as decimal numbers.

Numeric values use, by default, the decimal point character set with SET DECIMAL (see [SET DECIMAL], page 267). Use DECIMAL=DOT or DECIMAL=COMMA to force a particular decimal point character.

CELLS=VALUES FORMAT=VARIABLE

Writes variables using their print formats. Leading and trailing spaces are removed from numeric values, and trailing spaces are removed from string values.

CELLS=LABEL FORMAT=PLAIN
CELLS=LABEL FORMAT=VARIABLE

Writes value labels where they exist, and otherwise writes the values themselves as described above.

Regardless of CELLS and TEXTOPTIONS FORMAT, numeric system-missing values are output as a single space.

For TYPE=TAB, tab characters delimit values. For TYPE=CSV, the TEXTOPTIONS DELIMITER and DECIMAL settings determine the character that separate values within a line. If DELIMITER is specified, then the specified string separate values. If DELIMITER is not specified, then the default is a comma with DECIMAL=DOT or a semicolon with DECIMAL=COMMA. If DECIMAL is not given either, it is implied by the decimal point character set with SET DECIMAL (see [SET DECIMAL], page 267).

The TEXTOPTIONS QUALIFIER setting specifies a character that is output before and after a value that contains the delimiter character or the qualifier character. The default is a double quote ('`"`'). A qualifier character that appears within a value is doubled.

9.9 SYSFILE INFO

SYSFILE INFO FILE='*file_name*' [ENCODING='*encoding*'].

`SYSFILE INFO` reads the dictionary in an SPSS system file, SPSS/PC+ system file, or SPSS portable file, and displays the information in its dictionary.

Specify a file name or file handle. `SYSFILE INFO` reads that file and displays information on its dictionary.

PSPP automatically detects the encoding of string data in the file, when possible. The character encoding of old SPSS system files cannot always be guessed correctly, and SPSS/PC+ system files do not include any indication of their encoding. Specify the `ENCODING` subcommand with an IANA character set name as its string argument to

override the default, or specify `ENCODING='DETECT'` to analyze and report possibly valid encodings for the system file. The `ENCODING` subcommand is a PSPP extension.

`SYSFILE INFO` does not affect the current active dataset.

9.10 XEXPORT

XEXPORT
  /OUTFILE='*file_name*'
  /DIGITS=*n*
  /DROP=*var_list*
  /KEEP=*var_list*
  /RENAME=(*src_names*=*target_names*)...
  /TYPE={COMM,TAPE}
  /MAP

The `XEXPORT` transformation writes the active dataset dictionary and data to a specified portable file.

This transformation is a PSPP extension.

It is similar to the `EXPORT` procedure, with two differences:

- `XEXPORT` is a transformation, not a procedure. It is executed when the data is read by a procedure or procedure-like command.
- `XEXPORT` does not support the `UNSELECTED` subcommand.

See Section 9.2 [EXPORT], page 79, for more information.

9.11 XSAVE

XSAVE
  /OUTFILE='*file_name*'
  /{UNCOMPRESSED,COMPRESSED,ZCOMPRESSED}
  /PERMISSIONS={WRITEABLE,READONLY}
  /DROP=*var_list*
  /KEEP=*var_list*
  /VERSION=*version*
  /RENAME=(*src_names*=*target_names*)...
  /NAMES
  /MAP

The `XSAVE` transformation writes the active dataset's dictionary and data to a system file. It is similar to the `SAVE` procedure, with two differences:

- `XSAVE` is a transformation, not a procedure. It is executed when the data is read by a procedure or procedure-like command.
- `XSAVE` does not support the `UNSELECTED` subcommand.

See Section 9.6 [SAVE], page 86, for more information.

10 Combining Data Files

This chapter describes commands that allow data from system files, portable files, and open datasets to be combined to form a new active dataset. These commands can combine data files in the following ways:

- `ADD FILES` interleaves or appends the cases from each input file. It is used with input files that have variables in common, but distinct sets of cases.
- `MATCH FILES` adds the data together in cases that match across multiple input files. It is used with input files that have cases in common, but different information about each case.
- `UPDATE` updates a master data file from data in a set of transaction files. Each case in a transaction data file modifies a matching case in the primary data file, or it adds a new case if no matching case can be found.

These commands share the majority of their syntax, which is described in the following section, followed by one section for each command that describes its specific syntax and semantics.

10.1 Common Syntax

Per input file:

/FILE={*,'*file_name*'}
[/RENAME=(*src_names*=*target_names*)...]
[/IN=*var_name*]
[/SORT]

Once per command:

/BY *var_list*[({D|A})] [*var_list*[({D|A}]]...
[/DROP=*var_list*]
[/KEEP=*var_list*]
[/FIRST=*var_name*]
[/LAST=*var_name*]
[/MAP]

This section describes the syntactical features in common among the `ADD FILES`, `MATCH FILES`, and `UPDATE` commands. The following sections describe details specific to each command.

Each of these commands reads two or more input files and combines them. The command's output becomes the new active dataset. None of the commands actually change the input files. Therefore, if you want the changes to become permanent, you must explicitly save them using an appropriate procedure or transformation (see Chapter 9 [System and Portable File IO], page 78).

The syntax of each command begins with a specification of the files to be read as input. For each input file, specify FILE with a system file or portable file's name as a string, a dataset (see Section 6.7 [Datasets], page 29) or file handle name, (see Section 6.9 [File Handles], page 42), or an asterisk ('`*`') to use the active dataset as input. Use of portable files on `FILE` is a PSPP extension.

At least two FILE subcommands must be specified. If the active dataset is used as an input source, then TEMPORARY must not be in effect.

Each FILE subcommand may be followed by any number of RENAME subcommands that specify a parenthesized group or groups of variable names as they appear in the input file, followed by those variables' new names, separated by an equals sign (=), *e.g.* /RENAME=(OLD1=NEW1)(OLD2=NEW2). To rename a single variable, the parentheses may be omitted: /RENAME=*old*=*new*. Within a parenthesized group, variables are renamed simultaneously, so that /RENAME=(*A B*=*B A*) exchanges the names of variables *A* and *B*. Otherwise, renaming occurs in left-to-right order.

Each FILE subcommand may optionally be followed by a single IN subcommand, which creates a numeric variable with the specified name and format F1.0. The IN variable takes value 1 in an output case if the given input file contributed to that output case, and 0 otherwise. The DROP, KEEP, and RENAME subcommands have no effect on IN variables.

If BY is used (see below), the SORT keyword must be specified after a FILE if that input file is not already sorted on the BY variables. When SORT is specified, PSPP sorts the input file's data on the BY variables before it applies it to the command. When SORT is used, BY is required. SORT is a PSPP extension.

PSPP merges the dictionaries of all of the input files to form the dictionary of the new active dataset, like so:

- The variables in the new active dataset are the union of all the input files' variables, matched based on their name. When a single input file contains a variable with a given name, the output file will contain exactly that variable. When more than one input file contains a variable with a given name, those variables must be all string or all numeric. If they are string variables, then the result will have the width of the longest variable with that name, with narrower values padded on the right with spaces to fill the width. Variables are matched after renaming with the RENAME subcommand. Thus, RENAME can be used to resolve conflicts. Only variables in the output file can conflict, so DROP or KEEP, as described below, can also resolve a conflict.
- The variable label for each output variable is taken from the first specified input file that has a variable label for that variable, and similarly for value labels and missing values.
- The file label of the new active dataset (see Section 17.12 [FILE LABEL], page 262) is that of the first specified FILE that has a file label.
- The documents in the new active dataset (see Section 17.5 [DOCUMENT], page 261) are the concatenation of all the input files' documents, in the order in which the FILE subcommands are specified.
- If all of the input files are weighted on the same variable, then the new active dataset is weighted on that variable. Otherwise, the new active dataset is not weighted.

The remaining subcommands apply to the output file as a whole, rather than to individual input files. They must be specified at the end of the command specification, following all of the FILE and related subcommands. The most important of these subcommands is BY, which specifies a set of one or more variables that may be used to find corresponding cases in each of the input files. The variables specified on BY must be present in all of the input files. Furthermore, if any of the input files are not sorted on the BY variables, then SORT must be specified for those input files.

The variables listed on BY may include (A) or (D) annotations to specify ascending or descending sort order. See Section 12.8 [SORT CASES], page 123, for more details on this notation. Adding (A) or (D) to the BY subcommand specification is a PSPP extension.

The DROP subcommand can be used to specify a list of variables to exclude from the output. By contrast, the KEEP subcommand can be used to specify variables to include in the output; all variables not listed are dropped. DROP and KEEP are executed in left-to-right order and may be repeated any number of times. DROP and KEEP do not affect variables created by the IN, FIRST, and LAST subcommands, which are always included in the new active dataset, but they can be used to drop BY variables.

The FIRST and LAST subcommands are optional. They may only be specified on MATCH FILES and ADD FILES, and only when BY is used. FIRST and LIST each adds a numeric variable to the new active dataset, with the name given as the subcommand's argument and F1.0 print and write formats. The value of the FIRST variable is 1 in the first output case with a given set of values for the BY variables, and 0 in other cases. Similarly, the LAST variable is 1 in the last case with a given of BY values, and 0 in other cases.

When any of these commands creates an output case, variables that are only in files that are not present for the current case are set to the system-missing value for numeric variables or spaces for string variables.

These commands may combine any number of files, limited only by the machine's memory.

10.2 ADD FILES

ADD FILES

Per input file:
/FILE={*,'*file_name*'}
[/RENAME=(*src_names*=*target_names*)...]
[/IN=*var_name*]
[/SORT]

Once per command:
[/BY *var_list*[({D|A})] [*var_list*[({D|A})]...]]
[/DROP=*var_list*]
[/KEEP=*var_list*]
[/FIRST=*var_name*]
[/LAST=*var_name*]
[/MAP]

ADD FILES adds cases from multiple input files. The output, which replaces the active dataset, consists all of the cases in all of the input files.

ADD FILES shares the bulk of its syntax with other PSPP commands for combining multiple data files. See Section 10.1 [Combining Files Common Syntax], page 92, above, for an explanation of this common syntax.

When BY is not used, the output of ADD FILES consists of all the cases from the first input file specified, followed by all the cases from the second file specified, and so on. When BY is used, the output is additionally sorted on the BY variables.

When `ADD FILES` creates an output case, variables that are not part of the input file from which the case was drawn are set to the system-missing value for numeric variables or spaces for string variables.

10.3 MATCH FILES

MATCH FILES

Per input file:
/{FILE,TABLE}={*,'*file_name*'}
[/RENAME=(*src_names*=*target_names*)...]
[/IN=*var_name*]
[/SORT]

Once per command:
/BY *var_list*[({D|A}] [*var_list*[({D|A})]...]
[/DROP=*var_list*]
[/KEEP=*var_list*]
[/FIRST=*var_name*]
[/LAST=*var_name*]
[/MAP]

`MATCH FILES` merges sets of corresponding cases in multiple input files into single cases in the output, combining their data.

`MATCH FILES` shares the bulk of its syntax with other PSPP commands for combining multiple data files. See Section 10.1 [Combining Files Common Syntax], page 92, above, for an explanation of this common syntax.

How `MATCH FILES` matches up cases from the input files depends on whether `BY` is specified:

- If `BY` is not used, `MATCH FILES` combines the first case from each input file to produce the first output case, then the second case from each input file for the second output case, and so on. If some input files have fewer cases than others, then the shorter files do not contribute to cases output after their input has been exhausted.
- If `BY` is used, `MATCH FILES` combines cases from each input file that have identical values for the `BY` variables.

  When `BY` is used, `TABLE` subcommands may be used to introduce *table lookup file*. `TABLE` has same syntax as `FILE`, and the `RENAME`, `IN`, and `SORT` subcommands may follow a `TABLE` in the same way as `FILE`. Regardless of the number of `TABLE`s, at least one `FILE` must specified. Table lookup files are treated in the same way as other input files for most purposes and, in particular, table lookup files must be sorted on the `BY` variables or the `SORT` subcommand must be specified for that `TABLE`.

  Cases in table lookup files are not consumed after they have been used once. This means that data in table lookup files can correspond to any number of cases in `FILE` input files. Table lookup files are analogous to lookup tables in traditional relational database systems.

  If a table lookup file contains more than one case with a given set of `BY` variables, only the first case is used.

When MATCH FILES creates an output case, variables that are only in files that are not present for the current case are set to the system-missing value for numeric variables or spaces for string variables.

10.4 UPDATE

UPDATE

Per input file:
/FILE={*,'*file_name*'}
[/RENAME=(*src_names*=*target_names*)...]
[/IN=*var_name*]
[/SORT]

Once per command:
/BY *var_list*[({D|A})] [*var_list*[({D|A})]]...
[/DROP=*var_list*]
[/KEEP=*var_list*]
[/MAP]

UPDATE updates a *master file* by applying modifications from one or more *transaction files*.

UPDATE shares the bulk of its syntax with other PSPP commands for combining multiple data files. See Section 10.1 [Combining Files Common Syntax], page 92, above, for an explanation of this common syntax.

At least two FILE subcommands must be specified. The first FILE subcommand names the master file, and the rest name transaction files. Every input file must either be sorted on the variables named on the BY subcommand, or the SORT subcommand must be used just after the FILE subcommand for that input file.

UPDATE uses the variables specified on the BY subcommand, which is required, to attempt to match each case in a transaction file with a case in the master file:

- When a match is found, then the values of the variables present in the transaction file replace those variables' values in the new active file. If there are matching cases in more than more transaction file, PSPP applies the replacements from the first transaction file, then from the second transaction file, and so on. Similarly, if a single transaction file has cases with duplicate BY values, then those are applied in order to the master file.

  When a variable in a transaction file has a missing value or when a string variable's value is all blanks, that value is never used to update the master file.
- If a case in the master file has no matching case in any transaction file, then it is copied unchanged to the output.
- If a case in a transaction file has no matching case in the master file, then it causes a new case to be added to the output, initialized from the values in the transaction file.

11 Manipulating Variables

Every value in a dataset is associated with a *variable*. Variables describe what the values represent and properties of those values, such as the format in which they should be displayed, whether they are numeric or alphabetic and how missing values should be represented. There are several utility commands for examining and adjusting variables.

11.1 DISPLAY

The `DISPLAY` command displays information about the variables in the active dataset. A variety of different forms of information can be requested. By default, all variables in the active dataset are displayed. However you can select variables of interest using the `/VARIABLES` subcommand.

DISPLAY [SORTED] NAMES [[/VARIABLES=]*var_list*].
DISPLAY [SORTED] INDEX [[/VARIABLES=]*var_list*].
DISPLAY [SORTED] LABELS [[/VARIABLES=]*var_list*].
DISPLAY [SORTED] VARIABLES [[/VARIABLES=]*var_list*].
DISPLAY [SORTED] DICTIONARY [[/VARIABLES=]*var_list*].
DISPLAY [SORTED] SCRATCH [[/VARIABLES=]*var_list*].
DISPLAY [SORTED] ATTRIBUTES [[/VARIABLES=]*var_list*].
DISPLAY [SORTED] @ATTRIBUTES [[/VARIABLES=]*var_list*].
DISPLAY [SORTED] VECTORS.

The following keywords primarily cause information about variables to be displayed. With these keywords, by default information is displayed about all variable in the active dataset, in the order that variables occur in the active dataset dictionary. The `SORTED` keyword causes output to be sorted alphabetically by variable name.

NAMES
: The variables' names are displayed.

INDEX
: The variables' names are displayed along with a value describing their position within the active dataset dictionary.

LABELS
: Variable names, positions, and variable labels are displayed.

VARIABLES
: Variable names, positions, print and write formats, and missing values are displayed.

DICTIONARY
: Variable names, positions, print and write formats, missing values, variable labels, and value labels are displayed.

SCRATCH
: Variable names are displayed, for scratch variables only (see Section 6.7.5 [Scratch Variables], page 41).

ATTRIBUTES
@ATTRIBUTES
: Datafile and variable attributes are displayed. The first form of the command omits those attributes whose names begin with `@` or `$@`. In the second for, all datafile and variable attributes are displayed.

With the VECTOR keyword, DISPLAY lists all the currently declared vectors. If the SORTED keyword is given, the vectors are listed in alphabetical order; otherwise, they are listed in textual order of definition within the PSPP syntax file.

For related commands, see Section 17.6 [DISPLAY DOCUMENTS], page 261, and Section 17.7 [DISPLAY FILE LABEL], page 261.

11.2 NUMERIC

NUMERIC explicitly declares new numeric variables, optionally setting their output formats.

NUMERIC *var_list* [(*fmt_spec*)] [/*var_list* [(*fmt_spec*)]]. . .

Specify the names of the new numeric variables as *var_list*. If you wish to set the variables' output formats, follow their names by an output format specification in parentheses (see Section 6.7.4 [Input and Output Formats], page 32); otherwise, the default is F8.2.

Variables created with NUMERIC are initialized to the system-missing value.

11.3 STRING

STRING creates new string variables.

STRING *var_list* (*fmt_spec*) [/*var_list* (*fmt_spec*)] [. . .].

Specify a list of names for the variable you want to create, followed by the desired output format specification in parentheses (see Section 6.7.4 [Input and Output Formats], page 32). Variable widths are implicitly derived from the specified output formats. The created variables will be initialized to spaces.

If you want to create several variables with distinct output formats, you can either use two or more separate STRING commands, or you can specify further variable list and format specification pairs, each separated from the previous by a slash ('/').

The following example is one way to create three string variables; Two of the variables have format A24 and the other A80:

```
STRING firstname lastname (A24) / address (A80).
```

Here is another way to achieve the same result:

```
STRING firstname lastname (A24).
STRING address (A80).
```

. . . and here is yet another way:

```
STRING firstname (A24).
STRING lastname (A24).
STRING address (A80).
```

11.4 RENAME VARIABLES

RENAME VARIABLES changes the names of variables in the active dataset.

RENAME VARIABLES (*old_names*=*new_names*). . . .

Specify lists of the old variable names and new variable names, separated by an equals sign ('='), within parentheses. There must be the same number of old and new variable names. Each old variable is renamed to the corresponding new variable name. Multiple

parenthesized groups of variables may be specified. When the old and new variable names contain only a single variable name, the parentheses are optional.

`RENAME VARIABLES` takes effect immediately. It does not cause the data to be read.

`RENAME VARIABLES` may not be specified following `TEMPORARY` (see Section 13.6 [TEMPORARY], page 132).

11.5 SORT VARIABLES

`SORT VARIABLES` reorders the variables in the active dataset's dictionary according to a chosen sort key.

SORT VARIABLES [BY]
(NAME | TYPE | FORMAT | LABEL | VALUES | MISSING | MEASURE
| ROLE | COLUMNS | ALIGNMENT | ATTRIBUTE *name*)
[(D)].

The main specification is one of the following identifiers, which determines how the variables are sorted:

NAME
: Sorts the variables according to their names, in a case-insensitive fashion. However, when variable names differ only in a number at the end, they are sorted numerically. For example, `VAR5` is sorted before `VAR400` even though '`4`' precedes '`5`'.

TYPE
: Sorts numeric variables before string variables, and shorter string variables before longer ones.

FORMAT
: Groups variables by print format; within a format, sorts narrower formats before wider ones; with the same format and width, sorts fewer decimal places before more decimal places. See Section 11.10 [FORMATS], page 101.

LABEL
: Sorts variables without a variable label before those with one. See Section 11.7 [VARIABLE LABELS], page 100.

VALUES
: Sorts variables without value labels before those with some. See Section 11.11 [VALUE LABELS], page 101.

MISSING
: Sorts variables without missing values before those with some. See Section 11.13 [MISSING VALUES], page 102.

MEASURE
: Sorts nominal variables first, followed by ordinal variables, followed by scale variables. See Section 11.17 [VARIABLE LEVEL], page 104.

ROLE
: Groups variables according to their role. See Section 11.18 [VARIABLE ROLE], page 104.

COLUMNS
: Sorts variables in ascending display width. See Section 11.16 [VARIABLE WIDTH], page 103.

ALIGNMENT
: Sorts variables according to their alignment, first left-aligned, then right-aligned, then centered. See Section 11.15 [VARIABLE ALIGNMENT], page 103.

ATTRIBUTE *name*

Sorts variables according to the first value of their *name* attribute. Variables without attribute are sorted first. See Section 11.14 [VARIABLE ATTRIBUTE], page 102.

Only one sort criterion can be specified. The sort is "stable," so to sort on multiple criteria one may perform multiple sorts. For example, the following will sort primarily based on alignment, with variables that have the same alignment ordered based on display width:

```
SORT VARIABLES BY COLUMNS.
SORT VARIABLES BY ALIGNMENT.
```

Specify `(D)` to reverse the sort order.

11.6 DELETE VARIABLES

`DELETE VARIABLES` deletes the specified variables from the dictionary.

DELETE VARIABLES *var_list*.

`DELETE VARIABLES` should not be used after defining transformations but before executing a procedure. If it is used in such a context, it causes the data to be read. If it is used while `TEMPORARY` is in effect, it causes the temporary transformations to become permanent.

`DELETE VARIABLES` may not be used to delete all variables from the dictionary; use `NEW FILE` to do that (see Section 8.11 [NEW FILE], page 74).

11.7 VARIABLE LABELS

In addition to a variable's name, each variable can have a *label*. Whereas a variable name is a concise, easy-to-type mnemonic for the variable, a label may be longer and more descriptive.

VARIABLE LABELS
variable 'label'
[*variable 'label'*]...

`VARIABLE LABELS` associates explanatory names with variables. This name, called a *variable label*, is displayed by statistical procedures.

Specify each variable followed by its label as a quoted string. Variable-label pairs may be separated by an optional slash '`/`'.

If a listed variable already has a label, the new one replaces it. Specifying an empty string as the label, e.g.'`''`', removes a label.

11.8 PRINT FORMATS

PRINT FORMATS *var_list* (*fmt_spec*) [*var_list* (*fmt_spec*)]....

`PRINT FORMATS` sets the print formats for the specified variables to the specified format specification.

Its syntax is identical to that of `FORMATS` (see Section 11.10 [FORMATS], page 101), but `PRINT FORMATS` sets only print formats, not write formats.

11.9 WRITE FORMATS

WRITE FORMATS *var_list* (*fmt_spec*) [*var_list* (*fmt_spec*)]. . . .

`WRITE FORMATS` sets the write formats for the specified variables to the specified format specification. Its syntax is identical to that of `FORMATS` (see Section 11.10 [FORMATS], page 101), but `WRITE FORMATS` sets only write formats, not print formats.

11.10 FORMATS

FORMATS *var_list* (*fmt_spec*) [*var_list* (*fmt_spec*)]. . . .

`FORMATS` set both print and write formats for the specified variables to the specified format specification. See Section 6.7.4 [Input and Output Formats], page 32.

Specify a list of variables followed by a format specification in parentheses. The print and write formats of the specified variables will be changed. All of the variables listed together must have the same type and, for string variables, the same width.

Additional lists of variables and formats may be included following the first one.

`FORMATS` takes effect immediately. It is not affected by conditional and looping structures such as `DO IF` or `LOOP`.

11.11 VALUE LABELS

The values of a variable can be associated with an arbitrary text string. In this way, a short value can stand for a longer, more descriptive label.

Both numeric and string variables can be given labels. For string variables, the values are case-sensitive, so that, for example, a capitalized value and its lowercase variant would have to be labeled separately if both are present in the data.

VALUE LABELS
  /*var_list value 'label'* [*value 'label'*]. . .

`VALUE LABELS` allows values of variables to be associated with labels.

To set up value labels for one or more variables, specify the variable names after a slash (‘`/`’), followed by a list of values and their associated labels, separated by spaces.

Value labels in output are normally broken into lines automatically. Put ‘`\n`’ in a label string to force a line break at that point. The label may still be broken into lines at additional points.

Before `VALUE LABELS` is executed, any existing value labels are cleared from the variables specified. Use `ADD VALUE LABELS` (see Section 11.12 [ADD VALUE LABELS], page 101) to add value labels without clearing those already present.

11.12 ADD VALUE LABELS

`ADD VALUE LABELS` has the same syntax and purpose as `VALUE LABELS` (see Section 11.11 [VALUE LABELS], page 101), but it does not clear value labels from the variables before adding the ones specified.

ADD VALUE LABELS
  /*var_list value 'label'* [*value 'label'*]. . .

11.13 MISSING VALUES

In many situations the data available for analysis is incomplete and a placeholder must be used in place of a value to indicate that the value is unknown. One way that missing values are represented is through the $SYSMIS variable (see Section 6.7.2 [System Variables], page 31). Another, more flexible way is through *user-missing values* which are determined on a per variable basis.

The `MISSING VALUES` command sets user-missing values for variables.

MISSING VALUES *var_list* (*missing_values*).

where *missing_values* takes one of the following forms:

num1
num1, *num2*
num1, *num2*, *num3*
num1 THRU *num2*
num1 THRU *num2*, *num3*
string1
string1, *string2*
string1, *string2*, *string3*

As part of a range, `LO` or `LOWEST` may take the place of *num1*;
`HI` or `HIGHEST` may take the place of *num2*.

`MISSING VALUES` sets user-missing values for numeric and string variables. Long string variables may have missing values, but characters after the first 8 bytes of the missing value must be spaces.

Specify a list of variables, followed by a list of their user-missing values in parentheses. Up to three discrete values may be given, or, for numeric variables only, a range of values optionally accompanied by a single discrete value. Ranges may be open-ended on one end, indicated through the use of the keyword `LO` or `LOWEST` or `HI` or `HIGHEST`.

The `MISSING VALUES` command takes effect immediately. It is not affected by conditional and looping constructs such as `DO IF` or `LOOP`.

11.14 VARIABLE ATTRIBUTE

`VARIABLE ATTRIBUTE` adds, modifies, or removes user-defined attributes associated with variables in the active dataset. Custom variable attributes are not interpreted by PSPP, but they are saved as part of system files and may be used by other software that reads them.

VARIABLE ATTRIBUTE
VARIABLES=*var_list*
ATTRIBUTE=*name*('*value*') [*name*('*value*')]...
ATTRIBUTE=*name*[*index*]('*value*') [*name*[*index*]('*value*')]...
DELETE=*name* [*name*]...
DELETE=*name*[*index*] [*name*[*index*]]...

The required `VARIABLES` subcommand must come first. Specify the variables to which the following `ATTRIBUTE` or `DELETE` subcommand should apply.

Use the `ATTRIBUTE` subcommand to add or modify custom variable attributes. Specify the name of the attribute as an identifier (see Section 6.1 [Tokens], page 25), followed by the

desired value, in parentheses, as a quoted string. The specified attributes are then added or modified in the variables specified on `VARIABLES`. Attribute names that begin with `$` are reserved for PSPP's internal use, and attribute names that begin with `@` or `$@` are not displayed by most PSPP commands that display other attributes. Other attribute names are not treated specially.

Attributes may also be organized into arrays. To assign to an array element, add an integer array index enclosed in square brackets (`[` and `]`) between the attribute name and value. Array indexes start at 1, not 0. An attribute array that has a single element (number 1) is not distinguished from a non-array attribute.

Use the `DELETE` subcommand to delete an attribute from the variable specified on `VARIABLES`. Specify an attribute name by itself to delete an entire attribute, including all array elements for attribute arrays. Specify an attribute name followed by an array index in square brackets to delete a single element of an attribute array. In the latter case, all the array elements numbered higher than the deleted element are shifted down, filling the vacated position.

To associate custom attributes with the entire active dataset, instead of with particular variables, use `DATAFILE ATTRIBUTE` (see Section 8.3 [DATAFILE ATTRIBUTE], page 62) instead.

`VARIABLE ATTRIBUTE` takes effect immediately. It is not affected by conditional and looping structures such as `DO IF` or `LOOP`.

11.15 VARIABLE ALIGNMENT

`VARIABLE ALIGNMENT` sets the alignment of variables for display editing purposes. It does not affect the display of variables in the PSPP output.

```
VARIABLE ALIGNMENT
        var_list ( LEFT | RIGHT | CENTER )
        [ /var_list ( LEFT | RIGHT | CENTER ) ]
        .
        .
        .
        [ /var_list ( LEFT | RIGHT | CENTER ) ]
```

11.16 VARIABLE WIDTH

```
VARIABLE WIDTH
        var_list (width)
        [ /var_list (width) ]
        .
        .
        .
        [ /var_list (width) ]
```

`VARIABLE WIDTH` sets the column width of variables for display editing purposes. It does not affect the display of variables in the PSPP output.

11.17 VARIABLE LEVEL

`VARIABLE LEVEL` *variables* ({`SCALE` | `NOMINAL` | `ORDINAL`})...

`VARIABLE LEVEL` sets the measurement level of *variables* as specified. See Section 6.7.1 [Attributes], page 29, for the definitions of the available measurement levels.

11.18 VARIABLE ROLE

VARIABLE ROLE
/*role var_list*
[/*role var_list*]...

`VARIABLE ROLE` sets the intended role of a variable for use in dialog boxes in graphical user interfaces. Each *role* specifies one of the following roles for the variables that follow it:

`INPUT` An input variable, such as an independent variable.

`TARGET` An output variable, such as a dependent variable.

`BOTH` A variable used for input and output.

`NONE` No role assigned. (This is a variable's default role.)

`PARTITION`
Used to break the data into groups for testing.

`SPLIT` No meaning except for certain third party software. (This role's meaning is unrelated to `SPLIT FILE`.)

The PSPPIRE GUI does not yet use variable roles as intended.

11.19 VECTOR

Two possible syntaxes:
VECTOR *vec_name*=*var_list*.
VECTOR *vec_name_list*(*count* [*format*]).

`VECTOR` allows a group of variables to be accessed as if they were consecutive members of an array with a vector(index) notation.

To make a vector out of a set of existing variables, specify a name for the vector followed by an equals sign ('`=`') and the variables to put in the vector. The variables must be all numeric or all string, and string variables must have the same width.

To make a vector and create variables at the same time, specify one or more vector names followed by a count in parentheses. This will create variables named `vec1` through `veccount`. By default, the new variables are numeric with format F8.2, but an alternate format may be specified inside the parentheses before or after the count and separated from it by white space or a comma. With a string format such as A8, the variables will be string variables; with a numeric format, they will be numeric. Variable names including the suffixes may not exceed 64 characters in length, and none of the variables may exist prior to `VECTOR`.

Vectors created with `VECTOR` disappear after any procedure or procedure-like command is executed. The variables contained in the vectors remain, unless they are scratch variables (see Section 6.7.5 [Scratch Variables], page 41).

Variables within a vector may be referenced in expressions using `vector(index)` syntax.

11.20 MRSETS

`MRSETS` creates, modifies, deletes, and displays multiple response sets. A multiple response set is a set of variables that represent multiple responses to a survey question.

Multiple responses are represented in one of the two following ways:

- A *multiple dichotomy set* is analogous to a survey question with a set of checkboxes. Each variable in the set is treated in a Boolean fashion: one value (the "counted value") means that the box was checked, and any other value means that it was not.
- A *multiple category set* represents a survey question where the respondent is instructed to list up to *n* choices. Each variable represents one of the responses.

```
MRSETS
  /MDGROUP NAME=name VARIABLES=var_list VALUE=value
   [CATEGORYLABELS={VARLABELS,COUNTEDVALUES}]
   [{LABEL='label',LABELSOURCE=VARLABEL}]

  /MCGROUP NAME=name VARIABLES=var_list [LABEL='label']

  /DELETE NAME={[names],ALL}

  /DISPLAY NAME={[names],ALL}
```

Any number of subcommands may be specified in any order.

The `MDGROUP` subcommand creates a new multiple dichotomy set or replaces an existing multiple response set. The `NAME`, `VARIABLES`, and `VALUE` specifications are required. The others are optional:

- *NAME* specifies the name used in syntax for the new multiple dichotomy set. The name must begin with '`$`'; it must otherwise follow the rules for identifiers (see Section 6.1 [Tokens], page 25).
- `VARIABLES` specifies the variables that belong to the set. At least two variables must be specified. The variables must be all string or all numeric.
- `VALUE` specifies the counted value. If the variables are numeric, the value must be an integer. If the variables are strings, then the value must be a string that is no longer than the shortest of the variables in the set (ignoring trailing spaces).
- `CATEGORYLABELS` optionally specifies the source of the labels for each category in the set:
  - `VARLABELS`, the default, uses variable labels or, for variables without variable labels, variable names. PSPP warns if two variables have the same variable label, since these categories cannot be distinguished in output.
  - `COUNTEDVALUES` instead uses each variable's value label for the counted value. PSPP warns if two variables have the same value label for the counted value or if one of the variables lacks a value label, since such categories cannot be distinguished in output.
- `LABEL` optionally specifies a label for the multiple response set. If neither `LABEL` nor `LABELSOURCE=VARLABEL` is specified, the set is unlabeled.
- `LABELSOURCE=VARLABEL` draws the multiple response set's label from the first variable label among the variables in the set; if none of the variables has a label,

the name of the first variable is used. LABELSOURCE=VARLABEL must be used with CATEGORYLABELS=COUNTEDVALUES. It is mutually exclusive with LABEL.

The MCGROUP subcommand creates a new multiple category set or replaces an existing multiple response set. The NAME and VARIABLES specifications are required, and LABEL is optional. Their meanings are as described above in MDGROUP. PSPP warns if two variables in the set have different value labels for a single value, since each of the variables in the set should have the same possible categories.

The DELETE subcommand deletes multiple response groups. A list of groups may be named within a set of required square brackets, or ALL may be used to delete all groups.

The DISPLAY subcommand displays information about defined multiple response sets. Its syntax is the same as the DELETE subcommand.

Multiple response sets are saved to and read from system files by, *e.g.*, the SAVE and GET command. Otherwise, multiple response sets are currently used only by third party software.

11.21 LEAVE

LEAVE prevents the specified variables from being reinitialized whenever a new case is processed.

LEAVE *var_list*.

Normally, when a data file is processed, every variable in the active dataset is initialized to the system-missing value or spaces at the beginning of processing for each case. When a variable has been specified on LEAVE, this is not the case. Instead, that variable is initialized to 0 (not system-missing) or spaces for the first case. After that, it retains its value between cases.

This becomes useful for counters. For instance, in the example below the variable SUM maintains a running total of the values in the ITEM variable.

```
DATA LIST /ITEM 1-3.
COMPUTE SUM=SUM+ITEM.
PRINT /ITEM SUM.
LEAVE SUM
BEGIN DATA.
123
404
555
999
END DATA.
```

Partial output from this example:

```
123   123.00
404   527.00
555  1082.00
999  2081.00
```

It is best to use LEAVE command immediately before invoking a procedure command, because the left status of variables is reset by certain transformations—for instance, COMPUTE and IF. Left status is also reset by all procedure invocations.

12 Data transformations

The PSPP procedures examined in this chapter manipulate data and prepare the active dataset for later analyses. They do not produce output, as a rule.

12.1 AGGREGATE

AGGREGATE
[OUTFILE={*,'*file_name*',*file_handle*} [MODE={REPLACE,ADDVARIABLES}]]
[/MISSING=COLUMNWISE]
[/PRESORTED]
[/DOCUMENT]
[/BREAK=*var_list*]
/*dest_var*['*label*']...=*agr_func*(*src_vars*[, *args*]...)...

`AGGREGATE` summarizes groups of cases into single cases. It divides cases into groups that have the same values for one or more variables called *break variables*. Several functions are available for summarizing case contents.

The `AGGREGATE` syntax consists of subcommands to control its behavior, all of which are optional, followed by one or more destination variable assigments, each of which uses an aggregation function to define how it is calculated.

The `OUTFILE` subcommand, which must be first, names the destination for `AGGREGATE` output. It may name a system file by file name or file handle (see Section 6.9 [File Handles], page 42), a dataset by its name (see Section 6.7 [Datasets], page 29), or '`*`' to replace the active dataset. `AGGREGATE` writes its output to this file.

With `OUTFILE=*` only, `MODE` may be specified immediately afterward with the value `ADDVARIABLES` or `REPLACE`:

- With `REPLACE`, the default, the active dataset is replaced by a new dataset which contains just the break variables and the destination varibles. The new file contains as many cases as there are unique combinations of the break variables.
- With `ADDVARIABLES`, the destination variables are added to those in the existing active dataset. Cases that have the same combination of values in their break variables receive identical values for the destination variables. The number of cases in the active dataset remains unchanged. The data must be sorted on the break variables, that is, `ADDVARIABLES` implies `PRESORTED`

If `OUTFILE` is omitted, `AGGREGATE` acts as if `OUTFILE=* MODE=ADDVARIABLES` were specified.

By default, `AGGREGATE` first sorts the data on the break variables. If the active dataset is already sorted or grouped by the break variables, specify `PRESORTED` to save time. With `MODE=ADDVARIABLES`, the data must be pre-sorted.

Specify `DOCUMENT` to copy the documents from the active dataset into the aggregate file (see Section 17.5 [DOCUMENT], page 261). Otherwise, the aggregate file does not contain any documents, even if the aggregate file replaces the active dataset.

Normally, `AGGREGATE` produces a non-missing value whenever there is enough non-missing data for the aggregation function in use, that is, just one non-missing value or, for the `SD` and `SD.` aggregation functions, two non-missing values. Specify

/MISSING=COLUMNWISE to make AGGREGATE output a missing value when one or more of the input values are missing.

The BREAK subcommand is optionally but usually present. On BREAK, list the variables used to divide the active dataset into groups to be summarized.

AGGREGATE is particular about the order of subcommands. OUTFILE must be first, followed by MISSING. PRESORTED and DOCUMENT follow MISSING, in either order, followed by BREAK, then followed by aggregation variable specifications.

At least one set of aggregation variables is required. Each set comprises a list of aggregation variables, an equals sign ('='), the name of an aggregation function (see the list below), and a list of source variables in parentheses. A few aggregation functions do not accept source variables, and some aggregation functions expect additional arguments after the source variable names.

AGGREGATE typically creates aggregation variables with no variable label, value labels, or missing values. Their default print and write formats depend on the aggregation function used, with details given in the table below. A variable label for an aggregation variable may be specified just after the variable's name in the aggregation variable list.

Each set must have exactly as many source variables as aggregation variables. Each aggregation variable receives the results of applying the specified aggregation function to the corresponding source variable.

The following aggregation functions may be applied only to numeric variables:

MEAN(*var_name...*)
: Arithmetic mean. Limited to numeric values. The default format is F8.2.

MEDIAN(*var_name...*)
: The median value. Limited to numeric values. The default format is F8.2.

SD(*var_name...*)
: Standard deviation of the mean. Limited to numeric values. The default format is F8.2.

SUM(*var_name...*)
: Sum. Limited to numeric values. The default format is F8.2.

These aggregation functions may be applied to numeric and string variables:

CGT(*var_name..., value*)
CLT(*var_name..., value*)
CIN(*var_name..., low, high*)
COUT(*var_name..., low, high*)
: Total weight of cases greater than or less than *value* or inside or outside the closed range [*low*,*high*], respectively. The default format is F5.3.

FGT(*var_name..., value*)
FLT(*var_name..., value*)
FIN(*var_name..., low, high*)
FOUT(*var_name..., low, high*)
: Fraction of values greater than or less than *value* or inside or outside the closed range [*low*,*high*], respectively. The default format is F5.3.

`FIRST(var_name...)`
`LAST(var_name...)`
: First or last non-missing value, respectively, in break group. The aggregation variable receives the complete dictionary information from the source variable. The sort performed by `AGGREGATE` (and by `SORT CASES`) is stable. This means that the first (or last) case with particular values for the break variables before sorting is also the first (or last) case in that break group after sorting.

`MIN(var_name...)`
`MAX(var_name...)`
: Minimum or maximum value, respectively. The aggregation variable receives the complete dictionary information from the source variable.

`N(var_name...)`
`NMISS(var_name...)`
: Total weight of non-missing or missing values, respectively. The default format is F7.0 if weighting is not enabled, F8.2 if it is (see Section 13.7 [WEIGHT], page 133).

`NU(var_name...)`
`NUMISS(var_name...)`
: Count of non-missing or missing values, respectively, ignoring case weights. The default format is F7.0.

`PGT(var_name..., value)`
`PLT(var_name..., value)`
`PIN(var_name..., low, high)`
`POUT(var_name..., low, high)`
: Percentage between 0 and 100 of values greater than or less than *VALUE* or inside or outside the closed range [*low*,*high*], respectively. The default format is F5.1.

These aggregation functions do not accept source variables:

`N`
: Total weight of cases aggregated to form this group. The default format is F7.0 if weighting is not enabled, F8.2 if it is (see Section 13.7 [WEIGHT], page 133).

`NU`
: Count of cases aggregated to form this group, ignoring case weights. The default format is F7.0.

Aggregation functions compare string values in terms of internal character codes. On most modern computers, this is ASCII or a superset thereof.

The aggregation functions listed above exclude all user-missing values from calculations. To include user-missing values, insert a period ('`.`') at the end of the function name. (*e.g.* '`SUM.`'). (Be aware that specifying such a function as the last token on a line causes the period to be interpreted as the end of the command.)

`AGGREGATE` both ignores and cancels the current `SPLIT FILE` settings (see Section 13.5 [SPLIT FILE], page 129).

12.1.1 Aggregate Example

The `personnel.sav` dataset provides the occupations and salaries of many individuals. For many purposes however such detailed information is not interesting, but often the aggregated statistics of each occupation are of interest. In Example 12.1 the `AGGREGATE` command is used to calculate the mean, the median and the standard deviation of each occupation.

```
GET FILE="personnel.sav".
AGGREGATE OUTFILE=* MODE=REPLACE
        /BREAK=occupation
        /occ_mean_salary=MEAN(salary)
        /occ_median_salary=MEDIAN(salary)
        /occ_std_dev_salary=SD(salary).
LIST.
```

Example 12.1: Calculating aggregated statistics from the `personnel.sav` file.

Since we chose the '`MODE=REPLACE`' option, in Results 12.1 cases for the individual persons are no longer present. They have each been replaced by a single case per aggregated value.

Data List

occupation	occ_mean_salary	occ_median_salary	occ_std_dev_salary
Artist	37836.18	34712.50	7631.48
Baker	45075.20	45075.20	4411.21
Barrister	39504.00	39504.00	.
Carpenter	39349.11	36190.04	7453.40
Cleaner	41142.50	39647.49	14378.98
Cook	40357.79	43194.00	11064.51
Manager	46452.14	45657.56	6901.69
Mathematician	34531.06	34763.06	5267.68
Painter	45063.55	45063.55	15159.67
Payload Specialist	34355.72	34355.72	.
Plumber	40413.91	40410.00	4726.05
Scientist	36687.07	36803.83	10873.54
Scrientist	42530.65	42530.65	.
Tailor	34586.79	34586.79	3728.98

Results 12.1: Aggregated mean, median and standard deviation per **occupation**.

Note that some values for the standard deviation are blank. This is because there is only one case with the respective occupation.

12.2 AUTORECODE

AUTORECODE VARIABLES=*src_vars* INTO *dest_vars*
[/DESCENDING]
[/PRINT]
[/GROUP]
[/BLANK = {VALID, MISSING}]

The AUTORECODE procedure considers the n values that a variable takes on and maps them onto values $1 \ldots n$ on a new numeric variable.

Subcommand VARIABLES is the only required subcommand and must come first. Specify VARIABLES, an equals sign ('='), a list of source variables, INTO, and a list of target variables. There must the same number of source and target variables. The target variables must not already exist.

AUTORECODE ordinarily assigns each increasing non-missing value of a source variable (for a string, this is based on character code comparisons) to consecutive values of its target variable. For example, the smallest non-missing value of the source variable is recoded to value 1, the next smallest to 2, and so on. If the source variable has user-missing values, they are recoded to consecutive values just above the non-missing values. For example, if a source variables has seven distinct non-missing values, then the smallest missing value would be recoded to 8, the next smallest to 9, and so on.

Use DESCENDING to reverse the sort order for non-missing values, so that the largest non-missing value is recoded to 1, the second-largest to 2, and so on. Even with DESCENDING, user-missing values are still recoded in ascending order just above the non-missing values.

The system-missing value is always recoded into the system-missing variable in target variables.

If a source value has a value label, then that value label is retained for the new value in the target variable. Otherwise, the source value itself becomes each new value's label.

Variable labels are copied from the source to target variables.

PRINT is currently ignored.

The GROUP subcommand is relevant only if more than one variable is to be recoded. It causes a single mapping between source and target values to be used, instead of one map per variable. With GROUP, user-missing values are taken from the first source variable that has any user-missing values.

If /BLANK=MISSING is given, then string variables which contain only whitespace are recoded as SYSMIS. If /BLANK=VALID is specified then they are allocated a value like any other. /BLANK is not relevant to numeric values. /BLANK=VALID is the default.

AUTORECODE is a procedure. It causes the data to be read. It ignores TEMPORARY (see Section 13.6 [TEMPORARY], page 132), so that "temporary" transformations become permanent.

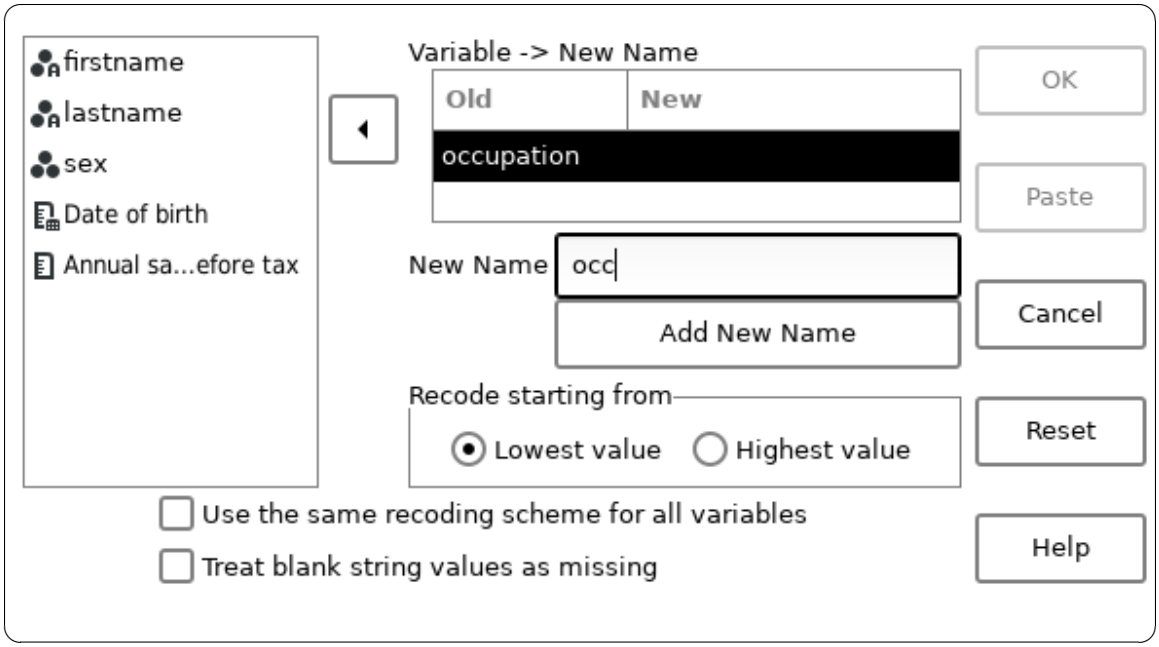
12.2.1 Autorecode Example

In the file personnel.sav, the variable **occupation** is a string variable. Except for data of a purely commentary nature, string variables are generally a bad idea. One reason is that data entry errors are easily overlooked. This has happened in personnel.sav; one entry which should read "Scientist" has been mistyped as "Scrientist". In Example 12.2 first, this error is corrected by the DO IF clause,[1] then we use AUTORECODE to create a new numeric variable which takes recoded values of **occupation**. Finally, we remove the old variable and rename the new variable to the name of the old variable.

[1] One must use care when correcting such data input errors rather than msimply marking them as missing. For example, if an occupation has been entered "Barister", did the person mean "Barrister" or did she mean "Barista"?

```
get file='personnel.sav'.

* Correct a typing error in the original file.
do if occupation = "Scrientist".
 compute occupation = "Scientist".
end if.

autorecode
          variables = occupation into occ
          /blank = missing.

* Delete the old variable.
delete variables occupation.

* Rename the new variable to the old variable's name.
rename variables (occ = occupation).

* Inspect the new variable.
display dictionary /variables=occupation.
```

Example 12.2: Changing a string variable to a numeric variable using `AUTORECODE` after correcting a data entry error



Screenshot 12.1: Autorecode dialog box set to recode **occupation** to **occ**

Notice in Result 12.1, how the new variable has been automatically allocated value labels which correspond to the strings of the old variable. This means that in future analyses the descriptive strings are reported instead of the numeric values.

```
                                   Variables
+----------+--------+--------------+-----+-----+---------+----------+---------+
|          |        |  Measurement |     |     |         |   Print  |  Write  |
|Name      |Position|     Level    | Role|Width|Alignment|  Format  |  Format |
+----------+--------+--------------+-----+-----+---------+----------+---------+
|occupation|       6|Unknown       |Input|    8|Right    |F2.0      |F2.0     |
+----------+--------+--------------+-----+-----+---------+----------+---------+

            Value Labels
+---------------+------------------+
|Variable Value |       Label      |
+---------------+------------------+
|occupation 1   |Artist            |
|           2   |Baker             |
|           3   |Barrister         |
|           4   |Carpenter         |
|           5   |Cleaner           |
|           6   |Cook              |
|           7   |Manager           |
|           8   |Mathematician     |
|           9   |Painter           |
|           10  |Payload Specialist|
|           11  |Plumber           |
|           12  |Scientist         |
|           13  |Tailor            |
+---------------+------------------+
```

Result 12.1: The properties of the **occupation** variable following `AUTORECODE`

12.3 COMPUTE

COMPUTE *variable* = *expression*.

or

COMPUTE vector(*index*) = *expression*.

`COMPUTE` assigns the value of an expression to a target variable. For each case, the expression is evaluated and its value assigned to the target variable. Numeric and string variables may be assigned. When a string expression's width differs from the target variable's width, the string result of the expression is truncated or padded with spaces on the right as necessary. The expression and variable types must match.

For numeric variables only, the target variable need not already exist. Numeric variables created by `COMPUTE` are assigned an `F8.2` output format. String variables must be declared before they can be used as targets for `COMPUTE`.

The target variable may be specified as an element of a vector (see Section 11.19 [VECTOR], page 104). In this case, an expression *index* must be specified in parentheses following the vector name. The expression *index* must evaluate to a numeric value that, after rounding down to the nearest integer, is a valid index for the named vector.

Using `COMPUTE` to assign to a variable specified on `LEAVE` (see Section 11.21 [LEAVE], page 106) resets the variable's left state. Therefore, `LEAVE` should be specified following `COMPUTE`, not before.

`COMPUTE` is a transformation. It does not cause the active dataset to be read.

When COMPUTE is specified following TEMPORARY (see Section 13.6 [TEMPORARY], page 132), the LAG function may not be used (see [LAG], page 55).

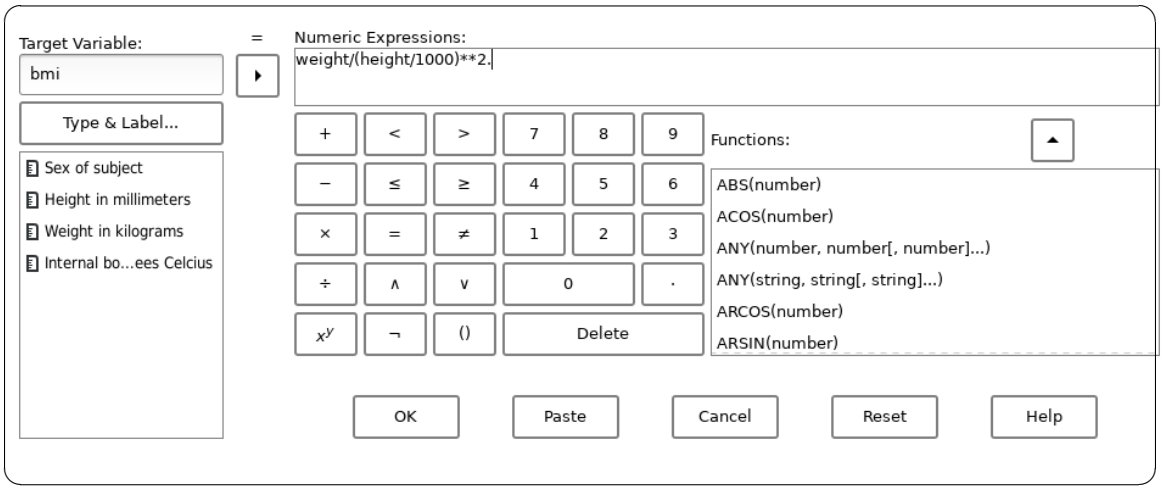
12.3.1 Compute Examples

The dataset physiology.sav contains the height and weight of persons. For some purposes, neither height nor weight alone is of interest. Epidemiologists are often more interested in the *body mass index* which can sometimes be used as a predictor for clinical conditions. The body mass index is defined as the weight of the person in kilograms divided by the square of the person's height in metres.[2]

```
get file='physiology.sav'.

* height is in mm so we must divide by 1000 to get metres.
compute bmi = weight / (height/1000)**2.
variable label bmi "Body Mass Index".

descriptives /weight height bmi.
```

Example 12.3: Computing the body mass index from **weight** and **height**

Example 12.3 shows how you can use COMPUTE to generate a new variable called **bmi** and have every case's value calculated from the existing values of **weight** and **height**. It also shows how you can add a label to this new variable (see Section 11.7 [VARIABLE LABELS], page 100), so that a more descriptive label appears in subsequent analyses, and this can be seen in the ouput from the DESCRIPTIVES command in Results 12.2.



Screenshot 12.2: Using the dialog box to generate a new variable and compute its values

The expression which follows the '=' sign can be as complicated as necessary. See Chapter 7 [Expressions], page 44, for a precise description of the language accepted. Normally it is easiest to enter the code directly, however there is a dialog box available if desired.

[2] Since BMI is a quantity with a ratio scale and has units, the term "index" is a misnomer, but that is what it is called.

This is illustrated in Screenshot 12.2. One advantage is that it offers a list of mathematical functions which can be selected and pasted into the expression.

```
                    Descriptive Statistics
+---------------------+--+-------+-------+-------+-------+
|                     | N|  Mean |Std Dev|Minimum|Maximum|
+---------------------+--+-------+-------+-------+-------+
|Weight in kilograms  |40|  72.12|  26.70|  -55.6|   92.1|
|Height in millimeters|40|1677.12| 262.87|    179|   1903|
|Body Mass Index      |40|  67.46| 274.08| -21.62|1756.82|
|Valid N (listwise)   |40|       |       |       |       |
|Missing N (listwise) | 0|       |       |       |       |
+---------------------+--+-------+-------+-------+-------+
```

Results 12.2: An analysis which includes **bmi** in its results

12.4 COUNT

COUNT *var_name* = *var*... (*value*...)
[/*var_name* = *var*... (*value*...)]...

Each *value* takes one of the following forms:
number
string
num1 THRU *num2*
MISSING
SYSMIS
where *num1* is a numeric expression or the words `LO` or `LOWEST`
and *num2* is a numeric expression or `HI` or `HIGHEST`.

`COUNT` creates or replaces a numeric *target* variable that counts the occurrence of a *criterion* value or set of values over one or more *test* variables for each case.

The target variable values are always nonnegative integers. They are never missing. The target variable is assigned an F8.2 output format. See Section 6.7.4 [Input and Output Formats], page 32. Any variables, including string variables, may be test variables.

User-missing values of test variables are treated just like any other values. They are **not** treated as system-missing values. User-missing values that are criterion values or inside ranges of criterion values are counted as any other values. However (for numeric variables), keyword `MISSING` may be used to refer to all system- and user-missing values.

`COUNT` target variables are assigned values in the order specified. In the command `COUNT A=A B(1) /B=A B(2).`, the following actions occur:

- The number of occurrences of 1 between A and B is counted.
- A is assigned this value.
- The number of occurrences of 1 between B and the **new** value of A is counted.
- B is assigned this value.

Despite this ordering, all `COUNT` criterion variables must exist before the procedure is executed—they may not be created as target variables earlier in the command! Break such a command into two separate commands.

12.4.1 Count Examples

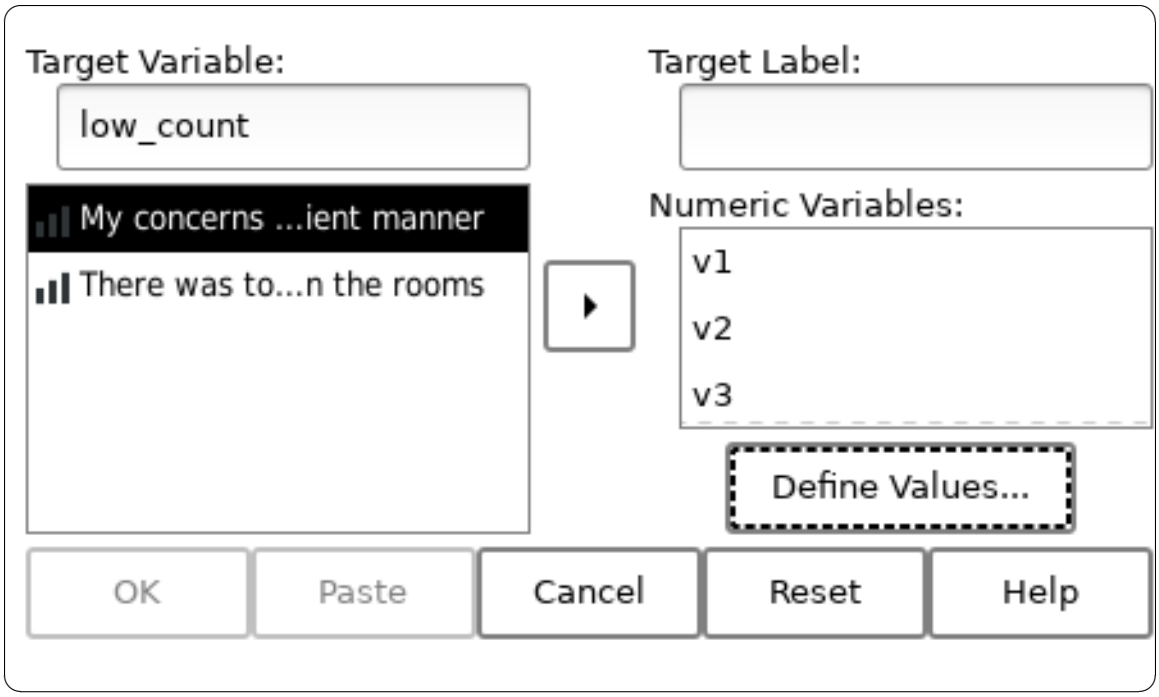
In the survey results in dataset `hotel.sav` a manager wishes to know how many respondents answered with low valued answers to questions **v1**, **v2** and **v3**. This can be found using the code in Example 12.4. Specifically, this code creates a new variable, and populates it with the number of values in **v1**–**v2** which are 2 or lower.

```
get file="hotel.sav".

count low_counts = v1 v2 v3 (low thru 2).

list /variables v1 v2 v3 low_counts.
```

Example 12.4: Counting low values to responses **v1**, **v2** and **v3**

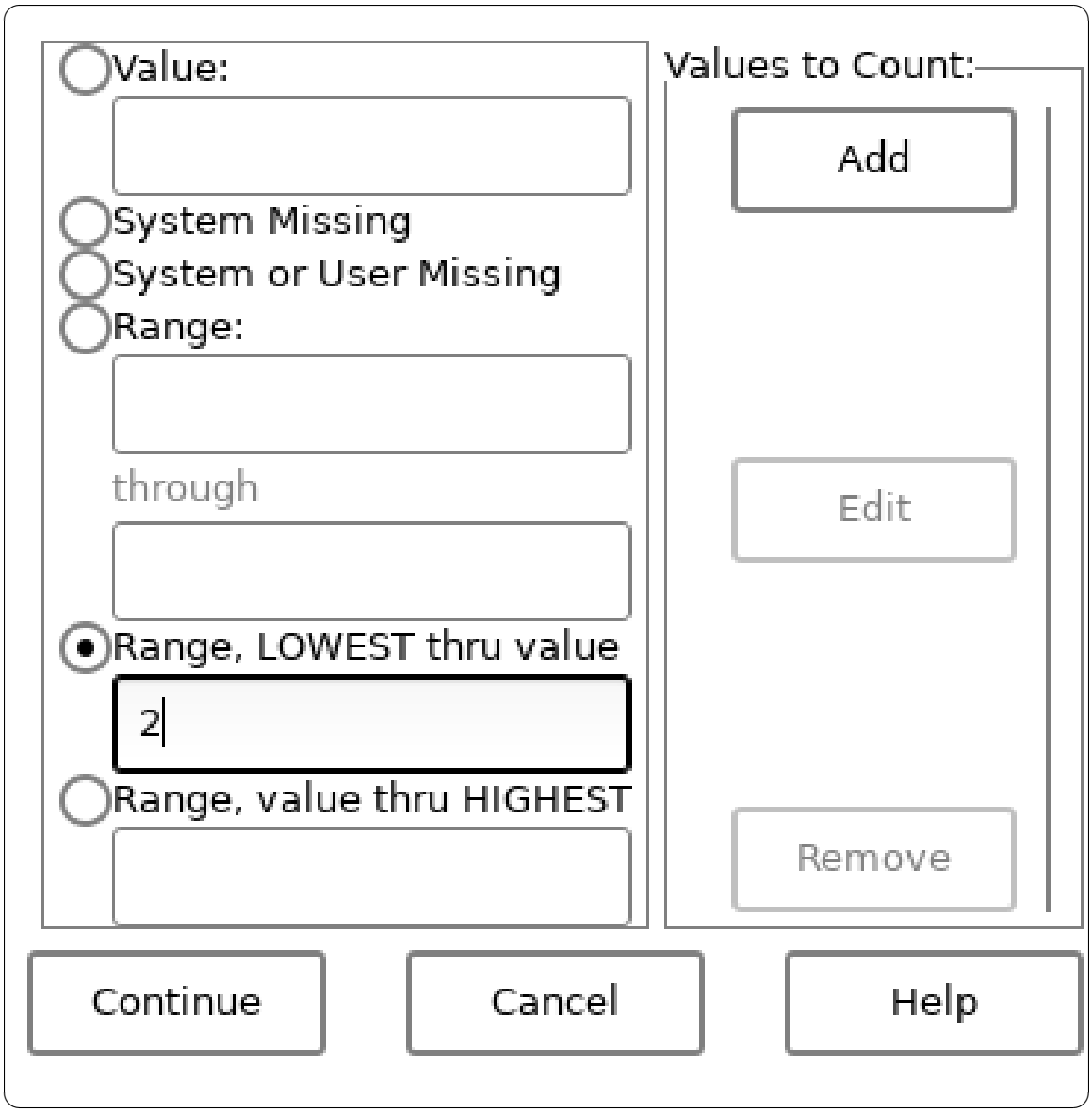
In Example 12.4 the `COUNT` transformation creates a new variable, **low_counts** and its values are shown using the `LIST` command.

If using the graphic user interface, a two step process must be used to set up the `COUNT` transformation. The first dialog box (Screenshot 12.3) provides for the variables to be chosen. Then, one must click on the button marked "Define Values..." to reveal the dialog box for selecting the values to count.



Screenshot 12.3: The variables **v1**, **v2** and **v3** selected, ready to define values to count

In this dialog box, you must select the values you wish to count — in this case all values up to and including 2 — as shown in Screenshot 12.4 and click "Add". As many ranges or may be added as you desire. When all desired ranges have been added click "Continue".



Screenshot 12.4: Count "Define Values" dialog with '`lowest thru 2`' selected

In Result 12.2 we can see the values of **low_counts** after the `COUNT` transformation has completed. The first value is 1, because there is only one variable amoung **v1**, **v2** and **3** which has a value of 2 or less. The second value is 2, because both **v1** and **v2** are 2 or less.

```
      Data List
+--+--+--+----------+
|v1|v2|v3|low_counts|
+--+--+--+----------+
| 4| 2| 3|      1.00|
| 1| 1| 4|      2.00|
| 4| 2| 2|      2.00|
| 3| 1| 3|      1.00|
| 5| 3| 1|      1.00|
| 2| 2| 5|      2.00|
| 3| 2| 4|      1.00|
| 1| 4| 5|      1.00|
| 3| 2| 3|      1.00|
| 2| 5| 4|      1.00|
| 4| 2| 2|      2.00|
| 2| 1| 4|      2.00|
| 1| 2| 5|      2.00|
| 2| 3| 3|      1.00|
| 4| 1| 1|      2.00|
| 1| 1| 5|      2.00|
| 1| 5| 5|      1.00|
+--+--+--+----------+
```

Result 12.2: The values of **v1**, **v2**, **v3** and **low_counts** after the `COUNT` transformation has run

12.5 FLIP

FLIP /VARIABLES=*var_list* /NEWNAMES=*var_name*.

`FLIP` transposes rows and columns in the active dataset. It causes cases to be swapped with variables, and vice versa.

All variables in the transposed active dataset are numeric. String variables take on the system-missing value in the transposed file.

`N` subcommands are required. If specified, the `VARIABLES` subcommand selects variables to be transformed into cases, and variables not specified are discarded. If the `VARIABLES` subcommand is omitted, all variables are selected for transposition.

The variables specified by `NEWNAMES`, which must be a string variable, is used to give names to the variables created by `FLIP`. Only the first 8 characters of the variable are used. If `NEWNAMES` is not specified then the default is a variable named **CASE_LBL**, if it exists. If it does not then the variables created by `FLIP` are named VAR000 through VAR999, then VAR1000, VAR1001, and so on.

When a `NEWNAMES` variable is available, the names must be canonicalized before becoming variable names. Invalid characters are replaced by letter '`V`' in the first position, or by '`_`' in subsequent positions. If the name thus generated is not unique, then numeric extensions are added, starting with 1, until a unique name is found or there are no remaining possibilities. If the latter occurs then the `FLIP` operation aborts.

The resultant dictionary contains a **CASE_LBL** variable, a string variable of width 8, which stores the names of the variables in the dictionary before the transposition. Variables names longer than 8 characters are truncated. If `FLIP` is called again on this dataset, the **CASE_LBL** variable can be passed to the `NEWNAMES` subcommand to recreate the original variable names.

FLIP honors N OF CASES (see Section 13.2 [N OF CASES], page 127). It ignores TEMPORARY (see Section 13.6 [TEMPORARY], page 132), so that "temporary" transformations become permanent.

12.5.1 Flip Examples

In Example 12.5, data has been entered using DATA LIST (see Section 8.5 [DATA LIST], page 64) such that the first variable in the dataset is a string variable containing a description of the other data for the case. Clearly this is not a convenient arrangement for performing statistical analyses, so it would have been better to think a little more carefully about how the data should have been arranged. However often the data is provided by some third party source, and you have no control over the form. Fortunately, we can use FLIP to exchange the variables and cases in the active dataset.

```
data list notable list /heading (a16) v1 v2 v3 v4 v5 v6
begin data.
date-of-birth 1970 1989 2001 1966 1976 1982
sex 1 0 0 1 0 1
score 10 10 9 3 8 9
end data.

echo 'Before FLIP:'.
display variables.
list.

flip /variables = all /newnames = heading.

echo 'After FLIP:'.
display variables.
list.
```

Example 12.5: Using FLIP to exchange variables and cases in a dataset

As you can see in Results 12.3 before the FLIP command has run there are seven variables (six containing data and one for the heading) and three cases. Afterwards there are four variables (one per case, plus the **CASE_LBL** variable) and six cases. You can delete the **CASE_LBL** variable (see Section 11.6 [DELETE VARIABLES], page 100) if you don't need it.

```
Before FLIP:

                  Variables
+-------+--------+------------+------------+
|Name   |Position|Print Format|Write Format|
+-------+--------+------------+------------+
|heading|       1|A16         |A16         |
|v1     |       2|F8.2        |F8.2        |
|v2     |       3|F8.2        |F8.2        |
|v3     |       4|F8.2        |F8.2        |
|v4     |       5|F8.2        |F8.2        |
|v5     |       6|F8.2        |F8.2        |
|v6     |       7|F8.2        |F8.2        |
+-------+--------+------------+------------+

                           Data List
+-------------+-------+-------+-------+-------+-------+-------+
|   heading   |   v1  |   v2  |   v3  |   v4  |   v5  |   v6  |
+-------------+-------+-------+-------+-------+-------+-------+
|date-of-birth|1970.00|1989.00|2001.00|1966.00|1976.00|1982.00|
|sex          |   1.00|    .00|    .00|   1.00|    .00|   1.00|
|score        |  10.00|  10.00|   9.00|   3.00|   8.00|   9.00|
+-------------+-------+-------+-------+-------+-------+-------+

After FLIP:

                     Variables
+-------------+--------+------------+------------+
|Name         |Position|Print Format|Write Format|
+-------------+--------+------------+------------+
|CASE_LBL     |       1|A8          |A8          |
|date_of_birth|       2|F8.2        |F8.2        |
|sex          |       3|F8.2        |F8.2        |
|score        |       4|F8.2        |F8.2        |
+-------------+--------+------------+------------+

             Data List
+--------+-------------+----+-----+
|CASE_LBL|date_of_birth| sex|score|
+--------+-------------+----+-----+
|v1      |      1970.00|1.00|10.00|
|v2      |      1989.00| .00|10.00|
|v3      |      2001.00| .00| 9.00|
|v4      |      1966.00|1.00| 3.00|
|v5      |      1976.00| .00| 8.00|
|v6      |      1982.00|1.00| 9.00|
+--------+-------------+----+-----+
```

Results 12.3: The results of using `FLIP` to exchange variables and cases in a dataset

12.6 IF

IF *condition variable=expression.*

or

IF *condition* vector(*index*)=*expression.*

The IF transformation conditionally assigns the value of a target expression to a target variable, based on the truth of a test expression.

Specify a boolean-valued expression (see Chapter 7 [Expressions], page 44) to be tested following the IF keyword. This expression is evaluated for each case. If the value is true, then the value of the expression is computed and assigned to the specified variable. If the value is false or missing, nothing is done. Numeric and string variables may be assigned. When a string expression's width differs from the target variable's width, the string result of the expression is truncated or padded with spaces on the right as necessary. The expression and variable types must match.

The target variable may be specified as an element of a vector (see Section 11.19 [VECTOR], page 104). In this case, a vector index expression must be specified in parentheses following the vector name. The index expression must evaluate to a numeric value that, after rounding down to the nearest integer, is a valid index for the named vector.

Using IF to assign to a variable specified on LEAVE (see Section 11.21 [LEAVE], page 106) resets the variable's left state. Therefore, LEAVE should be specified following IF, not before.

When IF is specified following TEMPORARY (see Section 13.6 [TEMPORARY], page 132), the LAG function may not be used (see [LAG], page 55).

12.7 RECODE

The RECODE command is used to transform existing values into other, user specified values. The general form is:

RECODE *src_vars*
(*src_value* *src_value* ... = *dest_value*)
(*src_value* *src_value* ... = *dest_value*)
(*src_value* *src_value* ... = *dest_value*) ...
[INTO *dest_vars*].

Following the RECODE keyword itself comes *src_vars* which is a list of variables whose values are to be transformed. These variables may be string variables or they may be numeric. However the list must be homogeneous; you may not mix string variables and numeric variables in the same recoding.

After the list of source variables, there should be one or more *mappings*. Each mapping is enclosed in parentheses, and contains the source values and a destination value separated by a single '='. The source values are used to specify the values in the dataset which need to change, and the destination value specifies the new value to which they should be changed. Each *src_value* may take one of the following forms:

number If the source variables are numeric then *src_value* may be a literal number.

string If the source variables are string variables then *src_value* may be a literal string (like all strings, enclosed in single or double quotes).

num1 THRU *num2*
This form is valid only when the source variables are numeric. It specifies all values in the range between *num1* and *num2*, including both endpoints of the range. By convention, *num1* should be less than *num2*. Open-ended ranges may be specified using 'LO' or 'LOWEST' for *num1* or 'HI' or 'HIGHEST' for *num2*.

'MISSING' The literal keyword 'MISSING' matches both system missing and user missing values. It is valid for both numeric and string variables.

'SYSMIS' The literal keyword 'SYSMIS' matches system missing values. It is valid for both numeric variables only.

'ELSE' The 'ELSE' keyword may be used to match any values which are not matched by any other *src_value* appearing in the command. If this keyword appears, it should be used in the last mapping of the command.

After the source variables comes an '=' and then the *dest_value*. The *dest_value* may take any of the following forms:

number A literal numeric value to which the source values should be changed. This implies the destination variable must be numeric.

string A literal string value (enclosed in quotation marks) to which the source values should be changed. This implies the destination variable must be a string variable.

'SYSMIS' The keyword 'SYSMIS' changes the value to the system missing value. This implies the destination variable must be numeric.

'COPY' The special keyword 'COPY' means that the source value should not be modified, but copied directly to the destination value. This is meaningful only if 'INTO *dest_vars*' is specified.

Mappings are considered from left to right. Therefore, if a value is matched by a *src_value* from more than one mapping, the first (leftmost) mapping which matches is considered. Any subsequent matches are ignored.

The clause 'INTO *dest_vars*' is optional. The behaviour of the command is slightly different depending on whether it appears or not.

If 'INTO *dest_vars*' does not appear, then values are recoded "in place". This means that the recoded values are written back to the source variables from whence the original values came. In this case, the *dest_value* for every mapping must imply a value which has the same type as the *src_value*. For example, if the source value is a string value, it is not permissible for *dest_value* to be 'SYSMIS' or another forms which implies a numeric result. It is also not permissible for *dest_value* to be longer than the width of the source variable.

The following example two numeric variables *x* and *y* are recoded in place. Zero is recoded to 99, the values 1 to 10 inclusive are unchanged, values 1000 and higher are recoded to the system-missing value and all other values are changed to 999:

```
recode x y
        (0 = 99)
        (1 THRU 10 = COPY)
        (1000 THRU HIGHEST = SYSMIS)
        (ELSE = 999).
```

If 'INTO *dest_vars*' is given, then recoded values are written into the variables specified in *dest_vars*, which must therefore contain a list of valid variable names. The number of variables in *dest_vars* must be the same as the number of variables in *src_vars* and the respective order of the variables in *dest_vars* corresponds to the order of *src_vars*. That

is to say, the recoded value whose original value came from the *n*th variable in *src_vars* is placed into the *n*th variable in *dest_vars*. The source variables are unchanged. If any mapping implies a string as its destination value, then the respective destination variable must already exist, or have been declared using `STRING` or another transformation. Numeric variables however are automatically created if they don't already exist. The following example deals with two source variables, *a* and *b* which contain string values. Hence there are two destination variables *v1* and *v2*. Any cases where *a* or *b* contain the values '`apple`', '`pear`' or '`pomegranate`' result in *v1* or *v2* being filled with the string '`fruit`' whilst cases with '`tomato`', '`lettuce`' or '`carrot`' result in '`vegetable`'. Any other values produce the result '`unknown`':

```
string v1 (a20).
string v2 (a20).

recode a b
        ("apple" "pear" "pomegranate" = "fruit")
        ("tomato" "lettuce" "carrot" = "vegetable")
        (ELSE = "unknown")
        into v1 v2.
```

There is one very special mapping, not mentioned above. If the source variable is a string variable then a mapping may be specified as '`(CONVERT)`'. This mapping, if it appears must be the last mapping given and the '`INTO` *`dest_vars`*' clause must also be given and must not refer to a string variable. '`CONVERT`' causes a number specified as a string to be converted to a numeric value. For example it converts the string '`"3"`' into the numeric value 3 (note that it does not convert '`three`' into 3). If the string cannot be parsed as a number, then the system-missing value is assigned instead. In the following example, cases where the value of *x* (a string variable) is the empty string, are recoded to 999 and all others are converted to the numeric equivalent of the input value. The results are placed into the numeric variable *y*:

```
recode x
       ("" = 999)
        (convert)
        into y.
```

It is possible to specify multiple recodings on a single command. Introduce additional recodings with a slash ('`/`') to separate them from the previous recodings:

```
recode
        a  (2 = 22) (else = 99)
        /b (1 = 3) into z
        .
```

Here we have two recodings. The first affects the source variable *a* and recodes in-place the value 2 into 22 and all other values to 99. The second recoding copies the values of *b* into the variable *z*, changing any instances of 1 into 3.

12.8 SORT CASES

SORT CASES BY *var_list*[({D|A}] [*var_list*[({D|A}]] ...

`SORT CASES` sorts the active dataset by the values of one or more variables.

Specify BY and a list of variables to sort by. By default, variables are sorted in ascending order. To override sort order, specify (D) or (DOWN) after a list of variables to get descending order, or (A) or (UP) for ascending order. These apply to all the listed variables up until the preceding (A), (D), (UP) or (DOWN).

The sort algorithms used by SORT CASES are stable. This means records which have equal values of the sort variables have the same relative order before and after sorting. Thus, re-sorting an already sorted file does not affect the ordering of cases.

SORT CASES is a procedure. It causes the data to be read.

SORT CASES attempts to sort the entire active dataset in main memory. If workspace is exhausted, it falls back to a merge sort algorithm which creates numerous temporary files.

SORT CASES may not be specified following TEMPORARY.

12.8.1 Sorting Example

In Example 12.6 the data from the file physiology.sav is sorted by two variables, *viz* **sex** in descending order and **temperature** in ascending order.

```
get file='physiology.sav'.
sort cases by sex (D) temperature(A).
list.
```

Example 12.6: Sorting cases by two variables.

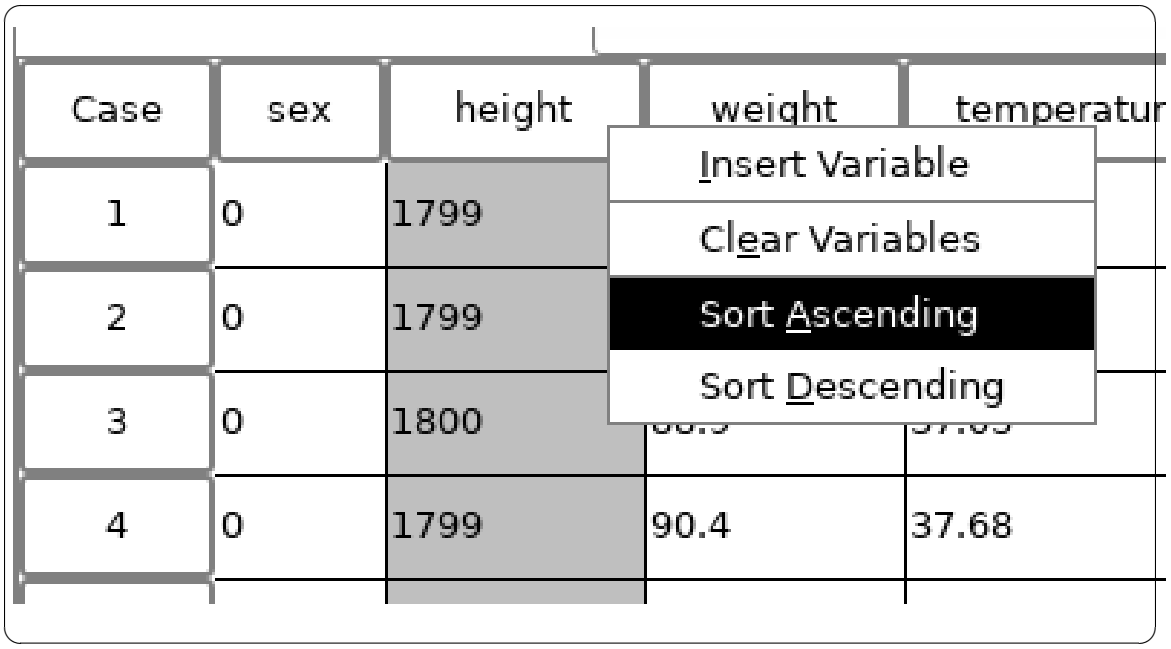
In Results 12.4 you can see that all the cases with a **sex** of '1' (female) appear before those with a sex of '0' (male). This is because they have been sorted in descending order. Within each sex, the data is sorted on the **temperature** variable, this time in ascending order.

```
            Data List
+---+------+------+-----------+
|sex|height|weight|temperature|
+---+------+------+-----------+
|  1|  1606|  56.1|      34.56|
|  1|   179|  56.3|      35.15|
|  1|  1609|  55.4|      35.46|
|  1|  1606|  56.0|      36.06|
|  1|  1607|  56.3|      36.26|
|  1|  1604|  56.0|      36.57|
|  1|  1604|  56.6|      36.81|
|  1|  1606|  56.3|      36.88|
|  1|  1604|  57.8|      37.32|
|  1|  1598|  55.6|      37.37|
|  1|  1607|  55.9|      37.84|
|  1|  1605|  54.5|      37.86|
|  1|  1603|  56.1|      38.80|
|  1|  1604|  58.1|      38.85|
|  1|  1605|  57.7|      38.98|
|  1|  1709|  55.6|      39.45|
|  1|  1604| -55.6|      39.72|
|  1|  1601|  55.9|      39.90|
|  0|  1799|  90.3|      32.59|
|  0|  1799|  89.0|      33.61|
|  0|  1799|  90.6|      34.04|
|  0|  1801|  90.5|      34.42|
|  0|  1802|  87.7|      35.03|
|  0|  1793|  90.1|      35.11|
|  0|  1801|  92.1|      35.98|
|  0|  1800|  89.5|      36.10|
|  0|  1645|  92.1|      36.68|
|  0|  1698|  90.2|      36.94|
|  0|  1800|  89.6|      37.02|
|  0|  1800|  88.9|      37.03|
|  0|  1801|  88.9|      37.12|
|  0|  1799|  90.4|      37.33|
|  0|  1903|  91.5|      37.52|
|  0|  1799|  90.9|      37.53|
|  0|  1800|  91.0|      37.60|
|  0|  1799|  90.4|      37.68|
|  0|  1801|  91.7|      38.98|
|  0|  1801|  90.9|      39.03|
|  0|  1799|  89.3|      39.77|
|  0|  1884|  88.6|      39.97|
+---+------+------+-----------+
```

Results 12.4: The `physiology.sav` file after sorting.

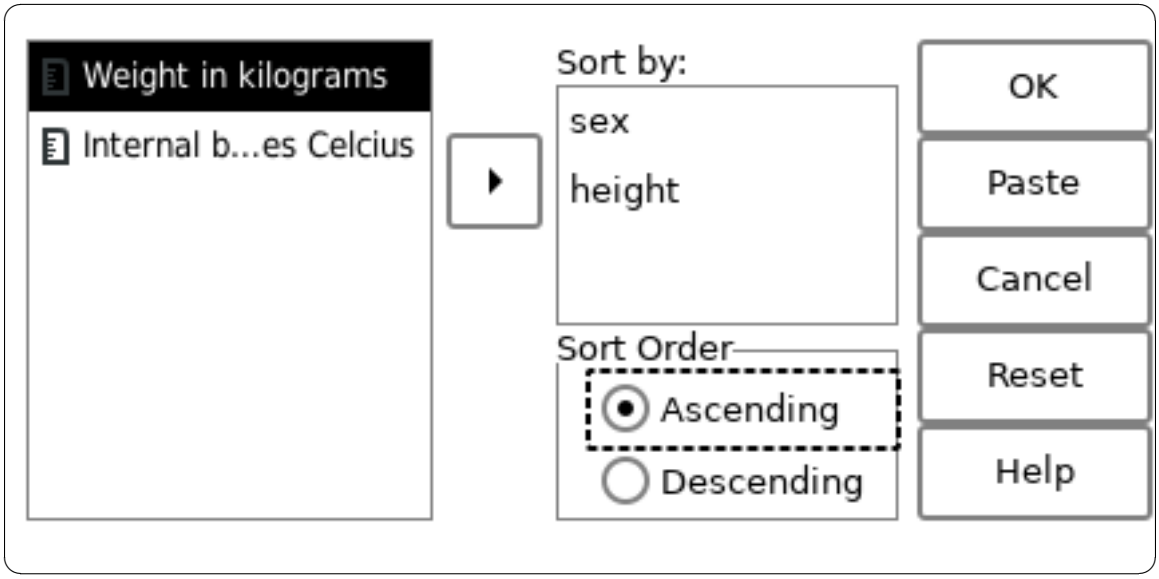
Note that `SORT CASES`, like all other transformations, affects only the active file. It does not have any effect upon the `physiology.sav` file itself. For that, you would have to rewrite the file using the `SAVE` command (see Section 9.6 [SAVE], page 86).

When using the graphic user interface, it is often simpler to perform a sort directly from the data view. To do this, switch to the data view. Select the column corresponding to the variable by which you want to sort and click button 1 and then click button 3. A popup menu will appear like that shown in Screenshot 12.5. Select either "Sort Ascending" or "Sort Descending" from this menu.



Screenshot 12.5: Sorting the data on a single variable **height**

However, sometimes you will want to sort on two or more variables, and that is not possible using this method. In this case, you must either use some code or the "Sort Cases" dialog from the Data menu. Screenshot 12.6 shows the dialog box set up to perform a sort on both **sex** and **height**. Note that the order in which you enter the variables is important. In this case, the data will be first sorted on **sex**, and then all cases for which **sex** is the same will then be sorted by **height**.



Screenshot 12.6: Sorting the data on two variables **sex** and **height**

13 Selecting data for analysis

This chapter documents PSPP commands that temporarily or permanently select data records from the active dataset for analysis.

13.1 FILTER

FILTER BY *var_name*.
FILTER OFF.

`FILTER` allows a boolean-valued variable to be used to select cases from the data stream for processing.

To set up filtering, specify `BY` and a variable name. Keyword BY is optional but recommended. Cases which have a zero or system- or user-missing value are excluded from analysis, but not deleted from the data stream. Cases with other values are analyzed. To filter based on a different condition, use transformations such as `COMPUTE` or `RECODE` to compute a filter variable of the required form, then specify that variable on `FILTER`.

`FILTER OFF` turns off case filtering.

Filtering takes place immediately before cases pass to a procedure for analysis. Only one filter variable may be active at a time. Normally, case filtering continues until it is explicitly turned off with `FILTER OFF`. However, if `FILTER` is placed after `TEMPORARY`, it filters only the next procedure or procedure-like command.

13.2 N OF CASES

N [OF CASES] *num_of_cases* [ESTIMATED].

`N OF CASES` limits the number of cases processed by any procedures that follow it in the command stream. `N OF CASES 100`, for example, tells PSPP to disregard all cases after the first 100.

When `N OF CASES` is specified after `TEMPORARY`, it affects only the next procedure (see Section 13.6 [TEMPORARY], page 132). Otherwise, cases beyond the limit specified are not processed by any later procedure.

If the limit specified on `N OF CASES` is greater than the number of cases in the active dataset, it has no effect.

When `N OF CASES` is used along with `SAMPLE` or `SELECT IF`, the case limit is applied to the cases obtained after sampling or case selection, regardless of how `N OF CASES` is placed relative to `SAMPLE` or `SELECT IF` in the command file. Thus, the commands `N OF CASES 100` and `SAMPLE .5` both randomly sample approximately half of the active dataset's cases, then select the first 100 of those sampled, regardless of their order in the command file.

`N OF CASES` with the `ESTIMATED` keyword gives an estimated number of cases before `DATA LIST` or another command to read in data. `ESTIMATED` never limits the number of cases processed by procedures. PSPP currently does not make use of case count estimates.

13.3 SAMPLE

SAMPLE *num1* [FROM *num2*].

`SAMPLE` randomly samples a proportion of the cases in the active file. Unless it follows `TEMPORARY`, it operates as a transformation, permanently removing cases from the active dataset.

The proportion to sample can be expressed as a single number between 0 and 1. If k is the number specified, and N is the number of currently-selected cases in the active dataset, then after `SAMPLE` *k*., approximately $k*N$ cases are selected.

The proportion to sample can also be specified in the style `SAMPLE` *m* `FROM` *N*. With this style, cases are selected as follows:

1. If N is equal to the number of currently-selected cases in the active dataset, exactly m cases are selected.
2. If N is greater than the number of currently-selected cases in the active dataset, an equivalent proportion of cases are selected.
3. If N is less than the number of currently-selected cases in the active, exactly m cases are selected *from the first N cases in the active dataset.*

`SAMPLE` and `SELECT IF` are performed in the order specified by the syntax file.

`SAMPLE` is always performed before `N OF CASES`, regardless of ordering in the syntax file (see Section 13.2 [N OF CASES], page 127).

The same values for `SAMPLE` may result in different samples. To obtain the same sample, use the `SET` command to set the random number seed to the same value before each `SAMPLE`. Different samples may still result when the file is processed on systems with differing endianness or floating-point formats. By default, the random number seed is based on the system time.

13.4 SELECT IF

SELECT IF *expression*.

`SELECT IF` selects cases for analysis based on the value of *expression*. Cases not selected are permanently eliminated from the active dataset, unless `TEMPORARY` is in effect (see Section 13.6 [TEMPORARY], page 132).

Specify a boolean expression (see Chapter 7 [Expressions], page 44). If the value of the expression is true for a particular case, the case is analyzed. If the expression has a false or missing value, then the case is deleted from the data stream.

Place `SELECT IF` as early in the command file as possible. Cases that are deleted early can be processed more efficiently in time and space. Once cases have been deleted from the active dataset using `SELECT IF` they cannot be re-instated. If you want to be able to re-instate cases, then use `FILTER` (see Section 13.1 [FILTER], page 127) instead.

When `SELECT IF` is specified following `TEMPORARY` (see Section 13.6 [TEMPORARY], page 132), the `LAG` function may not be used (see [LAG], page 55).

13.4.1 Example Select-If

A shop steward is interested in the salaries of younger personnel in a firm. The file `personnel.sav` provides the salaries of all the workers and their dates of birth. The syntax

in Example 13.1 shows how SELECT IF can be used to limit analysis only to those persons born after December 31, 1999.

```
get file = 'personnel.sav'.

echo 'Salaries of all personnel'.
descriptives salary.

echo 'Salaries of personnel born after December 31 1999'.
select if dob > date.dmy (31,12,1999).
descriptives salary.
```

Example 13.1: Using SELECT IF to select persons born on or after a certain date.

From Result 13.1 one can see that there are 56 persons listed in the dataset, and 17 of them were born after December 31, 1999.

```
Salaries of all personnel

                    Descriptive Statistics
+------------------------+--+--------+-------+-------+-------+
|                        | N|  Mean  |Std Dev|Minimum|Maximum|
+------------------------+--+--------+-------+-------+-------+
|Annual salary before tax|56|40028.97|8721.17|$23,451|$57,044|
|Valid N (listwise)      |56|        |       |       |       |
|Missing N (listwise)    | 0|        |       |       |       |
+------------------------+--+--------+-------+-------+-------+

Salaries of personnel born after December 31 1999

                    Descriptive Statistics
+------------------------+--+--------+-------+-------+-------+
|                        | N|  Mean  |Std Dev|Minimum|Maximum|
+------------------------+--+--------+-------+-------+-------+
|Annual salary before tax|17|31828.59|4454.80|$23,451|$39,504|
|Valid N (listwise)      |17|        |       |       |       |
|Missing N (listwise)    | 0|        |       |       |       |
+------------------------+--+--------+-------+-------+-------+
```

Result 13.1: Salary descriptives before and after the SELECT IF transformation.

Note that the personnel.sav file from which the data were read is unaffected. The transformation affects only the active file.

13.5 SPLIT FILE

SPLIT FILE [{LAYERED, SEPARATE}] BY *var_list*.
SPLIT FILE OFF.

SPLIT FILE allows multiple sets of data present in one data file to be analyzed separately using single statistical procedure commands.

Specify a list of variable names to analyze multiple sets of data separately. Groups of adjacent cases having the same values for these variables are analyzed by statistical procedure commands as one group. An independent analysis is carried out for each group of cases, and the variable values for the group are printed along with the analysis.

When a list of variable names is specified, one of the keywords `LAYERED` or `SEPARATE` may also be specified. With `LAYERED`, which is the default, the separate analyses for each group are presented together in a single table. With `SEPARATE`, each analysis is presented in a separate table. Not all procedures honor the distinction.

Groups are formed only by *adjacent* cases. To create a split using a variable where like values are not adjacent in the working file, first sort the data by that variable (see Section 12.8 [SORT CASES], page 123).

Specify `OFF` to disable `SPLIT FILE` and resume analysis of the entire active dataset as a single group of data.

When `SPLIT FILE` is specified after `TEMPORARY`, it affects only the next procedure (see Section 13.6 [TEMPORARY], page 132).

13.5.1 Example Split

The file `horticulture.sav` contains data describing the **yield** of a number of horticultural specimens which have been subjected to various **treatment**s. If we wanted to investigate linear statistics of the **yeild**, one way to do this is using the `DESCRIPTIVES` (see Section 15.1 [DESCRIPTIVES], page 149). However, it is reasonable to expect the mean to be different depending on the **treatment**. So we might want to perform three separate procedures — one for each treatment.[1] Example 13.2 shows how this can be done automatically using the `SPLIT FILE` command.

```
get file='horticulture.sav'.

* Ensure cases are sorted before splitting.
sort cases by treatment.

split file by treatment.

* Run descriptives on the yield variable
descriptives /variable = yield.
```

Example 13.2: Running `DESCRIPTIVES` on each value of **treatment**

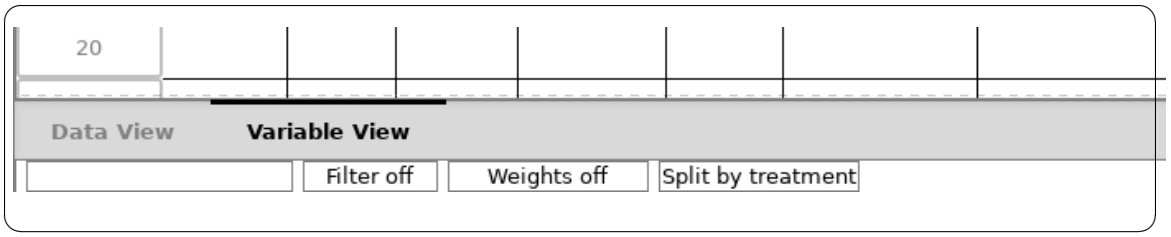
In Example 13.3 you can see that the table of descriptive statistics appears 3 times — once for each value of **treatment**. In this example '`N`', the number of observations are identical in all splits. This is because that experiment was deliberately designed that way. However in general one can expect a different '`N`' for each split.

[1] There are other, possibly better, ways to achieve a similar result using the `MEANS` or `EXAMINE` commands.

```
    Split Values
+---------+-------+
|Variable | Value |
+---------+-------+
|treatment|control|
+---------+-------+

                 Descriptive Statistics
+--------------------+--+-----+-------+-------+-------+
|                    | N| Mean|Std Dev|Minimum|Maximum|
+--------------------+--+-----+-------+-------+-------+
|yield               |30|51.23|   8.28|  37.86|  68.59|
|Valid N (listwise)  |30|     |       |       |       |
|Missing N (listwise)| 0|     |       |       |       |
+--------------------+--+-----+-------+-------+-------+

      Split Values
+---------+------------+
|Variable |    Value   |
+---------+------------+
|treatment|conventional|
+---------+------------+

                 Descriptive Statistics
+--------------------+--+-----+-------+-------+-------+
|                    | N| Mean|Std Dev|Minimum|Maximum|
+--------------------+--+-----+-------+-------+-------+
|yield               |30|53.57|   8.92|  36.30|  70.66|
|Valid N (listwise)  |30|     |       |       |       |
|Missing N (listwise)| 0|     |       |       |       |
+--------------------+--+-----+-------+-------+-------+

      Split Values
+---------+-----------+
|Variable |   Value   |
+---------+-----------+
|treatment|traditional|
+---------+-----------+

                 Descriptive Statistics
+--------------------+--+-----+-------+-------+-------+
|                    | N| Mean|Std Dev|Minimum|Maximum|
+--------------------+--+-----+-------+-------+-------+
|yield               |30|56.87|   8.88|  39.08|  75.93|
|Valid N (listwise)  |30|     |       |       |       |
|Missing N (listwise)| 0|     |       |       |       |
+--------------------+--+-----+-------+-------+-------+
```

Example 13.3: The results of running `DESCRIPTIVES` with an active split

Unless `TEMPORARY` was used, after a split has been defined for a dataset it remains active until explicitly disabled. In the graphical user interface, the active split variable (if any) is displayed in the status bar (see Screenshot 13.1. If a dataset is saved to a system file (see Section 9.6 [SAVE], page 86) whilst a split is active, the split stastus is stored in the file and will be automatically loaded when that file is loaded.



Screenshot 13.1: The status bar indicating that the data set is split using the **treatment** variable

13.6 TEMPORARY

TEMPORARY.

`TEMPORARY` is used to make the effects of transformations following its execution temporary. These transformations affect only the execution of the next procedure or procedure-like command. Their effects are not be saved to the active dataset.

The only specification on `TEMPORARY` is the command name.

`TEMPORARY` may not appear within a `DO IF` or `LOOP` construct. It may appear only once between procedures and procedure-like commands.

Scratch variables cannot be used following `TEMPORARY`.

13.6.1 Example Temporary

In Example 13.4 there are two `COMPUTE` transformation. One of them immediatly follows a `TEMPORARY` command, and therefore has effect only for the next procedure, which in this case is the first `DESCRIPTIVES` command.

```
data list notable /x 1-2.
begin data.
 2
 4
10
15
20
24
end data.

compute x=x/2.

temporary.
compute x=x+3.

descriptives x.
descriptives x.
```

Example 13.4: Running a `COMPUTE` transformation after `TEMPORARY`

The data read by the first `DESCRIPTIVES` procedure are 4, 5, 8, 10.5, 13, 15. The data read by the second `DESCRIPTIVES` procedure are 1, 2, 5, 7.5, 10, 12. This is because the

second COMPUTE transformation has no effect on the second DESCRIPTIVES procedure. You can check these figures in Result 13.2.

```
                Descriptive Statistics
+--------------------+-+----+-------+-------+-------+
|                    |N|Mean|Std Dev|Minimum|Maximum|
+--------------------+-+----+-------+-------+-------+
|x                   |6|9.25|   4.38|      4|     15|
|Valid N (listwise)  |6|    |       |       |       |
|Missing N (listwise)|0|    |       |       |       |
+--------------------+-+----+-------+-------+-------+

                Descriptive Statistics
+--------------------+-+----+-------+-------+-------+
|                    |N|Mean|Std Dev|Minimum|Maximum|
+--------------------+-+----+-------+-------+-------+
|x                   |6|6.25|   4.38|      1|     12|
|Valid N (listwise)  |6|    |       |       |       |
|Missing N (listwise)|0|    |       |       |       |
+--------------------+-+----+-------+-------+-------+
```

Result 13.2: The results of running two consecutive DESCRIPTIVES commands after a temporary transformation

13.7 WEIGHT

WEIGHT BY *var_name*.
WEIGHT OFF.

WEIGHT assigns cases varying weights, changing the frequency distribution of the active dataset. Execution of WEIGHT is delayed until data have been read.

If a variable name is specified, WEIGHT causes the values of that variable to be used as weighting factors for subsequent statistical procedures. Use of keyword BY is optional but recommended. Weighting variables must be numeric. Scratch variables may not be used for weighting (see Section 6.7.5 [Scratch Variables], page 41).

When OFF is specified, subsequent statistical procedures weight all cases equally.

A positive integer weighting factor w on a case yields the same statistical output as would replicating the case w times. A weighting factor of 0 is treated for statistical purposes as if the case did not exist in the input. Weighting values need not be integers, but negative and system-missing values for the weighting variable are interpreted as weighting factors of 0. User-missing values are not treated specially.

When WEIGHT is specified after TEMPORARY, it affects only the next procedure (see Section 13.6 [TEMPORARY], page 132).

WEIGHT does not cause cases in the active dataset to be replicated in memory.

13.7.1 Example Weights

One could define a dataset containing an inventory of stock items. It would be reasonable to use a string variable for a description of the item, and a numeric variable for the number in stock, like in Example 13.5.

```
data list notable list /item (a16) quantity (f8.0).
begin   data
nuts    345
screws  10034
washers 32012
bolts   876
end data.

echo 'Unweighted frequency table'.
frequencies /variables = item /format=dfreq.

weight by quantity.

echo 'Weighted frequency table'.
frequencies /variables = item /format=dfreq.
```

Example 13.5: Setting the weight on the variable **quantity**

One analysis which most surely would be of interest is the relative amounts or each item in stock. However without setting a weight variable, `FREQUENCIES` (see Section 15.2 [FREQUENCIES], page 152) does not tell us what we want to know, since there is only one case for each stock item. Example 13.6 shows the difference between the weighted and unweighted frequency tables.

```
Unweighted frequency table

                                 item
+-------------+---------+-------+-------------+------------------+
|             |Frequency|Percent|Valid Percent|Cumulative Percent|
+-------------+---------+-------+-------------+------------------+
|Valid bolts  |        1|  25.0%|        25.0%|             25.0%|
|      nuts   |        1|  25.0%|        25.0%|             50.0%|
|      screws |        1|  25.0%|        25.0%|             75.0%|
|      washers|        1|  25.0%|        25.0%|            100.0%|
+-------------+---------+-------+-------------+------------------+
|Total        |        4| 100.0%|             |                  |
+-------------+---------+-------+-------------+------------------+

Weighted frequency table

                                 item
+-------------+---------+-------+-------------+------------------+
|             |Frequency|Percent|Valid Percent|Cumulative Percent|
+-------------+---------+-------+-------------+------------------+
|Valid washers|    32012|  74.0%|        74.0%|             74.0%|
|      screws |    10034|  23.2%|        23.2%|             97.2%|
|      bolts  |      876|   2.0%|         2.0%|             99.2%|
|      nuts   |      345|    .8%|          .8%|            100.0%|
+-------------+---------+-------+-------------+------------------+
|Total        |    43267| 100.0%|             |                  |
+-------------+---------+-------+-------------+------------------+
```

Example 13.6: Weighted and unweighted frequency tables of **items**

14 Conditional and Looping Constructs

This chapter documents PSPP commands used for conditional execution, looping, and flow of control.

14.1 BREAK

BREAK.

BREAK terminates execution of the innermost currently executing LOOP construct.

BREAK is allowed only inside LOOP...END LOOP. See Section 14.5 [LOOP], page 148, for more details.

14.2 DEFINE

14.2.1 Overview

DEFINE *macro_name*([*argument*[/*argument*]...])
...*body*...
!ENDDEFINE.

Each *argument* takes the following form:

{*!arg_name*= | !POSITIONAL}
[!DEFAULT(*default*)]
[!NOEXPAND]
{!TOKENS(*count*) | !CHAREND('*token*') | !ENCLOSE('*start*' | '*end*') | !CMDEND}

The following directives may be used within *body*:

!OFFEXPAND
!ONEXPAND

The following functions may be used within the body:

!BLANKS(*count*)
!CONCAT(*arg*...)
!EVAL(*arg*)
!HEAD(*arg*)
!INDEX(*haystack*, *needle*)
!LENGTH(*arg*)
!NULL
!QUOTE(*arg*)
!SUBSTR(*arg*, *start*[, *count*])
!TAIL(*arg*)
!UNQUOTE(*arg*)
!UPCASE(*arg*)

The body may also include the following constructs:

!IF (*condition*) !THEN *true-expansion* !ENDIF
!IF (*condition*) !THEN *true-expansion* !ELSE *false-expansion* !ENDIF

!DO *!var* = *start* !TO *end* [!BY *step*]

```
  body
!DOEND
!DO !var !IN (expression)
  body
!DOEND

!LET !var = expression
```

14.2.2 Introduction

The DEFINE command creates a *macro*, which is a name for a fragment of PSPP syntax called the macro's *body*. Following the DEFINE command, syntax may *call* the macro by name any number of times. Each call substitutes, or *expands*, the macro's body in place of the call, as if the body had been written in its place.

The following syntax defines a macro named `!vars` that expands to the variable names `v1 v2 v3`. The macro's name begins with '`!`', which is optional for macro names. The `()` following the macro name are required:

```
DEFINE !vars()
v1 v2 v3
!ENDDEFINE.
```

Here are two ways that `!vars` might be called given the preceding definition:

```
DESCRIPTIVES !vars.
FREQUENCIES /VARIABLES=!vars.
```

With macro expansion, the above calls are equivalent to the following:

```
DESCRIPTIVES v1 v2 v3.
FREQUENCIES /VARIABLES=v1 v2 v3.
```

The `!vars` macro expands to a fixed body. Macros may have more sophisticated contents:

- Macro *arguments* that are substituted into the body whenever they are named. The values of a macro's arguments are specified each time it is called. See Section 14.2.4 [Macro Arguments], page 137.
- Macro *functions*, expanded when the macro is called. See Section 14.2.6 [Macro Functions], page 140.
- `!IF` constructs, for conditional expansion. See Section 14.2.8 [Macro Conditional Expansion], page 144.
- Two forms of `!DO` construct, for looping over a numerical range or a collection of tokens. See Section 14.2.9 [Macro Loops], page 144.
- `!LET` constructs, for assigning to macro variables. See Section 14.2.10 [Macro Variable Assignment], page 145.

Many identifiers associated with macros begin with '`!`', a character not normally allowed in identifiers. These identifiers are reserved only for use with macros, which helps keep them from being confused with other kinds of identifiers.

The following sections provide more details on macro syntax and semantics.

14.2.3 Macro Bodies

As previously shown, a macro body may contain a fragment of a PSPP command (such as a variable name). A macro body may also contain full PSPP commands. In the latter case, the macro body should also contain the command terminators.

Most PSPP commands may occur within a macro. The `DEFINE` command itself is one exception, because the inner `!ENDDEFINE` ends the outer macro definition. For compatibility, `BEGIN DATA...END DATA.` should not be used within a macro.

The body of a macro may call another macro. The following shows one way that could work:

```
DEFINE !commands()
DESCRIPTIVES !vars.
FREQUENCIES /VARIABLES=!vars.
!ENDDEFINE.

* Initially define the 'vars' macro to analyze v1...v3.
DEFINE !vars() v1 v2 v3 !ENDDEFINE.
!commands

* Redefine 'vars' macro to analyze different variables.
DEFINE !vars() v4 v5 !ENDDEFINE.
!commands
```

The `!commands` macro would be easier to use if it took the variables to analyze as an argument rather than through another macro. The following section shows how to do that.

14.2.4 Macro Arguments

This section explains how to use macro arguments. As an initial example, the following syntax defines a macro named `!analyze` that takes all the syntax up to the first command terminator as an argument:

```
DEFINE !analyze(!POSITIONAL !CMDEND)
DESCRIPTIVES !1.
FREQUENCIES /VARIABLES=!1.
!ENDDEFINE.
```

When `!analyze` is called, it expands to a pair of analysis commands with each `!1` in the body replaced by the argument. That is, these calls:

```
!analyze v1 v2 v3.
!analyze v4 v5.
```

act like the following:

```
DESCRIPTIVES v1 v2 v3.
FREQUENCIES /VARIABLES=v1 v2 v3.
DESCRIPTIVES v4 v5.
FREQUENCIES /VARIABLES=v4 v5.
```

Macros may take any number of arguments, described within the parentheses in the DEFINE command. Arguments come in two varieties based on how their values are specified when the macro is called:

- A *positional* argument has a required value that follows the macro's name. Use the `!POSITIONAL` keyword to declare a positional argument.

  When a macro is called, the positional argument values appear in the same order as their definitions, before any keyword argument values.

  References to a positional argument in a macro body are numbered: `!1` is the first positional argument, `!2` the second, and so on. In addition, `!*` expands to all of the positional arguments' values, separated by spaces.

  The following example uses a positional argument:

```
DEFINE !analyze(!POSITIONAL !CMDEND)
DESCRIPTIVES !1.
FREQUENCIES /VARIABLES=!1.
!ENDDEFINE.

!analyze v1 v2 v3.
!analyze v4 v5.
```

- A *keyword* argument has a name. In the macro call, its value is specified with the syntax *`name=value`*. The names allow keyword argument values to take any order in the call.

  In declaration and calls, a keyword argument's name may not begin with '`!`', but references to it in the macro body do start with a leading '`!`'.

  The following example uses a keyword argument that defaults to ALL if the argument is not assigned a value:

```
DEFINE !analyze_kw(vars=!DEFAULT(ALL) !CMDEND)
DESCRIPTIVES !vars.
FREQUENCIES /VARIABLES=!vars.
!ENDDEFINE.

!analyze_kw vars=v1 v2 v3.  /* Analyze specified variables.
!analyze_kw.                /* Analyze all variables.
```

If a macro has both positional and keyword arguments, then the positional arguments must come first in the DEFINE command, and their values also come first in macro calls. A keyword argument may be omitted by leaving its keyword out of the call, and a positional argument may be omitted by putting a command terminator where it would appear. (The latter case also omits any following positional arguments and all keyword arguments, if there are any.) When an argument is omitted, a default value is used: either the value specified in `!DEFAULT(`*`value`*`)`, or an empty value otherwise.

Each argument declaration specifies the form of its value:

`!TOKENS(`*`count`*`)`

Exactly *count* tokens, e.g. `!TOKENS(1)` for a single token. Each identifier, number, quoted string, operator, or punctuator is a token. See Section 6.1 [Tokens], page 25, for a complete definition.

The following variant of `!analyze_kw` accepts only a single variable name (or `ALL`) as its argument:

```
DEFINE !analyze_one_var(!POSITIONAL !TOKENS(1))
```

```
DESCRIPTIVES !1.
FREQUENCIES /VARIABLES=!1.
!ENDDEFINE.

!analyze_one_var v1.
```

`!CHAREND('token')`

Any number of tokens up to *token*, which should be an operator or punctuator token such as '/' or '+'. The *token* does not become part of the value.

With the following variant of `!analyze_kw`, the variables must be following by '/':

```
DEFINE !analyze_parens(vars=!CHARNED('/'))
DESCRIPTIVES !vars.
FREQUENCIES /VARIABLES=!vars.
!ENDDEFINE.

!analyze_parens vars=v1 v2 v3/.
```

`!ENCLOSE('start','end')`

Any number of tokens enclosed between *start* and *end*, which should each be operator or punctuator tokens. For example, use `!ENCLOSE('(',')')` for a value enclosed within parentheses. (Such a value could never have right parentheses inside it, even paired with left parentheses.) The start and end tokens are not part of the value.

With the following variant of `!analyze_kw`, the variables must be specified within parentheses:

```
DEFINE !analyze_parens(vars=!ENCLOSE('(',')'))
DESCRIPTIVES !vars.
FREQUENCIES /VARIABLES=!vars.
!ENDDEFINE.

!analyze_parens vars=(v1 v2 v3).
```

`!CMDEND` Any number of tokens up to the end of the command. This should be used only for the last positional parameter, since it consumes all of the tokens in the command calling the macro.

The following variant of `!analyze_kw` takes all the variable names up to the end of the command as its argument:

```
DEFINE !analyze_kw(vars=!CMDEND)
DESCRIPTIVES !vars.
FREQUENCIES /VARIABLES=!vars.
!ENDDEFINE.

!analyze_kw vars=v1 v2 v3.
```

By default, when an argument's value contains a macro call, the call is expanded each time the argument appears in the macro's body. The `!NOEXPAND` keyword in an argument

declaration suppresses this expansion. See Section 14.2.5 [Controlling Macro Expansion], page 140.

14.2.5 Controlling Macro Expansion

Multiple factors control whether macro calls are expanded in different situations. At the highest level, `SET MEXPAND` controls whether macro calls are expanded. By default, it is enabled. See [SET MEXPAND], page 272, for details.

A macro body may contain macro calls. By default, these are expanded. If a macro body contains `!OFFEXPAND` or `!ONEXPAND` directives, then `!OFFEXPAND` disables expansion of macro calls until the following `!ONEXPAND`.

A macro argument's value may contain a macro call. These macro calls are expanded, unless the argument was declared with the `!NOEXPAND` keyword.

The argument to a macro function is a special context that does not expand macro calls. For example, if `!vars` is the name of a macro, then `!LENGTH(!vars)` expands to 5, as does `!LENGTH(!1)` if positional argument 1 has value `!vars`. To expand macros in these cases, use the `!EVAL` macro function, e.g. `!LENGTH(!EVAL(!vars))` or `!LENGTH(!EVAL(!1))`. See Section 14.2.6 [Macro Functions], page 140, for details.

These rules apply to macro calls, not to uses within a macro body of macro functions, macro arguments, and macro variables created by `!DO` or `!LET`, which are always expanded.

`SET MEXPAND` may appear within the body of a macro, but it will not affect expansion of the macro that it appears in. Use `!OFFEXPAND` and `!ONEXPAND` instead.

14.2.6 Macro Functions

Macro bodies may manipulate syntax using macro functions. Macro functions accept tokens as arguments and expand to sequences of characters.

The arguments to macro functions have a restricted form. They may only be a single token (such as an identifier or a string), a macro argument, or a call to a macro function. Thus, the following are valid macro arguments:

```
x    5.0    x    !1    "5 + 6"    !CONCAT(x,y)
```

and the following are not:

```
x y    5+6
```

Macro functions expand to sequences of characters. When these character strings are processed further as character strings, e.g. with `!LENGTH`, any character string is valid. When they are interpreted as PSPP syntax, e.g. when the expansion becomes part of a command, they need to be valid for that purpose. For example, `!UNQUOTE("It's")` will yield an error if the expansion `It's` becomes part of a PSPP command, because it contains unbalanced single quotes, but `!LENGTH(!UNQUOTE("It's"))` expands to 4.

The following macro functions are available. Each function's documentation includes examples in the form *call* ↦ *expansion*.

`!BLANKS` (*count*) [Macro Function]

Expands to *count* unquoted spaces, where *count* is a nonnegative integer. Outside quotes, any positive number of spaces are equivalent; for a quoted string of spaces, use `!QUOTE(!BLANKS(count))`.

In the examples below, '_' stands in for a space to make the results visible.

```
!BLANKS(0)                  ↦ empty
!BLANKS(1)                  ↦ _
!BLANKS(2)                  ↦ __
!QUOTE(!BLANKS(5))          ↦ '_____'
```

!CONCAT (*arg*...) [Macro Function]

Expands to the concatenation of all of the arguments. Before concatenation, each quoted string argument is unquoted, as if !UNQUOTE were applied. This allows for "token pasting", combining two (or more) tokens into a single one:

```
!CONCAT(x, y)               ↦ xy
!CONCAT('x', 'y')           ↦ xy
!CONCAT(12, 34)             ↦ 1234
!CONCAT(!NULL, 123)         ↦ 123
```

!CONCAT is often used for constructing a series of similar variable names from a prefix followed by a number and perhaps a suffix. For example:

```
!CONCAT(x, 0)               ↦ x0
!CONCAT(x, 0, y)            ↦ x0y
```

An identifier token must begin with a letter (or '#' or '@'), which means that attempting to use a number as the first part of an identifier will produce a pair of distinct tokens rather than a single one. For example:

```
!CONCAT(0, x)               ↦ 0 x
!CONCAT(0, x, y)            ↦ 0 xy
```

!EVAL (*arg*) [Macro Function]

Expands macro calls in *arg*. This is especially useful if *arg* is the name of a macro or a macro argument that expands to one, because arguments to macro functions are not expanded by default (see Section 14.2.5 [Controlling Macro Expansion], page 140).

The following examples assume that !vars is a macro that expands to a b c:

```
!vars                       ↦ a b c
!QUOTE(!vars)               ↦ '!vars'
!EVAL(!vars)                ↦ a b c
!QUOTE(!EVAL(!vars))        ↦ 'a b c'
```

These examples additionally assume that argument !1 has value !vars:

```
!1                          ↦ a b c
!QUOTE(!1)                  ↦ '!vars'
!EVAL(!1)                   ↦ a b c
!QUOTE(!EVAL(!1))           ↦ 'a b c'
```

!HEAD (*arg*) [Macro Function]
!TAIL (*arg*) [Macro Function]

!HEAD expands to just the first token in an unquoted version of *arg*, and !TAIL to all the tokens after the first.

```
!HEAD('a b c')              ↦ a
!HEAD('a')                  ↦ a
```

```
!HEAD(!NULL)                ↦ empty
!HEAD('')                   ↦ empty

!TAIL('a b c')              ↦ b c
!TAIL('a')                  ↦ empty
!TAIL(!NULL)                ↦ empty
!TAIL('')                   ↦ empty
```

`!INDEX` (*haystack*, *needle*) [Macro Function]

Looks for *needle* in *haystack*. If it is present, expands to the 1-based index of its first occurrence; if not, expands to 0.

```
!INDEX(banana, an)          ↦ 2
!INDEX(banana, nan)         ↦ 3
!INDEX(banana, apple)       ↦ 0
!INDEX("banana", nan)       ↦ 4
!INDEX("banana", "nan")     ↦ 0
!INDEX(!UNQUOTE("banana"), !UNQUOTE("nan")) ↦ 3
```

`!LENGTH` (*arg*) [Macro Function]

Expands to a number token representing the number of characters in *arg*.

```
!LENGTH(123)                ↦ 3
!LENGTH(123.00)             ↦ 6
!LENGTH( 123 )              ↦ 3
!LENGTH("123")              ↦ 5
!LENGTH(xyzzy)              ↦ 5
!LENGTH("xyzzy")            ↦ 7
!LENGTH("xy""zzy")          ↦ 9
!LENGTH(!UNQUOTE("xyzzy"))  ↦ 5
!LENGTH(!UNQUOTE("xy""zzy")) ↦ 6
!LENGTH(!1)                 ↦ 5 if !1 is a b c
!LENGTH(!1)                 ↦ 0 if !1 is empty
!LENGTH(!NULL)              ↦ 0
```

`!NULL` [Macro Function]

Expands to an empty character sequence.

```
!NULL                       ↦ empty
!QUOTE(!NULL)               ↦ ''
```

`!QUOTE` (*arg*) [Macro Function]
`!UNQUOTE` (*arg*) [Macro Function]

The `!QUOTE` function expands to its argument surrounded by apostrophes, doubling any apostrophes inside the argument to make sure that it is valid PSPP syntax for a string. If the argument was already a quoted string, `!QUOTE` expands to it unchanged.

Given a quoted string argument, the `!UNQUOTED` function expands to the string's contents, with the quotes removed and any doubled quote marks reduced to singletons. If the argument was not a quoted string, `!UNQUOTE` expands to the argument unchanged.

```
!QUOTE(123.0)               ↦ '123.0'
```

```
!QUOTE( 123 )                ↦ '123'
!QUOTE('a b c')              ↦ 'a b c'
!QUOTE("a b c")              ↦ "a b c"
!QUOTE(!1)                   ↦ 'a ''b'' c' if !1 is a 'b' c

!UNQUOTE(123.0)              ↦ 123.0
!UNQUOTE( 123 )              ↦ 123
!UNQUOTE('a b c')            ↦ a b c
!UNQUOTE("a b c")            ↦ a b c
!UNQUOTE(!1)                 ↦ a 'b' c if !1 is a 'b' c

!QUOTE(!UNQUOTE(123.0))      ↦ '123.0'
!QUOTE(!UNQUOTE( 123 ))      ↦ '123'
!QUOTE(!UNQUOTE('a b c'))    ↦ 'a b c'
!QUOTE(!UNQUOTE("a b c"))    ↦ 'a b c'
!QUOTE(!UNQUOTE(!1))         ↦ 'a ''b'' c' if !1 is a 'b' c
```

`!SUBSTR` (*arg*, *start*[, *count*]) [Macro Function]

Expands to a substring of *arg* starting from 1-based position *start*. If *count* is given, it limits the number of characters in the expansion; if it is omitted, then the expansion extends to the end of *arg*.

```
!SUBSTR(banana, 3)           ↦ nana
!SUBSTR(banana, 3, 3)        ↦ nan
!SUBSTR("banana", 1, 3)         ↦ error ("ba is not a valid token)
!SUBSTR(!UNQUOTE("banana"), 3) ↦ nana
!SUBSTR("banana", 3, 3)      ↦ ana

!SUBSTR(banana, 3, 0)        ↦ empty
!SUBSTR(banana, 3, 10)       ↦ nana
!SUBSTR(banana, 10, 3)       ↦ empty
```

`!UPCASE` (*arg*) [Macro Function]

Expands to an unquoted version of *arg* with all letters converted to uppercase.

```
!UPCASE(freckle)             ↦ FRECKLE
!UPCASE('freckle')           ↦ FRECKLE
!UPCASE('a b c')             ↦ A B C
!UPCASE('A B C')             ↦ A B C
```

14.2.7 Macro Expressions

Macro expressions are used in conditional expansion and loops, which are described in the following sections. A macro expression may use the following operators, listed in descending order of operator precedence:

`()` Parentheses override the default operator precedence.

`!EQ !NE !GT !LT !GE !LE = ~= <> > < >= <=`

Relational operators compare their operands and yield a Boolean result, either '`0`' for false or '`1`' for true.

These operators always compare their operands as strings. This can be surprising when the strings are numbers because, e.g., `1 < 1.0` and `10 < 2` both evaluate to '`1`' (true).

Comparisons are case sensitive, so that `a = A` evaluates to '`0`' (false).

`!NOT ~`
`!AND &`
`!OR |`

Logical operators interpret their operands as Boolean values, where quoted or unquoted '`0`' is false and anything else is true, and yield a Boolean result, either '`0`' for false or '`1`' for true.

Macro expressions do not include any arithmetic operators.

An operand in an expression may be a single token (including a macro argument name) or a macro function invocation. Either way, the expression evaluator unquotes the operand, so that `1 = '1'` is true.

14.2.8 Macro Conditional Expansion

The `!IF` construct may be used inside a macro body to allow for conditional expansion. It takes the following forms:

```
!IF (expression) !THEN true-expansion !IFEND
!IF (expression) !THEN true-expansion !ELSE false-expansion !IFEND
```

When *expression* evaluates to true, the macro processor expands *true-expansion*; otherwise, it expands *false-expansion*, if it is present. The macro processor considers quoted or unquoted '`0`' to be false, and anything else to be true.

14.2.9 Macro Loops

The body of a macro may include two forms of loops: loops over numerical ranges and loops over tokens. Both forms expand a *loop body* multiple times, each time setting a named *loop variable* to a different value. The loop body typically expands the loop variable at least once.

The MITERATE setting (see [SET MITERATE], page 273) limits the number of iterations in a loop. This is a safety measure to ensure that macro expansion terminates. PSPP issues a warning when the MITERATE limit is exceeded.

Loops Over Ranges

```
!DO !var = start !TO end [!BY step]
  body
!DOEND
```

A loop over a numerical range has the form shown above. *start*, *end*, and *step* (if included) must be expressions with numeric values. The macro processor accepts both integers and real numbers. The macro processor expands *body* for each numeric value from *start* to *end*, inclusive.

The default value for *step* is 1. If *step* is positive and *first* > *last*, or if *step* is negative and *first* < *last*, then the macro processor doesn't expand the body at all. *step* may not be zero.

Loops Over Tokens

```
!DO !var !IN (expression)
  body
!DOEND
```

A loop over tokens takes the form shown above. The macro processor evaluates *expression* and expands *body* once per token in the result, substituting the token for *!var* each time it appears.

14.2.10 Macro Variable Assignment

The `!LET` construct evaluates an expression and assigns the result to a macro variable. It may create a new macro variable or change the value of one created by a previous `!LET` or `!DO`, but it may not change the value of a macro argument. `!LET` has the following form:

```
!LET !var = expression
```

If *expression* is more than one token, it must be enclosed in parentheses.

14.2.11 Macro Settings

Some macro behavior is controlled through the SET command (see Section 17.20 [SET], page 265). This section describes these settings.

Any SET command that changes these settings within a macro body only takes effect following the macro. This is because PSPP expands a macro's entire body at once, so that the SET command inside the body only executes afterwards.

The MEXPAND setting (see [SET MEXPAND], page 272) controls whether macros will be expanded at all. By default, macro expansion is on. To avoid expansion of macros called within a macro body, use `!OFFEXPAND` and `!ONEXPAND` (see Section 14.2.5 [Controlling Macro Expansion], page 140).

When MPRINT (see [SET MPRINT], page 272) is turned on, PSPP outputs an expansion of each macro called. This feature can be useful for debugging macro definitions. For reading the expanded version, note that macro expansion removes comments and standardizes white space.

MNEST (see [SET MNEST], page 273) limits the depth of expansion of macro calls, that is, the nesting level of macro expansion. The default is 50. This is mainly useful to avoid infinite expansion in the case of a macro that calls itself.

MITERATE (see [SET MITERATE], page 273) limits the number of iterations in a `!DO` construct. The default is 1000.

14.2.12 Additional Notes

14.2.12.1 Calling Macros from Macros

If the body of macro A includes a call to macro B, the call can use macro arguments (including `!*`) and macro variables as part of arguments to B. For `!TOKENS` arguments, the argument or variable name counts as one token regardless of the number that it expands into; for `!CHAREND` and `!ENCLOSE` arguments, the delimiters come only from the call, not the expansions; and `!CMDEND` ends at the calling command, not any end of command within an argument or variable.

Macro functions are not supported as part of the arguments in a macro call. To get the same effect, use `!LET` to define a macro variable, then pass the macro variable to the macro.

When macro A calls macro B, the order of their `DEFINE` commands doesn't matter, as long as macro B has been defined when A is called.

14.2.12.2 Command Terminators

Macros and command terminators require care. Macros honor the syntax differences between interactive and batch syntax (see Section 6.3 [Syntax Variants], page 27), which means that the interpretation of a macro can vary depending on the syntax mode in use. We assume here that interactive mode is in use, in which '`.`' at the end of a line is the primary way to end a command.

The `DEFINE` command needs to end with '`.`' following the `!ENDDEFINE`. The macro body may contain '`.`' if it is intended to expand to whole commands, but using '`.`' within a macro body that expands to just syntax fragments (such as a list of variables) will cause syntax errors.

Macro directives such as `!IF` and `!DO` do not end with '`.`'.

14.2.12.3 Expansion Contexts

Macros do not expand within comments, whether introduced within a line by `/*` or as a separate COMMENT or '`*`' commands (see Section 17.4 [COMMENT], page 260). (SPSS does expand macros in COMMENT and '`*`'.)

Macros do not expand within quoted strings.

Macros are expanded in the `TITLE` and `SUBTITLE` commands as long as their arguments are not quoted strings.

14.2.12.4 PRESERVE and RESTORE

Some macro bodies might use the SET command to change certain settings. When this is the case, consider using the PRESERVE and RESTORE commands to save and then restore these settings. See Section 17.19 [PRESERVE and RESTORE], page 265.

14.3 DO IF

```
DO IF condition.
        . . .
[ELSE IF condition.
        . . .
]. . .
[ELSE.
        . . .]
END IF.
```

`DO IF` allows one of several sets of transformations to be executed, depending on user-specified conditions.

If the specified boolean expression evaluates as true, then the block of code following `DO IF` is executed. If it evaluates as missing, then none of the code blocks is executed. If it is false, then the boolean expression on the first `ELSE IF`, if present, is tested in turn,

with the same rules applied. If all expressions evaluate to false, then the `ELSE` code block is executed, if it is present.

When `DO IF` or `ELSE IF` is specified following `TEMPORARY` (see Section 13.6 [TEMPORARY], page 132), the `LAG` function may not be used (see [LAG], page 55).

14.4 DO REPEAT

DO REPEAT dummy_name=expansion. . . .
. . .
END REPEAT [PRINT].

expansion takes one of the following forms:
var_list
num_or_range. . .
'string'. . .
ALL

num_or_range takes one of the following forms:
number
num1 TO num2

`DO REPEAT` repeats a block of code, textually substituting different variables, numbers, or strings into the block with each repetition.

Specify a dummy variable name followed by an equals sign ('`=`') and the list of replacements. Replacements can be a list of existing or new variables, numbers, strings, or `ALL` to specify all existing variables. When numbers are specified, runs of increasing integers may be indicated as *num1* `TO` *num2*, so that '`1 TO 5`' is short for '`1 2 3 4 5`'.

Multiple dummy variables can be specified. Each variable must have the same number of replacements.

The code within `DO REPEAT` is repeated as many times as there are replacements for each variable. The first time, the first value for each dummy variable is substituted; the second time, the second value for each dummy variable is substituted; and so on.

Dummy variable substitutions work like macros. They take place anywhere in a line that the dummy variable name occurs. This includes command and subcommand names, so command and subcommand names that appear in the code block should not be used as dummy variable identifiers. Dummy variable substitutions do not occur inside quoted strings, comments, unquoted strings (such as the text on the `TITLE` or `DOCUMENT` command), or inside `BEGIN DATA. . .END DATA`.

Substitution occurs only on whole words, so that, for example, a dummy variable PRINT would not be substituted into the word PRINTOUT.

New variable names used as replacements are not automatically created as variables, but only if used in the code block in a context that would create them, *e.g.* on a `NUMERIC` or `STRING` command or on the left side of a `COMPUTE` assignment.

Any command may appear within `DO REPEAT`, including nested `DO REPEAT` commands. If `INCLUDE` or `INSERT` appears within `DO REPEAT`, the substitutions do not apply to the included file.

If PRINT is specified on END REPEAT, the commands after substitutions are made should be printed to the listing file, prefixed by a plus sign ('+'). This feature is not yet implemented.

14.5 LOOP

LOOP [*index_var*=*start* TO *end* [BY *incr*]] [IF *condition*].
. . .
END LOOP [IF *condition*].

LOOP iterates a group of commands. A number of termination options are offered.

Specify index_var to make that variable count from one value to another by a particular increment. *index_var* must be a pre-existing numeric variable. *start*, *end*, and *incr* are numeric expressions (see Chapter 7 [Expressions], page 44.)

During the first iteration, *index_var* is set to the value of *start*. During each successive iteration, *index_var* is increased by the value of *incr*. If *end* > *start*, then the loop terminates when *index_var* > *end*; otherwise it terminates when *index_var* < *end*. If *incr* is not specified then it defaults to +1 or -1 as appropriate.

If *end* > *start* and *incr* < 0, or if *end* < *start* and *incr* > 0, then the loop is never executed. *index_var* is nevertheless set to the value of start.

Modifying *index_var* within the loop is allowed, but it has no effect on the value of *index_var* in the next iteration.

Specify a boolean expression for the condition on LOOP to cause the loop to be executed only if the condition is true. If the condition is false or missing before the loop contents are executed the first time, the loop contents are not executed at all.

If index and condition clauses are both present on LOOP, the index variable is always set before the condition is evaluated. Thus, a condition that makes use of the index variable will always see the index value to be used in the next execution of the body.

Specify a boolean expression for the condition on END LOOP to cause the loop to terminate if the condition is true after the enclosed code block is executed. The condition is evaluated at the end of the loop, not at the beginning, so that the body of a loop with only a condition on END LOOP will always execute at least once.

If the index clause is not present, then the global MXLOOPS setting, which defaults to 40, limits the number of iterations (see [SET MXLOOPS], page 268).

BREAK also terminates LOOP execution (see Section 14.1 [BREAK], page 135).

Loop index variables are by default reset to system-missing from one case to another, not left, unless a scratch variable is used as index. When loops are nested, this is usually undesired behavior, which can be corrected with LEAVE (see Section 11.21 [LEAVE], page 106) or by using a scratch variable as the loop index.

When LOOP or END LOOP is specified following TEMPORARY (see Section 13.6 [TEMPORARY], page 132), the LAG function may not be used (see [LAG], page 55).

15 Statistics

This chapter documents the statistical procedures that PSPP supports so far.

15.1 DESCRIPTIVES

```
DESCRIPTIVES
        /VARIABLES=var_list
        /MISSING={VARIABLE,LISTWISE} {INCLUDE,NOINCLUDE}
        /FORMAT={LABELS,NOLABELS} {NOINDEX,INDEX} {LINE,SERIAL}
        /SAVE
        /STATISTICS={ALL,MEAN,SEMEAN,STDDEV,VARIANCE,KURTOSIS,
                     SKEWNESS,RANGE,MINIMUM,MAXIMUM,SUM,DEFAULT,
                     SESKEWNESS,SEKURTOSIS}
      /SORT={NONE,MEAN,SEMEAN,STDDEV,VARIANCE,KURTOSIS,SKEWNESS,
         RANGE,MINIMUM,MAXIMUM,SUM,SESKEWNESS,SEKURTOSIS,NAME}
            {A,D}
```

The `DESCRIPTIVES` procedure reads the active dataset and outputs linear descriptive statistics requested by the user. In addition, it can optionally compute Z-scores.

The `VARIABLES` subcommand, which is required, specifies the list of variables to be analyzed. Keyword `VARIABLES` is optional.

All other subcommands are optional:

The `MISSING` subcommand determines the handling of missing variables. If `INCLUDE` is set, then user-missing values are included in the calculations. If `NOINCLUDE` is set, which is the default, user-missing values are excluded. If `VARIABLE` is set, then missing values are excluded on a variable by variable basis; if `LISTWISE` is set, then the entire case is excluded whenever any value in that case has a system-missing or, if `INCLUDE` is set, user-missing value.

The `FORMAT` subcommand has no effect. It is accepted for backward compatibility.

The `SAVE` subcommand causes `DESCRIPTIVES` to calculate Z scores for all the specified variables. The Z scores are saved to new variables. Variable names are generated by trying first the original variable name with Z prepended and truncated to a maximum of 8 characters, then the names ZSC000 through ZSC999, STDZ00 through STDZ09, ZZZZ00 through ZZZZ09, ZQZQ00 through ZQZQ09, in that sequence. In addition, Z score variable names can be specified explicitly on `VARIABLES` in the variable list by enclosing them in parentheses after each variable. When Z scores are calculated, PSPP ignores `TEMPORARY`, treating temporary transformations as permanent.

The `STATISTICS` subcommand specifies the statistics to be displayed:

`ALL` All of the statistics below.

`MEAN` Arithmetic mean.

`SEMEAN` Standard error of the mean.

`STDDEV` Standard deviation.

`VARIANCE` Variance.

`KURTOSIS` Kurtosis and standard error of the kurtosis.

`SKEWNESS` Skewness and standard error of the skewness.

`RANGE` Range.

`MINIMUM` Minimum value.

`MAXIMUM` Maximum value.

`SUM` Sum.

`DEFAULT` Mean, standard deviation of the mean, minimum, maximum.

`SEKURTOSIS`
Standard error of the kurtosis.

`SESKEWNESS`
Standard error of the skewness.

The `SORT` subcommand specifies how the statistics should be sorted. Most of the possible values should be self-explanatory. `NAME` causes the statistics to be sorted by name. By default, the statistics are listed in the order that they are specified on the `VARIABLES` subcommand. The `A` and `D` settings request an ascending or descending sort order, respectively.

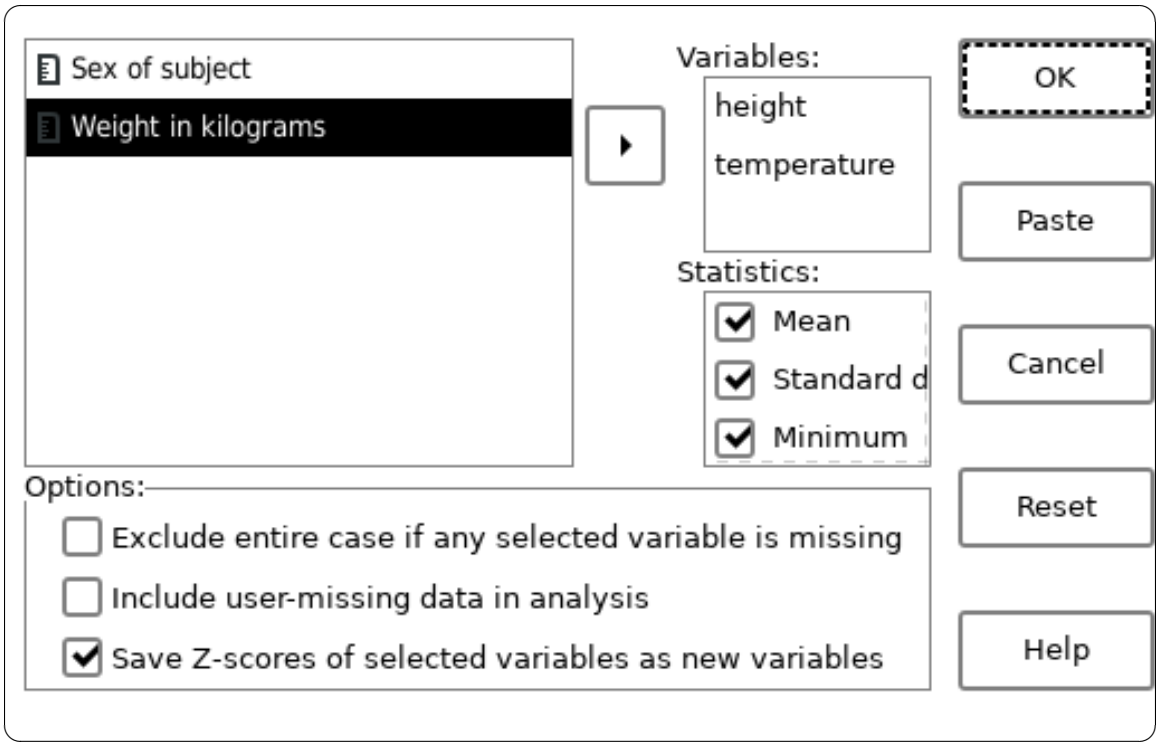
15.1.1 Descriptives Example

The `physiology.sav` file contains various physiological data for a sample of persons. Running the `DESCRIPTIVES` command on the variables **height** and **temperature** with the default options allows one to see simple linear statistics for these two variables. In Example 15.1, these variables are specfied on the `VARIABLES` subcommand and the `SAVE` option has been used, to request that Z scores be calculated.

After the command has completed, this example runs `DESCRIPTIVES` again, this time on the **zheight** and **ztemperature** variables, which are the two normalized (Z-score) variables generated by the first `DESCRIPTIVES` command.

```
get file='physiology.sav'.

descriptives
        /variables = height temperature
        /save.

descriptives
        /variables = zheight ztemperature.
```

Example 15.1: Running two `DESCRIPTIVES` commands, one with the `SAVE` subcommand



Screenshot 15.1: The Descriptives dialog box with two variables and Z-Scores option selected

In Result 15.1, we can see that there are 40 valid data for each of the variables and no missing values. The mean average of the height and temperature is 16677.12 and 37.02 respectively. The descriptive statistics for temperature seem reasonable. However there is a very high standard deviation for **height** and a suspiciously low minimum. This is due to a data entry error in the data (see Section 5.2.1 [Identifying incorrect data], page 15).

In the second Descriptive Statistics command, one can see that the mean and standard deviation of both Z score variables is 0 and 1 respectively. All Z score statistics should have these properties since they are normalized versions of the original scores.

```
              Mapping of Variables to Z-scores
+---------------------------------------------+------------+
|                   Source                    |   Target   |
+---------------------------------------------+------------+
|Height in millimeters                        |Zheight     |
|Internal body temperature in degrees Celcius|Ztemperature|
+---------------------------------------------+------------+

                            Descriptive Statistics
+-----------------------------------------+--+-------+-------+-------+-------+
|                                         | N|  Mean |Std Dev|Minimum|Maximum|
+-----------------------------------------+--+-------+-------+-------+-------+
|Height in millimeters                    |40|1677.12| 262.87|    179|   1903|
|Internal body temperature in degrees     |40|  37.02|   1.82|  32.59|  39.97|
|Celcius                                  |  |       |       |       |       |
|Valid N (listwise)                       |40|       |       |       |       |
|Missing N (listwise)                     | 0|       |       |       |       |
+-----------------------------------------+--+-------+-------+-------+-------+

                            Descriptive Statistics
+-----------------------------------------+--+---------+------+-------+-------+
|                                         |  |         |  Std |       |       |
|                                         | N|   Mean  |  Dev |Minimum|Maximum|
+-----------------------------------------+--+---------+------+-------+-------+
|Z-score of Height in millimeters         |40|1.93E-015|  1.00|  -5.70|    .86|
|Z-score of Internal body temperature in  |40|1.37E-015|  1.00|  -2.44|   1.62|
|degrees Celcius                          |  |         |      |       |       |
|Valid N (listwise)                       |40|         |      |       |       |
|Missing N (listwise)                     | 0|         |      |       |       |
+-----------------------------------------+--+---------+------+-------+-------+
```

Result 15.1: Descriptives statistics including two normalized variables (Z-scores)

15.2 FREQUENCIES

FREQUENCIES
  /VARIABLES=*var_list*
  /FORMAT={TABLE,NOTABLE,LIMIT(*limit*)}
    {AVALUE,DVALUE,AFREQ,DFREQ}
  /MISSING={EXCLUDE,INCLUDE}
  /STATISTICS={DEFAULT,MEAN,SEMEAN,MEDIAN,MODE,STDDEV,VARIANCE,
    KURTOSIS,SKEWNESS,RANGE,MINIMUM,MAXIMUM,SUM,
    SESKEWNESS,SEKURTOSIS,ALL,NONE}
  /NTILES=*ntiles*
  /PERCENTILES=percent...
  /HISTOGRAM=[MINIMUM(*x_min*)] [MAXIMUM(*x_max*)]
    [{FREQ[(*y_max*)],PERCENT[(*y_max*)]}] [{NONORMAL,NORMAL}]
  /PIECHART=[MINIMUM(*x_min*)] [MAXIMUM(*x_max*)]
    [{FREQ,PERCENT}] [{NOMISSING,MISSING}]
  /BARCHART=[MINIMUM(*x_min*)] [MAXIMUM(*x_max*)]
    [{FREQ,PERCENT}]
  /ORDER={ANALYSIS,VARIABLE}

(These options are not currently implemented.)
/HBAR=...
/GROUPED=...

The FREQUENCIES procedure outputs frequency tables for specified variables. FREQUENCIES can also calculate and display descriptive statistics (including median and mode) and percentiles, and various graphical representations of the frequency distribution.

The VARIABLES subcommand is the only required subcommand. Specify the variables to be analyzed.

The FORMAT subcommand controls the output format. It has several possible settings:

TABLE, the default, causes a frequency table to be output for every variable specified. NOTABLE prevents them from being output. LIMIT with a numeric argument causes them to be output except when there are more than the specified number of values in the table.

Normally frequency tables are sorted in ascending order by value. This is AVALUE. DVALUE tables are sorted in descending order by value. AFREQ and DFREQ tables are sorted in ascending and descending order, respectively, by frequency count.

The MISSING subcommand controls the handling of user-missing values. When EXCLUDE, the default, is set, user-missing values are not included in frequency tables or statistics. When INCLUDE is set, user-missing are included. System-missing values are never included in statistics, but are listed in frequency tables.

The available STATISTICS are the same as available in DESCRIPTIVES (see Section 15.1 [DESCRIPTIVES], page 149), with the addition of MEDIAN, the data's median value, and MODE, the mode. (If there are multiple modes, the smallest value is reported.) By default, the mean, standard deviation of the mean, minimum, and maximum are reported for each variable.

PERCENTILES causes the specified percentiles to be reported. The percentiles should be presented at a list of numbers between 0 and 100 inclusive. The NTILES subcommand causes the percentiles to be reported at the boundaries of the data set divided into the specified number of ranges. For instance, /NTILES=4 would cause quartiles to be reported.

The HISTOGRAM subcommand causes the output to include a histogram for each specified numeric variable. The X axis by default ranges from the minimum to the maximum value observed in the data, but the MINIMUM and MAXIMUM keywords can set an explicit range.[1] Histograms are not created for string variables.

Specify NORMAL to superimpose a normal curve on the histogram.

The PIECHART subcommand adds a pie chart for each variable to the data. Each slice represents one value, with the size of the slice proportional to the value's frequency. By default, all non-missing values are given slices. The MINIMUM and MAXIMUM keywords can be used to limit the displayed slices to a given range of values. The keyword NOMISSING causes missing values to be omitted from the piechart. This is the default. If instead, MISSING

[1] The number of bins is chosen according to the Freedman-Diaconis rule: $2 \times IQR(x) n^{-1/3}$, where $IQR(x)$ is the interquartile range of x and n is the number of samples. Note that EXAMINE uses a different algorithm to determine bin sizes.

is specified, then the pie chart includes a single slice representing all system missing and user-missing cases.

The `BARCHART` subcommand produces a bar chart for each variable. The `MINIMUM` and `MAXIMUM` keywords can be used to omit categories whose counts which lie outside the specified limits. The `FREQ` option (default) causes the ordinate to display the frequency of each category, whereas the `PERCENT` option displays relative percentages.

The `FREQ` and `PERCENT` options on `HISTOGRAM` and `PIECHART` are accepted but not currently honoured.

The `ORDER` subcommand is accepted but ignored.

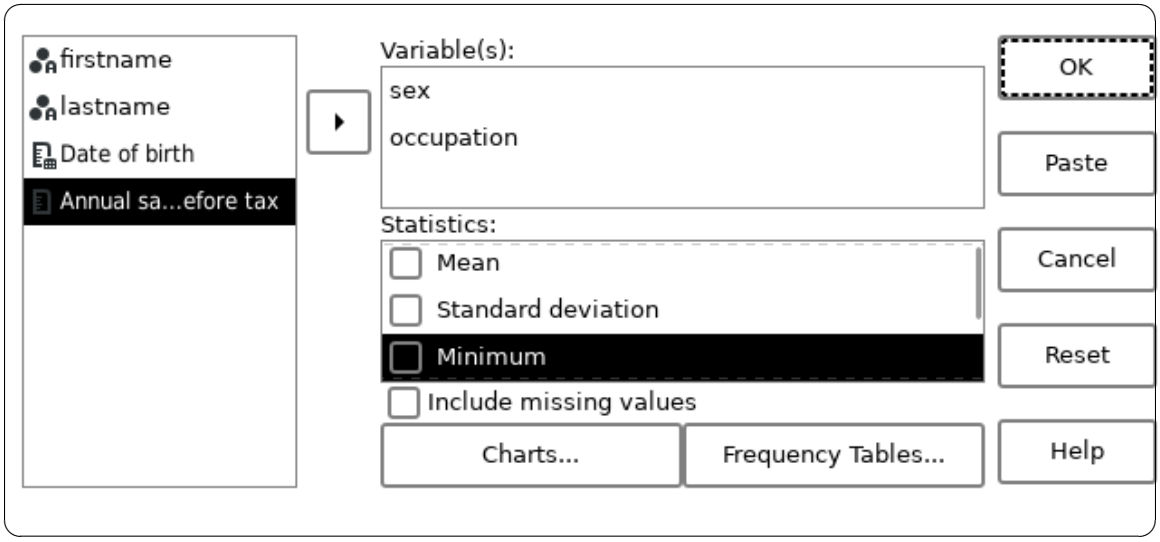
15.2.1 Frequencies Example

Example 15.2 runs a frequency analysis on the **sex** and **occupation** variables from the `personnel.sav` file. This is useful to get a general idea of the way in which these nominal variables are distributed.

```
get file='personnel.sav'.

frequencies /variables = sex occupation
            /statistics = none.
```

Example 15.2: Running frequencies on the **sex** and **occupation** variables

If you are using the graphic user interface, the dialog box is set up such that by default, several statistics are calculated. Some are not particularly useful for categorical variables, so you may want to disable those.



Screenshot 15.2: The frequencies dialog box with the **sex** and **occupation** variables selected

From Result 15.2 it is evident that there are 33 males, 21 females and 2 persons for whom their sex has not been entered.

One can also see how many of each occupation there are in the data. When dealing with string variables used as nominal values, running a frequency analysis is useful to detect data input entries. Notice that one **occupation** value has been mistyped as "Scrientist". This entry should be corrected, or marked as missing before using the data.

```
                                sex
+--------------+---------+-------+-------------+------------------+
|              |Frequency|Percent|Valid Percent|Cumulative Percent|
+--------------+---------+-------+-------------+------------------+
|Valid   Male  |       33|  58.9%|        61.1%|             61.1%|
|        Female|       21|  37.5%|        38.9%|            100.0%|
+--------------+---------+-------+-------------+------------------+
|Missing .     |        2|   3.6%|             |                  |
+--------------+---------+-------+-------------+------------------+
|Total         |       56| 100.0%|             |                  |
+--------------+---------+-------+-------------+------------------+

                                occupation
+------------------------+---------+-------+-------------+------------------+
|                        |Frequency|Percent|Valid Percent|Cumulative Percent|
+------------------------+---------+-------+-------------+------------------+
|Valid Artist            |        8|  14.3%|        14.3%|             14.3%|
|      Baker             |        2|   3.6%|         3.6%|             17.9%|
|      Barrister         |        1|   1.8%|         1.8%|             19.6%|
|      Carpenter         |        4|   7.1%|         7.1%|             26.8%|
|      Cleaner           |        4|   7.1%|         7.1%|             33.9%|
|      Cook              |        7|  12.5%|        12.5%|             46.4%|
|      Manager           |        8|  14.3%|        14.3%|             60.7%|
|      Mathematician     |        4|   7.1%|         7.1%|             67.9%|
|      Painter           |        2|   3.6%|         3.6%|             71.4%|
|      Payload Specialist|        1|   1.8%|         1.8%|             73.2%|
|      Plumber           |        5|   8.9%|         8.9%|             82.1%|
|      Scientist         |        7|  12.5%|        12.5%|             94.6%|
|      Scrientist        |        1|   1.8%|         1.8%|             96.4%|
|      Tailor            |        2|   3.6%|         3.6%|            100.0%|
+------------------------+---------+-------+-------------+------------------+
|Total                   |       56| 100.0%|             |                  |
+------------------------+---------+-------+-------------+------------------+
```

Result 15.2: The relative frequencies of **sex** and **occupation**

15.3 EXAMINE

EXAMINE
  VARIABLES= *var1* [*var2*] . . . [*varN*]
    [BY *factor1* [BY *subfactor1*]
      [*factor2* [BY *subfactor2*]]
      . . .
      [*factor3* [BY *subfactor3*]]
    ]
  /STATISTICS={DESCRIPTIVES, EXTREME[(n)], ALL, NONE}
/PLOT={BOXPLOT, NPPLOT, HISTOGRAM, SPREADLEVEL[(t)], ALL, NONE}
  /CINTERVAL p
  /COMPARE={GROUPS,VARIABLES}
  /ID=*identity_variable*

/{TOTAL,NOTOTAL}
/PERCENTILE=[*percentiles*]={HAVERAGE, WAVERAGE, ROUND, AEMPIRICAL, EMPIRICAL }
/MISSING={LISTWISE, PAIRWISE} [{EXCLUDE, INCLUDE}]
[{NOREPORT,REPORT}]

The `EXAMINE` command is used to perform exploratory data analysis. In particular, it is useful for testing how closely a distribution follows a normal distribution, and for finding outliers and extreme values.

The `VARIABLES` subcommand is mandatory. It specifies the dependent variables and optionally variables to use as factors for the analysis. Variables listed before the first `BY` keyword (if any) are the dependent variables. The dependent variables may optionally be followed by a list of factors which tell PSPP how to break down the analysis for each dependent variable.

Following the dependent variables, factors may be specified. The factors (if desired) should be preceded by a single `BY` keyword. The format for each factor is

factorvar [BY *subfactorvar*].

Each unique combination of the values of *factorvar* and *subfactorvar* divide the dataset into *cells*. Statistics are calculated for each cell and for the entire dataset (unless `NOTOTAL` is given).

The `STATISTICS` subcommand specifies which statistics to show. `DESCRIPTIVES` produces a table showing some parametric and non-parametrics statistics. `EXTREME` produces a table showing the extremities of each cell. A number in parentheses, n determines how many upper and lower extremities to show. The default number is 5.

The subcommands `TOTAL` and `NOTOTAL` are mutually exclusive. If `TOTAL` appears, then statistics for the entire dataset as well as for each cell are produced. If `NOTOTAL` appears, then statistics are produced only for the cells (unless no factor variables have been given). These subcommands have no effect if there have been no factor variables specified.

The `PLOT` subcommand specifies which plots are to be produced if any. Available plots are `HISTOGRAM`, `NPPLOT`, `BOXPLOT` and `SPREADLEVEL`. The first three can be used to visualise how closely each cell conforms to a normal distribution, whilst the spread vs. level plot can be useful to visualise how the variance differs between factors. Boxplots show you the outliers and extreme values.[2]

The `SPREADLEVEL` plot displays the interquartile range versus the median. It takes an optional parameter t, which specifies how the data should be transformed prior to plotting. The given value t is a power to which the data are raised. For example, if t is given as 2, then the square of the data is used. Zero, however is a special value. If t is 0 or is omitted, then data are transformed by taking its natural logarithm instead of raising to the power of t.

When one or more plots are requested, `EXAMINE` also performs the Shapiro-Wilk test for each category. There are however a number of provisos:

- All weight values must be integer.

[2] `HISTOGRAM` uses Sturges' rule to determine the number of bins, as approximately $1 + \log 2(n)$, where n is the number of samples. Note that `FREQUENCIES` uses a different algorithm to find the bin size.

- The cumulative weight value must be in the range [3, 5000]

The COMPARE subcommand is only relevant if producing boxplots, and it is only useful there is more than one dependent variable and at least one factor. If /COMPARE=GROUPS is specified, then one plot per dependent variable is produced, each of which contain boxplots for all the cells. If /COMPARE=VARIABLES is specified, then one plot per cell is produced, each containing one boxplot per dependent variable. If the /COMPARE subcommand is omitted, then PSPP behaves as if /COMPARE=GROUPS were given.

The ID subcommand is relevant only if /PLOT=BOXPLOT or /STATISTICS=EXTREME has been given. If given, it should provide the name of a variable which is to be used to labels extreme values and outliers. Numeric or string variables are permissible. If the ID subcommand is not given, then the case number is used for labelling.

The CINTERVAL subcommand specifies the confidence interval to use in calculation of the descriptives command. The default is 95%.

The PERCENTILES subcommand specifies which percentiles are to be calculated, and which algorithm to use for calculating them. The default is to calculate the 5, 10, 25, 50, 75, 90, 95 percentiles using the HAVERAGE algorithm.

The TOTAL and NOTOTAL subcommands are mutually exclusive. If NOTOTAL is given and factors have been specified in the VARIABLES subcommand, then statistics for the unfactored dependent variables are produced in addition to the factored variables. If there are no factors specified then TOTAL and NOTOTAL have no effect.

The following example generates descriptive statistics and histograms for two variables *score1* and *score2*. Two factors are given, *viz*: *gender* and *gender* BY *culture*. Therefore, the descriptives and histograms are generated for each distinct value of *gender and* for each distinct combination of the values of *gender* and *race*. Since the NOTOTAL keyword is given, statistics and histograms for *score1* and *score2* covering the whole dataset are not produced.

```
EXAMINE score1 score2 BY
        gender
        gender BY culture
        /STATISTICS = DESCRIPTIVES
        /PLOT = HISTOGRAM
        /NOTOTAL.
```

Here is a second example showing how the examine command can be used to find extremities.

```
EXAMINE height weight BY
        gender
        /STATISTICS = EXTREME (3)
        /PLOT = BOXPLOT
        /COMPARE = GROUPS
        /ID = name.
```

In this example, we look at the height and weight of a sample of individuals and how they differ between male and female. A table showing the 3 largest and the 3 smallest values of **height** and **weight** for each gender, and for the whole dataset as are shown. In addition, the /PLOT subcommand requests boxplots. Because /COMPARE = GROUPS was specified, boxplots for male and female are shown in juxtaposed in the same graphic, allowing us to easily

see the difference between the genders. Since the variable *name* was specified on the `ID` subcommand, values of the *name* variable are used to label the extreme values.

Warning! If you specify many dependent variables or factor variables for which there are many distinct values, then `EXAMINE` will produce a very large quantity of output.

15.4 GRAPH

GRAPH
  /HISTOGRAM [(NORMAL)]= *var*
  /SCATTERPLOT [(BIVARIATE)] = *var1* WITH *var2* [BY *var3*]
  /BAR = {*summary-function*(*var1*) | *count-function*} BY *var2* [BY *var3*]
  [/MISSING={LISTWISE, VARIABLE} [{EXCLUDE, INCLUDE}]]
[{NOREPORT,REPORT}]

The `GRAPH` command produces graphical plots of data. Only one of the subcommands `HISTOGRAM`, `BAR` or `SCATTERPLOT` can be specified, *i.e.* only one plot can be produced per call of `GRAPH`. The `MISSING` is optional.

15.4.1 Scatterplot

The subcommand `SCATTERPLOT` produces an xy plot of the data. `GRAPH` uses the third variable *var3*, if specified, to determine the colours and/or markers for the plot. The following is an example for producing a scatterplot.

```
GRAPH
        /SCATTERPLOT = height WITH weight BY gender.
```

This example produces a scatterplot where *height* is plotted versus *weight*. Depending on the value of the *gender* variable, the colour of the datapoint is different. With this plot it is possible to analyze gender differences for *height* versus *weight* relation.

15.4.2 Histogram

The subcommand `HISTOGRAM` produces a histogram. Only one variable is allowed for the histogram plot. The keyword `NORMAL` may be specified in parentheses, to indicate that the ideal normal curve should be superimposed over the histogram. For an alternative method to produce histograms see Section 15.3 [EXAMINE], page 155. The following example produces a histogram plot for the variable *weight*.

```
GRAPH
        /HISTOGRAM = weight.
```

15.4.3 Bar Chart

The subcommand `BAR` produces a bar chart. This subcommand requires that a *count-function* be specified (with no arguments) or a *summary-function* with a variable *var1* in parentheses. Following the summary or count function, the keyword `BY` should be specified and then a catagorical variable, *var2*. The values of the variable *var2* determine the labels of the bars to be plotted. Optionally a second categorical variable *var3* may be specified in which case a clustered (grouped) bar chart is produced.

Valid count functions are

`COUNT` The weighted counts of the cases in each category.

`PCT` The weighted counts of the cases in each category expressed as a percentage of the total weights of the cases.

`CUFREQ` The cumulative weighted counts of the cases in each category.

`CUPCT` The cumulative weighted counts of the cases in each category expressed as a percentage of the total weights of the cases.

The summary function is applied to *var1* across all cases in each category. The recognised summary functions are:

`SUM` The sum.

`MEAN` The arithmetic mean.

`MAXIMUM` The maximum value.

`MINIMUM` The minimum value.

The following examples assume a dataset which is the results of a survey. Each respondent has indicated annual income, their sex and city of residence. One could create a bar chart showing how the mean income varies between of residents of different cities, thus:

```
GRAPH  /BAR  = MEAN(income) BY city.
```

This can be extended to also indicate how income in each city differs between the sexes.

```
GRAPH  /BAR  = MEAN(income) BY city BY sex.
```

One might also want to see how many respondents there are from each city. This can be achieved as follows:

```
GRAPH  /BAR  = COUNT BY city.
```

Bar charts can also be produced using the Section 15.2 [FREQUENCIES], page 152, and Section 15.6 [CROSSTABS], page 160, commands.

15.5 CORRELATIONS

```
CORRELATIONS
    /VARIABLES = var_list [ WITH var_list ]
    [
     .
     .
     .
     /VARIABLES = var_list [ WITH var_list ]
     /VARIABLES = var_list [ WITH var_list ]
    ]

    [ /PRINT={TWOTAIL, ONETAIL} {SIG, NOSIG} ]
    [ /STATISTICS=DESCRIPTIVES XPROD ALL]
    [ /MISSING={PAIRWISE, LISTWISE} {INCLUDE, EXCLUDE} ]
```

The `CORRELATIONS` procedure produces tables of the Pearson correlation coefficient for a set of variables. The significance of the coefficients are also given.

At least one `VARIABLES` subcommand is required. If you specify the `WITH` keyword, then a non-square correlation table is produced. The variables preceding `WITH`, are used as the

rows of the table, and the variables following `WITH` are used as the columns of the table. If no `WITH` subcommand is specified, then `CORRELATIONS` produces a square, symmetrical table using all variables.

The `MISSING` subcommand determines the handling of missing variables. If `INCLUDE` is set, then user-missing values are included in the calculations, but system-missing values are not. If `EXCLUDE` is set, which is the default, user-missing values are excluded as well as system-missing values.

If `LISTWISE` is set, then the entire case is excluded from analysis whenever any variable specified in any `/VARIABLES` subcommand contains a missing value. If `PAIRWISE` is set, then a case is considered missing only if either of the values for the particular coefficient are missing. The default is `PAIRWISE`.

The `PRINT` subcommand is used to control how the reported significance values are printed. If the `TWOTAIL` option is used, then a two-tailed test of significance is printed. If the `ONETAIL` option is given, then a one-tailed test is used. The default is `TWOTAIL`.

If the `NOSIG` option is specified, then correlation coefficients with significance less than 0.05 are highlighted. If `SIG` is specified, then no highlighting is performed. This is the default.

The `STATISTICS` subcommand requests additional statistics to be displayed. The keyword `DESCRIPTIVES` requests that the mean, number of non-missing cases, and the non-biased estimator of the standard deviation are displayed. These statistics are displayed in a separated table, for all the variables listed in any `/VARIABLES` subcommand. The `XPROD` keyword requests cross-product deviations and covariance estimators to be displayed for each pair of variables. The keyword `ALL` is the union of `DESCRIPTIVES` and `XPROD`.

15.6 CROSSTABS

```
CROSSTABS
      /TABLES=var_list BY var_list [BY var_list]...
      /MISSING={TABLE,INCLUDE,REPORT}
      /FORMAT={TABLES,NOTABLES}
            {AVALUE,DVALUE}
    /CELLS={COUNT,ROW,COLUMN,TOTAL,EXPECTED,RESIDUAL,SRESIDUAL,
            ASRESIDUAL,ALL,NONE}
      /COUNT={ASIS,CASE,CELL}
           {ROUND,TRUNCATE}
    /STATISTICS={CHISQ,PHI,CC,LAMBDA,UC,BTAU,CTAU,RISK,GAMMA,D,
                 KAPPA,ETA,CORR,ALL,NONE}
      /BARCHART

(Integer mode.)
      /VARIABLES=var_list (low,high)...
```

The `CROSSTABS` procedure displays crosstabulation tables requested by the user. It can calculate several statistics for each cell in the crosstabulation tables. In addition, a number of statistics can be calculated for each table itself.

The `TABLES` subcommand is used to specify the tables to be reported. Any number of dimensions is permitted, and any number of variables per dimension is allowed. The

`TABLES` subcommand may be repeated as many times as needed. This is the only required subcommand in *general mode*.

Occasionally, one may want to invoke a special mode called *integer mode*. Normally, in general mode, PSPP automatically determines what values occur in the data. In integer mode, the user specifies the range of values that the data assumes. To invoke this mode, specify the `VARIABLES` subcommand, giving a range of data values in parentheses for each variable to be used on the `TABLES` subcommand. Data values inside the range are truncated to the nearest integer, then assigned to that value. If values occur outside this range, they are discarded. When it is present, the `VARIABLES` subcommand must precede the `TABLES` subcommand.

In general mode, numeric and string variables may be specified on TABLES. In integer mode, only numeric variables are allowed.

The `MISSING` subcommand determines the handling of user-missing values. When set to `TABLE`, the default, missing values are dropped on a table by table basis. When set to `INCLUDE`, user-missing values are included in tables and statistics. When set to `REPORT`, which is allowed only in integer mode, user-missing values are included in tables but marked with a footnote and excluded from statistical calculations.

The `FORMAT` subcommand controls the characteristics of the crosstabulation tables to be displayed. It has a number of possible settings:

> `TABLES`, the default, causes crosstabulation tables to be output. `NOTABLES`, which is equivalent to `CELLS=NONE`, suppresses them.
>
> `AVALUE`, the default, causes values to be sorted in ascending order. `DVALUE` asserts a descending sort order.

The `CELLS` subcommand controls the contents of each cell in the displayed crosstabulation table. The possible settings are:

COUNT Frequency count.

ROW Row percent.

COLUMN Column percent.

TOTAL Table percent.

EXPECTED
Expected value.

RESIDUAL
Residual.

SRESIDUAL
Standardized residual.

ASRESIDUAL
Adjusted standardized residual.

ALL All of the above.

NONE Suppress cells entirely.

'/CELLS' without any settings specified requests COUNT, ROW, COLUMN, and TOTAL. If CELLS is not specified at all then only COUNT is selected.

By default, crosstabulation and statistics use raw case weights, without rounding. Use the /COUNT subcommand to perform rounding: CASE rounds the weights of individual weights as cases are read, CELL rounds the weights of cells within each crosstabulation table after it has been constructed, and ASIS explicitly specifies the default non-rounding behavior. When rounding is requested, ROUND, the default, rounds to the nearest integer and TRUNCATE rounds toward zero.

The STATISTICS subcommand selects statistics for computation:

CHISQ
: Pearson chi-square, likelihood ratio, Fisher's exact test, continuity correction, linear-by-linear association.

PHI
: Phi.

CC
: Contingency coefficient.

LAMBDA
: Lambda.

UC
: Uncertainty coefficient.

BTAU
: Tau-b.

CTAU
: Tau-c.

RISK
: Risk estimate.

GAMMA
: Gamma.

D
: Somers' D.

KAPPA
: Cohen's Kappa.

ETA
: Eta.

CORR
: Spearman correlation, Pearson's r.

ALL
: All of the above.

NONE
: No statistics.

Selected statistics are only calculated when appropriate for the statistic. Certain statistics require tables of a particular size, and some statistics are calculated only in integer mode.

'/STATISTICS' without any settings selects CHISQ. If the STATISTICS subcommand is not given, no statistics are calculated.

The '/BARCHART' subcommand produces a clustered bar chart for the first two variables on each table. If a table has more than two variables, the counts for the third and subsequent levels are aggregated and the chart is produced as if there were only two variables.

Please note: Currently the implementation of CROSSTABS has the following limitations:

- Significance of some directional measures is not calculated.
- Asymptotic standard error is not calculated for Goodman and Kruskal's tau or symmetric Somers' d.
- Approximate T is not calculated for symmetric uncertainty coefficient.

Fixes for any of these deficiencies would be welcomed.

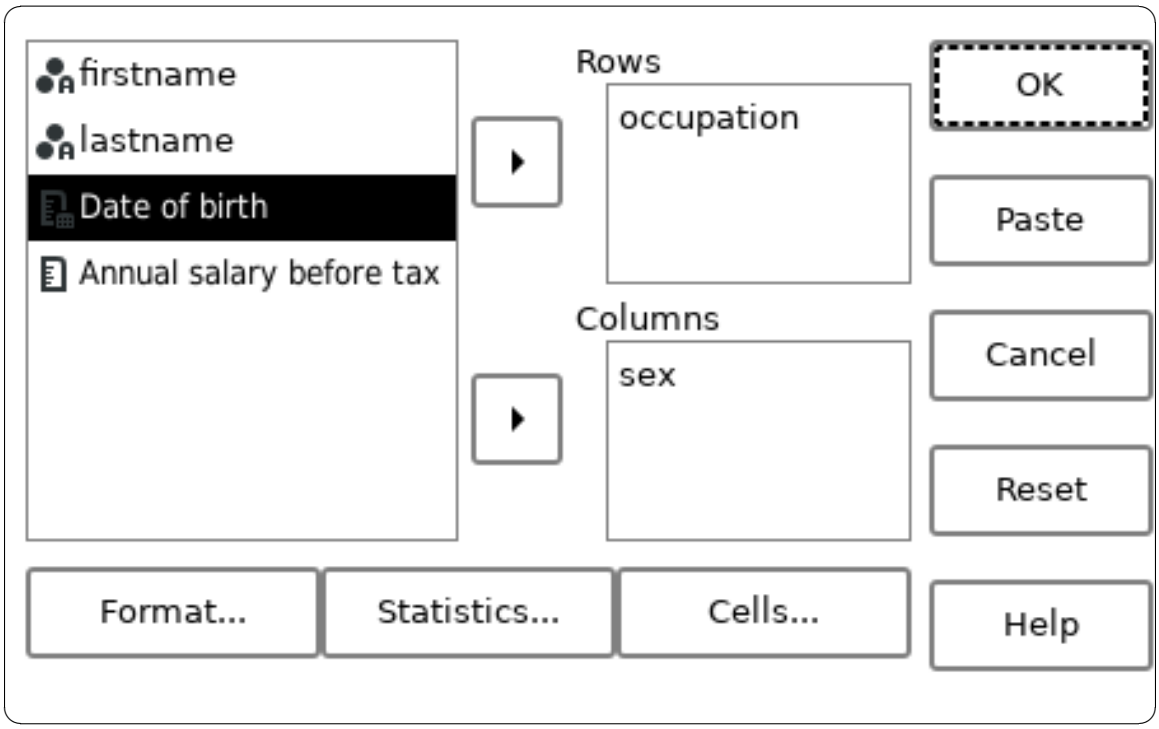
15.6.1 Crosstabs Example

A researcher wishes to know if, in an industry, a person's sex is related to the person's occupation. To investigate this, she has determined that the `personnel.sav` is a representative, randomly selected sample of persons. The researcher's null hypothesis is that a person's sex has no relation to a person's occupation. She uses a chi-squared test of independence to investigate the hypothesis.

```
get file="personnel.sav".

crosstabs
          /tables= occupation by sex
          /cells = count expected
          /statistics=chisq.
```

Example 15.3: Running crosstabs on the **sex** and **occupation** variables

The syntax in Example 15.3 conducts a chi-squared test of independence. The line `/tables = occupation by sex` indicates that **occupation** and **sex** are the variables to be tabulated. To do this using the graphic user interface you must place these variable names respectively in the '`Row`' and '`Column`' fields as shown in Screenshot 15.3.



Screenshot 15.3: The Crosstabs dialog box with the **sex** and **occupation** variables selected

Similarly, the '`Cells`' button shows a dialog box to select the `count` and `expected` options. All other cell options can be deselected for this test.

You would use the '`Format`' and '`Statistics`' buttons to select options for the `FORMAT` and `STATISTICS` subcommands. In this example, the '`Statistics`' requires only the '`Chisq`' option to be checked. All other options should be unchecked. No special settings are required from the '`Format`' dialog.

As shown in Results 15.1 `CROSSTABS` generates a contingency table containing the observed count and the expected count of each sex and each occupation. The expected count is the count which would be observed if the null hypothesis were true.

The significance of the Pearson Chi-Square value is very much larger than the normally accepted value of 0.05 and so one cannot reject the null hypothesis. Thus the researcher must conclude that a person's sex has no relation to the person's occupation.

Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
occupation × sex	54	96.4%	2	3.6%	56	100.0%

occupation × sex

		sex		
		Male	Female	Total
occupation Artist	Count	2	6	8
	Expected	4.89	3.11	.15
Baker	Count	1	1	2
	Expected	1.22	.78	.04
Barrister	Count	0	1	1
	Expected	.61	.39	.02
Carpenter	Count	3	1	4
	Expected	2.44	1.56	.07
Cleaner	Count	4	0	4
	Expected	2.44	1.56	.07
Cook	Count	3	2	5
	Expected	3.06	1.94	.09
Manager	Count	4	4	8
	Expected	4.89	3.11	.15
Mathematician	Count	3	1	4
	Expected	2.44	1.56	.07
Painter	Count	1	1	2
	Expected	1.22	.78	.04
Payload Specialist	Count	1	0	1
	Expected	.61	.39	.02
Plumber	Count	5	0	5
	Expected	3.06	1.94	.09
Scientist	Count	5	2	7
	Expected	4.28	2.72	.13
Scrientist	Count	0	1	1
	Expected	.61	.39	.02
Tailor	Count	1	1	2
	Expected	1.22	.78	.04
Total	Count	33	21	54
	Expected	.61	.39	1.00

Chi-Square Tests

15.7 CTABLES

CTABLES has the following overall syntax. At least one TABLE subcommand is required:

```
CTABLES
  ...global subcommands...
  [/TABLE axis [BY axis [BY axis]]
   ...per-table subcommands...]...
```

where each *axis* may be empty or take one of the following forms:

```
variable
variable [{C | S}]
axis + axis
axis > axis
(axis)
axis [summary [string] [format]]
```

The following subcommands precede the first TABLE subcommand and apply to all of the output tables. All of these subcommands are optional:

```
/FORMAT
   [MINCOLWIDTH={DEFAULT | width}]
   [MAXCOLWIDTH={DEFAULT | width}]
   [UNITS={POINTS | INCHES | CM}]
   [EMPTY={ZERO | BLANK | string}]
   [MISSING=string]
/VLABELS
   VARIABLES=variables
   DISPLAY={DEFAULT | NAME | LABEL | BOTH | NONE}
/SMISSING {VARIABLE | LISTWISE}
/PCOMPUTE &postcompute=EXPR(expression)
/PPROPERTIES &postcompute...
   [LABEL=string]
   [FORMAT=[summary format]...]
   [HIDESOURCECATS={NO | YES}
/WEIGHT VARIABLE=variable
/HIDESMALLCOUNTS COUNT=count
```

The following subcommands follow TABLE and apply only to the previous TABLE. All of these subcommands are optional:

```
/SLABELS
   [POSITION={COLUMN | ROW | LAYER}]
   [VISIBLE={YES | NO}]
/CLABELS {AUTO | {ROWLABELS|COLLABELS}={OPPOSITE|LAYER}}
/CATEGORIES VARIABLES=variables
   {[value, value...]
  | [ORDER={A | D}]
    [KEY={VALUE | LABEL | summary(variable)}]
    [MISSING={EXCLUDE | INCLUDE}]}
   [TOTAL={NO | YES} [LABEL=string] [POSITION={AFTER | BEFORE}]]
   [EMPTY={INCLUDE | EXCLUDE}]
```

/TITLES
[TITLE=*string*...]
[CAPTION=*string*...]
[CORNER=*string*...]

The CTABLES (aka "custom tables") command produces multi-dimensional tables from categorical and scale data. It offers many options for data summarization and formatting.

This section's examples use data from the 2008 (USA) National Survey of Drinking and Driving Attitudes and Behaviors, a public domain data set from the (USA) National Highway Traffic Administration and available at https://data.transportation.gov. PSPP includes this data set, with a modified dictionary, as examples/nhtsa.sav.

15.7.1 Basics

The only required subcommand is TABLE, which specifies the variables to include along each axis:

/TABLE *rows* [BY *columns* [BY *layers*]]

In TABLE, each of *rows*, *columns*, and *layers* is either empty or an axis expression that specifies one or more variables. At least one must specify an axis expression.

15.7.1.1 Categorical Variables

An axis expression that names a categorical variable divides the data into cells according to the values of that variable. When all the variables named on TABLE are categorical, by default each cell displays the number of cases that it contains, so specifying a single variable yields a frequency table, much like the output of the FREQUENCIES command (see Section 15.2 [FREQUENCIES], page 152):

```
CTABLES /TABLE=ageGroup.
         Custom Tables
+-----------------------+-----+
|                       |Count|
+-----------------------+-----+
|Age group 15 or younger|    0|
|          16 to 25     | 1099|
|          26 to 35     |  967|
|          36 to 45     | 1037|
|          46 to 55     | 1175|
|          56 to 65     | 1247|
|          66 or older  | 1474|
+-----------------------+-----+
```

Specifying a row and a column categorical variable yields a crosstabulation, much like the output of the CROSSTABS command (see Section 15.6 [CROSSTABS], page 160):

```
CTABLES /TABLE=ageGroup BY gender.
             Custom Tables
+-----------------------+------------+
|                       |S3a. GENDER:|
|                       +-----+------+
|                       | Male|Female|
|                       +-----+------+
|                       |Count| Count|
+-----------------------+-----+------+
|Age group 15 or younger|    0|     0|
```

```
|          16 to 25     |  594|   505|
|          26 to 35     |  476|   491|
|          36 to 45     |  489|   548|
|          46 to 55     |  526|   649|
|          56 to 65     |  516|   731|
|          66 or older  |  531|   943|
+-----------------------+-----+------+
```

The '>' "nesting" operator nests multiple variables on a single axis, e.g.:

```
CTABLES /TABLE likelihoodOfBeingStoppedByPolice BY ageGroup > gender.
```

```
                                Custom Tables
+--------------------------------+-----------------------------------------+
|                                |  86. In the past year, have you hosted a  |
|                                |  social event or party where alcohol was  |
|                                |             served to adults?             |
|                                +---------------------+---------------------+
|                                |         Yes         |          No         |
|                                +---------------------+---------------------+
|                                |        Count        |        Count        |
+--------------------------------+---------------------+---------------------+
|Age    15 or      S3a.     Male |                   0|                   0|
|group  younger    GENDER:  Female|                   0|                   0|
|      --------------------------+---------------------+---------------------+
|       16 to 25   S3a.     Male |                 208|                 386|
|                  GENDER:  Female|                 202|                 303|
|      --------------------------+---------------------+---------------------+
|       26 to 35   S3a.     Male |                 225|                 251|
|                  GENDER:  Female|                 242|                 249|
|      --------------------------+---------------------+---------------------+
|       36 to 45   S3a.     Male |                 223|                 266|
|                  GENDER:  Female|                 240|                 307|
|      --------------------------+---------------------+---------------------+
|       46 to 55   S3a.     Male |                 201|                 325|
|                  GENDER:  Female|                 282|                 366|
|      --------------------------+---------------------+---------------------+
|       56 to 65   S3a.     Male |                 196|                 320|
|                  GENDER:  Female|                 279|                 452|
|      --------------------------+---------------------+---------------------+
|       66 or      S3a.     Male |                 162|                 367|
|       older      GENDER:  Female|                 243|                 700|
+--------------------------------+---------------------+---------------------+
```

The '+' "stacking" operator allows a single output table to include multiple data analyses. With '+', `CTABLES` divides the output table into multiple *sections*, each of which includes an analysis of the full data set. For example, the following command separately tabulates age group and driving frequency by gender:

```
CTABLES /TABLE ageGroup + freqOfDriving BY gender.
```

```
                                Custom Tables
+-------------------------------------------------------------+------------+
|                                                             |S3a. GENDER:|
|                                                             +-----+------+
|                                                             | Male|Female|
|                                                             +-----+------+
|                                                             |Count| Count|
+-------------------------------------------------------------+-----+------+
|Age group                                  15 or younger     |    0|     0|
|                                           16 to 25          |  594|   505|
```

```
|                                          26 to 35           |  476|   491|
|                                          36 to 45           |  489|   548|
|                                          46 to 55           |  526|   649|
|                                          56 to 65           |  516|   731|
|                                          66 or older        |  531|   943|
+-------------------------------------------------------------+-----+------+
| 1. How often do you usually drive a car or  Every day       | 2305|  2362|
|other motor vehicle?                      Several days a week|  440|   834|
|                                          Once a week or less|  125|   236|
|                                          Only certain times |   58|    72|
|                                          a year             |     |      |
|                                          Never              |  192|   348|
+-------------------------------------------------------------+-----+------+
```

When '+' and '>' are used together, '>' binds more tightly. Use parentheses to override operator precedence. Thus:

```
CTABLES /TABLE hasConsideredReduction + hasBeenCriticized > gender.
CTABLES /TABLE (hasConsideredReduction + hasBeenCriticized) > gender.
```

```
                              Custom Tables
+---------------------------------------------------------------------+-----+
|                                                                     |Count|
+---------------------------------------------------------------------+-----+
|26. During the last 12 months, has there been a    Yes               |  513|
|time when you felt you should cut down on your    ---------------------+-----+
|drinking?                                          No                | 3710|
+---------------------------------------------------------------------+-----+
|27. During the last 12 months, has there been a    Yes S3a.      Male  |  135|
|time when people criticized your drinking?             GENDER:   Female|   49|
|                                                  ---------------------+-----+
|                                                   No  S3a.      Male  | 1916|
|                                                       GENDER:   Female| 2126|
+---------------------------------------------------------------------+-----+

                              Custom Tables
+---------------------------------------------------------------------+-----+
|                                                                     |Count|
+---------------------------------------------------------------------+-----+
|26. During the last 12 months, has there been a    Yes S3a.      Male  |  333|
|time when you felt you should cut down on your         GENDER:   Female|  180|
|drinking?                                         ---------------------+-----+
|                                                   No  S3a.      Male  | 1719|
|                                                       GENDER:   Female| 1991|
+---------------------------------------------------------------------+-----+
|27. During the last 12 months, has there been a    Yes S3a.      Male  |  135|
|time when people criticized your drinking?             GENDER:   Female|   49|
|                                                  ---------------------+-----+
|                                                   No  S3a.      Male  | 1916|
|                                                       GENDER:   Female| 2126|
+---------------------------------------------------------------------+-----+
```

15.7.1.2 Scalar Variables

For a categorical variable, CTABLES divides the table into a cell per category. For a scalar variable, CTABLES instead calculates a summary measure, by default the mean, of the values that fall into a cell. For example, if the only variable specified is a scalar variable, then the output is a single cell that holds the mean of all of the data:

```
CTABLES /TABLE age.
```

```
          Custom Tables
+--------------------------+----+
|                          |Mean|
+--------------------------+----+
|D1. AGE: What is your age?|  48|
+--------------------------+----+
```

A scalar variable may nest with categorical variables. The following example shows the mean age of survey respondents across gender and language groups:

```
CTABLES /TABLE gender > age BY region.
```

```
                                Custom Tables
+-------------------------------------+---------------------------------------+
|                                     |Was this interview conducted in English|
|                                     |              or Spanish?              |
|                                     +-------------------+-------------------+
|                                     |      English      |      Spanish      |
|                                     +-------------------+-------------------+
|                                     |        Mean       |        Mean       |
+-------------------------------------+-------------------+-------------------+
|D1. AGE: What is   S3a.        Male  |                46|                37|
|your age?          GENDER:     Female|                51|                39|
+-------------------------------------+-------------------+-------------------+
```

The order of nesting of scalar and categorical variables affects table labeling, but it does not affect the data displayed in the table. The following example shows how the output changes when the nesting order of the scalar and categorical variable are interchanged:

```
CTABLES /TABLE age > gender BY region.
```

```
                                Custom Tables
+-------------------------------------+---------------------------------------+
|                                     |Was this interview conducted in English|
|                                     |              or Spanish?              |
|                                     +-------------------+-------------------+
|                                     |      English      |      Spanish      |
|                                     +-------------------+-------------------+
|                                     |        Mean       |        Mean       |
+-------------------------------------+-------------------+-------------------+
|S3a.       Male   D1. AGE: What is   |                46|                37|
|GENDER:           your age?          |                  |                  |
|          --------------------------+-------------------+-------------------+
|           Female D1. AGE: What is   |                51|                39|
|                  your age?          |                  |                  |
+-------------------------------------+-------------------+-------------------+
```

Only a single scalar variable may appear in each section; that is, a scalar variable may not nest inside a scalar variable directly or indirectly. Scalar variables may only appear on one axis within `TABLE`.

15.7.1.3 Overriding Measurement Level

By default, `CTABLES` uses a variable's measurement level to decide whether to treat it as categorical or scalar. Variables assigned the nominal or ordinal measurement level are treated as categorical, and scalar variables are treated as scalar.

When PSPP reads data from a file in an external format, such as a text file, variables' measurement levels are often unknown. If `CTABLES` runs when a variable has an unknown measurement level, it makes an initial pass through the data to guess measurement levels

using the rules described in an earlier section (see [Measurement Level], page 30). Use the `VARIABLE LEVEL` command to set or change a variable's measurement level (see Section 11.17 [VARIABLE LEVEL], page 104).

To treat a variable as categorical or scalar only for one use on `CTABLES`, add '`[C]`' or '`[S]`', respectively, after the variable name. The following example shows the output when variable `monthDaysMin1drink` is analyzed as scalar (the default for its measurement level) and as categorical:

```
CTABLES
    /TABLE monthDaysMin1drink BY gender
    /TABLE monthDaysMin1drink [C] BY gender.
```

Custom Tables

	S3a. GENDER:	
	Male	Female
	Mean	Mean
20. On how many of the thirty days in this typical month did you have one or more alcoholic beverages to drink?	7	5

Custom Tables

		S3a. GENDER:	
		Male	Female
		Count	Count
20. On how many of the thirty days in this typical month did you have one or more alcoholic beverages to drink?	None	152	258
	1	403	653
	2	284	324
	3	169	215
	4	178	143
	5	107	106
	6	67	59
	7	31	11
	8	101	74
	9	6	4
	10	95	75
	11	4	0
	12	58	33
	13	3	2
	14	13	3
	15	79	58
	16	10	6
	17	4	2
	18	5	4
	19	2	0
	20	105	47
	21	2	0
	22	3	3
	23	0	3
	24	3	0

```
|                                                                25     |   35|    25|
|                                                                26     |    1|     1|
|                                                                27     |    3|     3|
|                                                                28     |   13|     8|
|                                                                29     |    3|     3|
|                                                                Every  |  104|    43|
|                                                                day    |     |      |
+---------------------------------------------------------------+-----+------+
```

15.7.2 Data Summarization

The `CTABLES` command allows the user to control how the data are summarized with *summary specifications*, syntax that lists one or more summary function names, optionally separated by commas, and which are enclosed in square brackets following a variable name on the `TABLE` subcommand. When all the variables are categorical, summary specifications can be given for the innermost nested variables on any one axis. When a scalar variable is present, only the scalar variable may have summary specifications.

The following example includes a summary specification for column and row percentages for categorical variables, and mean and median for a scalar variable:

```
CTABLES
    /TABLE=age [MEAN, MEDIAN] BY gender
    /TABLE=ageGroup [COLPCT, ROWPCT] BY gender.
```

```
                  Custom Tables
+-------------------------+----------------------+
|                         |      S3a. GENDER:    |
|                         +-----------+----------+
|                         |    Male   |  Female  |
|                         +----+------+----+-----+
|                         |Mean|Median|Mean|Median|
+-------------------------+----+------+----+-----+
|D1. AGE: What is your age?|  46|    45|  50|    52|
+-------------------------+----+------+----+-----+
```

```
                     Custom Tables
+----------------------+----------------------------+
|                      |         S3a. GENDER:       |
|                      +--------------+-------------+
|                      |     Male     |   Female    |
|                      +--------+-----+--------+----+
|                      |Column %|Row %|Column %|Row %|
+----------------------+--------+-----+--------+----+
|Age group 15 or younger|     .0%|    .|     .0%|    .|
|          16 to 25    |   19.0%|54.0%|   13.1%|46.0%|
|          26 to 35    |   15.2%|49.2%|   12.7%|50.8%|
|          36 to 45    |   15.6%|47.2%|   14.2%|52.8%|
|          46 to 55    |   16.8%|44.8%|   16.8%|55.2%|
|          56 to 65    |   16.5%|41.4%|   18.9%|58.6%|
|          66 or older |   17.0%|36.0%|   24.4%|64.0%|
+----------------------+--------+-----+--------+----+
```

A summary specification may override the default label and format by appending a string or format specification or both (in that order) to the summary function name. For example:

```
CTABLES /TABLE=ageGroup [COLPCT 'Gender %' PCT5.0,
                         ROWPCT 'Age Group %' PCT5.0]
```

```
                BY gender.
                          Custom Tables
+-----------------------+-----------------------------------------+
|                       |              S3a. GENDER:               |
|                       +--------------------+--------------------+
|                       |        Male        |       Female       |
|                       +--------+-----------+--------+-----------+
|                       |Gender %|Age Group %|Gender %|Age Group %|
+-----------------------+--------+-----------+--------+-----------+
|Age group 15 or younger|      0%|          .|      0%|          .|
|          16 to 25     |     19%|        54%|     13%|        46%|
|          26 to 35     |     15%|        49%|     13%|        51%|
|          36 to 45     |     16%|        47%|     14%|        53%|
|          46 to 55     |     17%|        45%|     17%|        55%|
|          56 to 65     |     16%|        41%|     19%|        59%|
|          66 or older  |     17%|        36%|     24%|        64%|
+-----------------------+--------+-----------+--------+-----------+
```

In addition to the standard formats, `CTABLES` allows the user to specify the following special formats:

`NEGPAREN`*w.d*	Encloses negative numbers in parentheses.	`42.96`	`(42.96)`
`NEQUAL`*w.d*	Adds a `N=` prefix.	`N=42.96`	`N=-42.96`
`PAREN`*w.d*	Encloses all numbers in parentheses.	`(42.96)`	`(-42.96)`
`PCTPAREN`*w.d*	Encloses all numbers in parentheses with a '`%`' suffix.	`(42.96%)`	`(-42.96%)`

Parentheses provide a shorthand to apply summary specifications to multiple variables. For example, both of these commands:

```
CTABLES /TABLE=ageGroup[COLPCT] + membersOver16[COLPCT] BY gender.
CTABLES /TABLE=(ageGroup + membersOver16)[COLPCT] BY gender.
```

produce the same output shown below:

```
                                Custom Tables
+-------------------------------------------------------------+---------------+
|                                                             |  S3a. GENDER: |
|                                                             +-------+-------+
|                                                             |  Male | Female|
|                                                             +-------+-------+
|                                                             | Column| Column|
|                                                             |   %   |   %   |
+-------------------------------------------------------------+-------+-------+
|Age group                                          15 or     |    .0%|    .0%|
|                                                   younger   |       |       |
|                                                   16 to 25  |  19.0%|  13.1%|
|                                                   26 to 35  |  15.2%|  12.7%|
|                                                   36 to 45  |  15.6%|  14.2%|
|                                                   46 to 55  |  16.8%|  16.8%|
|                                                   56 to 65  |  16.5%|  18.9%|
|                                                   66 or older|  17.0%|  24.4%|
+-------------------------------------------------------------+-------+-------+
|S1. Including yourself, how many members of this  None      |    .0%|    .0%|
|household are age 16 or older?                    1         |  21.4%|  35.0%|
|                                                   2         |  61.9%|  52.3%|
```

```
|                                                          3          |  11.0%|   8.2%|
|                                                          4          |   4.2%|   3.2%|
|                                                          5          |   1.1%|    .9%|
|                                                          6 or more  |    .4%|    .4%|
+------------------------------------------------------------+-------+-------+
```

The following sections list the available summary functions. After each function's name is given its default label and format. If no format is listed, then the default format is the print format for the variable being summarized.

15.7.2.1 Summary Functions for Individual Cells

This section lists the summary functions that consider only an individual cell in `CTABLES`. Only one such summary function, `COUNT`, may be applied to both categorical and scale variables:

`COUNT` ("Count", F40.0)
: The sum of weights in a cell.

  If `CATEGORIES` for one or more of the variables in a table include missing values (see Section 15.7.5 [CTABLES Per-Variable Category Options], page 182), then some or all of the categories for a cell might be missing values. `COUNT` counts data included in a cell regardless of whether its categories are missing.

The following summary functions apply only to scale variables or totals and subtotals for categorical variables. Be cautious about interpreting the summary value in the latter case, because it is not necessarily meaningful; however, the mean of a Likert scale, etc. may have a straightforward interpreation.

`MAXIMUM` ("Maximum")
: The largest value.

`MEAN` ("Mean")
: The mean.

`MEDIAN` ("Median")
: The median value.

`MINIMUM` ("Minimum")
: The smallest value.

`MISSING` ("Missing")
: Sum of weights of user- and system-missing values.

`MODE` ("Mode")
: The highest-frequency value. Ties are broken by taking the smallest mode.

`PTILE` n ("Percentile n")
: The nth percentile, where $0 \leq n \leq 100$.

`RANGE` ("Range")
: The maximum minus the minimum.

`SEMEAN` ("Std Error of Mean")
: The standard error of the mean.

`STDDEV` ("Std Deviation")
The standard deviation.

`SUM` ("Sum")
The sum.

`TOTALN` ("Total N", F40.0)
The sum of weights in a cell.

For scale data, `COUNT` and `TOTALN` are the same.

For categorical data, `TOTALN` counts missing values in excluded categories, that is, user-missing values not in an explicit category list on `CATEGORIES` (see Section 15.7.5 [CTABLES Per-Variable Category Options], page 182), or user-missing values excluded because `MISSING=EXCLUDE` is in effect on `CATEGORIES`, or system-missing values. `COUNT` does not count these.

See Section 15.7.9.2 [CTABLES Missing Values for Summary Variables], page 189, for details of how `CTABLES` summarizes missing values.

`VALIDN` ("Valid N", F40.0)
The sum of valid count weights in included categories.

For categorical variables, `VALIDN` does not count missing values regardless of whether they are in included categories via `CATEGORIES`. `VALIDN` does not count valid values that are in excluded categories. See Section 15.7.9.2 [CTABLES Missing Values for Summary Variables], page 189, for details.

`VARIANCE` ("Variance")
The variance.

15.7.2.2 Summary Functions for Groups of Cells

These summary functions summarize over multiple cells within an area of the output chosen by the user and specified as part of the function name. The following basic *areas* are supported, in decreasing order of size:

`TABLE` A *section*. Stacked variables divide sections of the output from each other. sections may span multiple layers.

`LAYER` A section within a single layer.

`SUBTABLE` A *subtable*, whose contents are the cells that pair an innermost row variable and an innermost column variable within a single layer.

The following shows how the output for the table expression `hasBeenPassengerOfDesignatedDriver > hasBeenPassengerOfDrunkDriver BY isLicensedDriver > hasHostedEventWithAlcohol + hasBeenDesignatedDriver BY gender`[3] is divided up into `TABLE`, `LAYER`, and `SUBTABLE` areas. Each unique value for Table ID is one section, and similarly for Layer ID and Subtable ID. Thus, this output has two `TABLE` areas (one for `isLicensedDriver` and one for `hasBeenDesignatedDriver`), four `LAYER` areas (for those two variables, per layer), and 12 `SUBTABLE` areas.

```
                                Custom Tables
     Male
```

[3] This is not necessarily a meaningful table. To make it easier to read, short variable labels are used.

```
+--------------------------------+-----------------+------+
|                                |     licensed    |desDrv|
|                                +--------+--------+---+--+
|                                |   Yes  |   No   |   |  |
|                                +--------+--------+   |  |
|                                | hostAlc| hostAlc|   |  |
|                                +----+---+----+---+   |  |
|                                | Yes| No| Yes| No|Yes|No|
+--------------------------------+----+---+----+---+---+--+
|desPas Yes druPas Yes Table ID  |   1|  1|   1|  1|  2| 2|
|                      Layer ID  |   1|  1|   1|  1|  2| 2|
|                      Subtable ID|  1|  1|   2|  2|  3| 3|
|                 ----------------+----+---+----+---+---+--+
|                  No  Table ID  |   1|  1|   1|  1|  2| 2|
|                      Layer ID  |   1|  1|   1|  1|  2| 2|
|                      Subtable ID|  1|  1|   2|  2|  3| 3|
|      --------------------------+----+---+----+---+---+--+
|       No  druPas Yes Table ID  |   1|  1|   1|  1|  2| 2|
|                      Layer ID  |   1|  1|   1|  1|  2| 2|
|                      Subtable ID|  4|  4|   5|  5|  6| 6|
|                 ----------------+----+---+----+---+---+--+
|                  No  Table ID  |   1|  1|   1|  1|  2| 2|
|                      Layer ID  |   1|  1|   1|  1|  2| 2|
|                      Subtable ID|  4|  4|   5|  5|  6| 6|
+--------------------------------+----+---+----+---+---+--+
```

`CTABLES` also supports the following *area*s that further divide a subtable or a layer within a section:

`LAYERROW`
`LAYERCOL` A row or column, respectively, in one layer of a section.

`ROW`
`COL` A row or column, respectively, in a subtable.

The following summary functions for groups of cells are available for each *area* described above, for both categorical and scale variables:

`area`PCT or `area`PCT.COUNT ("*Area* %", PCT40.1)
A percentage of total counts within *area*.

`area`PCT.VALIDN ("*Area* Valid N %", PCT40.1)
A percentage of total counts for valid values within *area*.

`area`PCT.TOTALN ("*Area* Total N %", PCT40.1)
A percentage of total counts for all values within *area*.

Scale variables and totals and subtotals for categorical variables may use the following additional group cell summary function:

`area`PCT.SUM ("*Area* Sum %", PCT40.1)
Percentage of the sum of the values within *area*.

15.7.2.3 Summary Functions for Adjusted Weights

If the `WEIGHT` subcommand specified an effective weight variable (see Section 15.7.11 [CTABLES Effective Weight], page 193), then the following summary functions use its value

instead of the dictionary weight variable. Otherwise, they are equivalent to the summary function without the 'E'-prefix:

- ECOUNT ("Adjusted Count", F40.0)
- ETOTALN ("Adjusted Total N", F40.0)
- EVALIDN ("Adjusted Valid N", F40.0)

15.7.2.4 Unweighted Summary Functions

The following summary functions with a 'U'-prefix are equivalent to the same ones without the prefix, except that they use unweighted counts:

- UCOUNT ("Unweighted Count", F40.0)
- U*area*PCT or U*area*PCT.COUNT ("Unweighted *Area* %", PCT40.1)
- U*area*PCT.VALIDN ("Unweighted *Area* Valid N %", PCT40.1)
- U*area*PCT.TOTALN ("Unweighted *Area* Total N %", PCT40.1)
- UMEAN ("Unweighted Mean")
- UMEDIAN ("Unweighted Median")
- UMISSING ("Unweighted Missing")
- UMODE ("Unweighted Mode")
- U*area*PCT.SUM ("Unweighted *Area* Sum %", PCT40.1)
- UPTILE *n* ("Unweighted Percentile *n*")
- USEMEAN ("Unweighted Std Error of Mean")
- USTDDEV ("Unweighted Std Deviation")
- USUM ("Unweighted Sum")
- UTOTALN ("Unweighted Total N", F40.0)
- UVALIDN ("Unweighted Valid N", F40.0)
- UVARIANCE ("Unweighted Variance", F40.0)

15.7.3 Statistics Positions and Labels

```
/SLABELS
   [POSITION={COLUMN | ROW | LAYER}]
   [VISIBLE={YES | NO}]
```

The SLABELS subcommand controls the position and visibility of summary statistics for the TABLE subcommand that it follows.

POSITION sets the axis on which summary statistics appear. With POSITION=COLUMN, which is the default, each summary statistic appears in a column. For example:

```
CTABLES /TABLE=age [MEAN, MEDIAN] BY gender.
```

```
                    Custom Tables
+--------------------------+----------------------+
|                          |      S3a. GENDER:    |
|                          +-----------+----------+
|                          |    Male   |  Female  |
|                          +----+------+----+-----+
|                          |Mean|Median|Mean|Median|
+--------------------------+----+------+----+-----+
```

```
|D1. AGE: What is your age?|  46|    45|  50|    52|
+-------------------------+----+------+----+------+
```

With POSITION=ROW, each summary statistic appears in a row, as shown below:

```
CTABLES /TABLE=age [MEAN, MEDIAN] BY gender /SLABELS POSITION=ROW.
```

```
                 Custom Tables
+--------------------------------+-------------+
|                                | S3a. GENDER:|
|                                +-----+-------+
|                                | Male| Female|
+--------------------------------+-----+-------+
|D1. AGE: What is your age? Mean |   46|     50|
|                          Median|   45|     52|
+--------------------------------+-----+-------+
```

POSITION=LAYER is also available to place each summary statistic in a separate layer.

Labels for summary statistics are shown by default. Use VISIBLE=NO to suppress them. Because unlabeled data can cause confusion, it should only be considered if the meaning of the data is evident, as in a simple case like this:

```
CTABLES /TABLE=ageGroup [TABLEPCT] /SLABELS VISIBLE=NO.
```

```
         Custom Tables
+-----------------------+-----+
|Age group 15 or younger|  .0%|
|          16 to 25     |15.7%|
|          26 to 35     |13.8%|
|          36 to 45     |14.8%|
|          46 to 55     |16.8%|
|          56 to 65     |17.8%|
|          66 or older  |21.1%|
+-----------------------+-----+
```

15.7.4 Category Label Positions

/CLABELS {AUTO | {ROWLABELS|COLLABELS}={OPPOSITE|LAYER}}

The CLABELS subcommand controls the position of category labels for the TABLE subcommand that it follows. By default, or if AUTO is specified, category labels for a given variable nest inside the variable's label on the same axis. For example, the command below results in age categories nesting within the age group variable on the rows axis and gender categories within the gender variable on the columns axis:

```
CTABLES /TABLE ageGroup BY gender.
```

```
             Custom Tables
+-----------------------+------------+
|                       |S3a. GENDER:|
|                       +-----+------+
|                       | Male|Female|
|                       +-----+------+
|                       |Count| Count|
+-----------------------+-----+------+
|Age group 15 or younger|    0|     0|
|          16 to 25     |  594|   505|
|          26 to 35     |  476|   491|
|          36 to 45     |  489|   548|
|          46 to 55     |  526|   649|
|          56 to 65     |  516|   731|
|          66 or older  |  531|   943|
```

```
+----------------------+-----+------+
```

`ROWLABELS=OPPOSITE` or `COLLABELS=OPPOSITE` move row or column variable category labels, respectively, to the opposite axis. The setting affects only the innermost variable or variables, which must be categorical, on the given axis. For example:

```
CTABLES /TABLE ageGroup BY gender /CLABELS ROWLABELS=OPPOSITE.
CTABLES /TABLE ageGroup BY gender /CLABELS COLLABELS=OPPOSITE.
```

```
                              Custom Tables
+-----+-----------------------------------------------------------------------
|     |                                     S3a. GENDER:
|     +-------------------------------------------+-------------------------
|     |                   Male                    |                   Female
|     +-------+-----+-----+-----+-----+-----+-----+-------+-----+-----+-----+
|     | 15 or |16 to|26 to|36 to|46 to|56 to|66 or| 15 or |16 to|26 to|36 to|
|     |younger|  25 |  35 |  45 |  55 |  65 |older|younger|  25 |  35 |  45 |
|     +-------+-----+-----+-----+-----+-----+-----+-------+-----+-----+-----+
|     | Count |Count|Count|Count|Count|Count|Count| Count |Count|Count|Count|
+-----+-------+-----+-----+-----+-----+-----+-----+-------+-----+-----+-----+
|Age  |      0|  594|  476|  489|  526|  516|  531|      0|  505|  491|  548|
|group|       |     |     |     |     |     |     |       |     |     |     |
+-----+-------+-----+-----+-----+-----+-----+-----+-------+-----+-----+-----+

+-----+-----------------+
|     |                 |
|     +-----------------+
|     |                 |
|     +-----+-----+-----+
|     |46 to|56 to|66 or|
|     |  55 |  65 |older|
|     +-----+-----+-----+
|     |Count|Count|Count|
+-----+-----+-----+-----+
|Age  |  649|  731|  943|
|group|     |     |     |
+-----+-----+-----+-----+

               Custom Tables
+------------------------------+------------+
|                              |S3a. GENDER:|
|                              +------------+
|                              |    Count   |
+------------------------------+------------+
|Age group 15 or younger Male  |           0|
|                        Female|           0|
|         ---------------------+------------+
|          16 to 25      Male  |         594|
|                        Female|         505|
|         ---------------------+------------+
|          26 to 35      Male  |         476|
|                        Female|         491|
|         ---------------------+------------+
|          36 to 45      Male  |         489|
|                        Female|         548|
|         ---------------------+------------+
|          46 to 55      Male  |         526|
|                        Female|         649|
|         ---------------------+------------+
```

```
|          56 to 65      Male  |         516|
|                        Female|         731|
|         ---------------------+------------+
|          66 or older   Male  |         531|
|                        Female|         943|
+------------------------------+------------+
```

ROWLABELS=LAYER or COLLABELS=LAYER move the innermost row or column variable category labels, respectively, to the layer axis.

Only one axis's labels may be moved, whether to the opposite axis or to the layer axis.

Effect on Summary Statistics

CLABELS primarily affects the appearance of tables, not the data displayed in them. However, CTABLES can affect the values displayed for statistics that summarize areas of a table, since it can change the definitions of these areas.

For example, consider the following syntax and output:

```
CTABLES /TABLE ageGroup BY gender [ROWPCT, COLPCT].
```

```
                    Custom Tables
+-----------------------+-----------------------------+
|                       |         S3a. GENDER:        |
|                       +--------------+--------------+
|                       |     Male     |    Female    |
|                       +-----+--------+-----+--------+
|                       |Row %|Column %|Row %|Column %|
+-----------------------+-----+--------+-----+--------+
|Age group 15 or younger|    .|     .0%|    .|     .0%|
|          16 to 25     |54.0%|   19.0%|46.0%|   13.1%|
|          26 to 35     |49.2%|   15.2%|50.8%|   12.7%|
|          36 to 45     |47.2%|   15.6%|52.8%|   14.2%|
|          46 to 55     |44.8%|   16.8%|55.2%|   16.8%|
|          56 to 65     |41.4%|   16.5%|58.6%|   18.9%|
|          66 or older  |36.0%|   17.0%|64.0%|   24.4%|
+-----------------------+-----+--------+-----+--------+
```

Using COLLABELS=OPPOSITE changes the definitions of rows and columns, so that column percentages display what were previously row percentages and the new row percentages become meaningless (because there is only one cell per row):

```
CTABLES
    /TABLE ageGroup BY gender [ROWPCT, COLPCT]
    /CLABELS COLLABELS=OPPOSITE.
```

```
                  Custom Tables
+------------------------------+---------------+
|                              |  S3a. GENDER: |
|                              +------+--------+
|                              | Row %|Column %|
+------------------------------+------+--------+
|Age group 15 or younger Male  |     .|       .|
|                        Female|     .|       .|
|         ---------------------+------+--------+
|          16 to 25      Male  |100.0%|   54.0%|
|                        Female|100.0%|   46.0%|
|         ---------------------+------+--------+
|          26 to 35      Male  |100.0%|   49.2%|
|                        Female|100.0%|   50.8%|
```

```
|         ---------------------+------+--------+
|          36 to 45      Male  |100.0%|   47.2%|
|                        Female|100.0%|   52.8%|
|         ---------------------+------+--------+
|          46 to 55      Male  |100.0%|   44.8%|
|                        Female|100.0%|   55.2%|
|         ---------------------+------+--------+
|          56 to 65      Male  |100.0%|   41.4%|
|                        Female|100.0%|   58.6%|
|         ---------------------+------+--------+
|          66 or older   Male  |100.0%|   36.0%|
|                        Female|100.0%|   64.0%|
+-----------------------------+------+--------+
```

Moving Categories for Stacked Variables

If `CLABELS` moves category labels from an axis with stacked variables, the variables that are moved must have the same category specifications (see Section 15.7.5 [CTABLES Per-Variable Category Options], page 182) and the same value labels.

The following shows both moving stacked category variables and adapting to the changing definitions of rows and columns:

```
CTABLES /TABLE (likelihoodOfBeingStoppedByPolice
                + likelihoodOfHavingAnAccident) [COLPCT].
CTABLES /TABLE (likelihoodOfBeingStoppedByPolice
                + likelihoodOfHavingAnAccident) [ROWPCT]
  /CLABELS ROW=OPPOSITE.
```

```
                              Custom Tables
+---------------------------------------------------------------------+-------+
|                                                                     | Column|
|                                                                     |   %   |
+---------------------------------------------------------------------+-------+
|105b. How likely is it that drivers who have had too     Almost      |  10.2%|
|much to drink to drive safely will A. Get stopped by the certain     |       |
|police?                                                  Very likely |  21.8%|
|                                                         Somewhat    |  40.2%|
|                                                         likely      |       |
|                                                         Somewhat    |  19.0%|
|                                                         unlikely    |       |
|                                                         Very        |   8.9%|
|                                                         unlikely    |       |
+---------------------------------------------------------------------+-------+
|105b. How likely is it that drivers who have had too     Almost      |  15.9%|
|much to drink to drive safely will B. Have an accident?  certain     |       |
|                                                         Very likely |  40.8%|
|                                                         Somewhat    |  35.0%|
|                                                         likely      |       |
|                                                         Somewhat    |   6.2%|
|                                                         unlikely    |       |
|                                                         Very        |   2.0%|
|                                                         unlikely    |       |
+---------------------------------------------------------------------+-------+

                              Custom Tables
+----------------------------+--------+-------+---------+----------+---------+
|                            | Almost |  Very | Somewhat| Somewhat |   Very  |
|                            | certain| likely|  likely | unlikely | unlikely|
```

```
|                              +--------+-------+---------+----------+---------+
|                              |  Row % | Row % |  Row %  |   Row %  |  Row %  |
+------------------------------+--------+-------+---------+----------+---------+
|105b. How likely is it that   |   10.2%|  21.8%|    40.2%|     19.0%|     8.9%|
|drivers who have had too much|        |       |         |          |         |
|to drink to drive safely will|        |       |         |          |         |
|A. Get stopped by the police?|        |       |         |          |         |
|105b. How likely is it that   |   15.9%|  40.8%|    35.0%|      6.2%|     2.0%|
|drivers who have had too much|        |       |         |          |         |
|to drink to drive safely will|        |       |         |          |         |
|B. Have an accident?          |        |       |         |          |         |
+------------------------------+--------+-------+---------+----------+---------+
```

15.7.5 Per-Variable Category Options

/CATEGORIES VARIABLES=*variables*
  {[*value*, *value*...]
  | [ORDER={A | D}]
   [KEY={VALUE | LABEL | *summary*(*variable*)}]
   [MISSING={EXCLUDE | INCLUDE}]}
  [TOTAL={NO | YES} [LABEL=*string*] [POSITION={AFTER | BEFORE}]]
  [EMPTY={INCLUDE | EXCLUDE}]

The CATEGORIES subcommand specifies, for one or more categorical variables, the categories to include and exclude, the sort order for included categories, and treatment of missing values. It also controls the totals and subtotals to display. It may be specified any number of times, each time for a different set of variables. CATEGORIES applies to the table produced by the TABLE subcommand that it follows.

CATEGORIES does not apply to scalar variables.

VARIABLES is required and must list the variables for the subcommand to affect.

The syntax may specify the categories to include and their sort order either explicitly or implicitly. The following sections give the details of each form of syntax, followed by information on totals and subtotals and the EMPTY setting.

15.7.5.1 Explicit Categories

To use CTABLES to explicitly specify categories to include, list the categories within square brackets in the desired sort order. Use spaces or commas to separate values. Categories not covered by the list are excluded from analysis.

Each element of the list takes one of the following forms:

number
'string' A numeric or string category value, for variables that have the corresponding type.

'date'
'time' A date or time category value, for variables that have a date or time print format.

min THRU *max*
LO THRU *max*
min THRU HI
: A range of category values, where *min* and *max* each takes one of the forms above, in increasing order.

MISSING
: All user-missing values. (To match individual user-missing values, specify their category values.)

OTHERNM
: Any non-missing value not covered by any other element of the list (regardless of where OTHERNM is placed in the list).

&postcompute
: A computed category name (see Section 15.7.10 [CTABLES Computed Categories], page 191).

SUBTOTAL
HSUBTOTAL
: A subtotal (see Section 15.7.5.3 [CTABLES Totals and Subtotals], page 184).

If multiple elements of the list cover a given category, the last one in the list takes precedence.

The following example syntax and output show how an explicit category can limit the displayed categories:

```
CTABLES /TABLE freqOfDriving.
CTABLES /TABLE freqOfDriving /CATEGORIES VARIABLES=freqOfDriving [1, 2, 3].
```

Custom Tables

		Count
1. How often do you usually drive a car or other motor vehicle?	Every day	4667
	Several days a week	1274
	Once a week or less	361
	Only certain times a year	130
	Never	540

Custom Tables

		Count
1. How often do you usually drive a car or other motor vehicle?	Every day	4667
	Several days a week	1274
	Once a week or less	361

15.7.5.2 Implicit Categories

In the absence of an explicit list of categories, CATEGORIES allows KEY, ORDER, and MISSING to specify how to select and sort categories.

The KEY setting specifies the sort key. By default, or with KEY=VALUE, categories are sorted by default. Categories may also be sorted by value label, with KEY=LABEL, or by the value of a summary function, e.g. KEY=COUNT.

By default, or with ORDER=A, categories are sorted in ascending order. Specify ORDER=D to sort in descending order.

User-missing values are excluded by default, or with MISSING=EXCLUDE. Specify MISSING=INCLUDE to include user-missing values. The system-missing value is always excluded.

The following example syntax and output show how MISSING=INCLUDE causes missing values to be included in a category list.

```
CTABLES /TABLE freqOfDriving.
CTABLES /TABLE freqOfDriving
        /CATEGORIES VARIABLES=freqOfDriving MISSING=INCLUDE.
```

```
                                Custom Tables
+---------------------------------------------------------------------+-----+
|                                                                     |Count|
+---------------------------------------------------------------------+-----+
| 1. How often do you usually drive a car or other  Every day         | 4667|
|motor vehicle?                                     Several days a week | 1274|
|                                                   Once a week or less |  361|
|                                                   Only certain times a|  130|
|                                                   year               |     |
|                                                   Never              |  540|
+---------------------------------------------------------------------+-----+

                                Custom Tables
+---------------------------------------------------------------------+-----+
|                                                                     |Count|
+---------------------------------------------------------------------+-----+
| 1. How often do you usually drive a car or other  Every day         | 4667|
|motor vehicle?                                     Several days a week | 1274|
|                                                   Once a week or less |  361|
|                                                   Only certain times a|  130|
|                                                   year               |     |
|                                                   Never              |  540|
|                                                   Don't know         |    8|
|                                                   Refused            |   19|
+---------------------------------------------------------------------+-----+
```

15.7.5.3 Totals and Subtotals

CATEGORIES also controls display of totals and subtotals. By default, or with TOTAL=NO, totals are not displayed. Use TOTAL=YES to display a total. By default, the total is labeled "Total"; use LABEL="*label*" to override it.

Subtotals are also not displayed by default. To add one or more subtotals, use an explicit category list and insert SUBTOTAL or HSUBTOTAL in the position or positions where the subtotal should appear. The subtotal becomes an extra row or column or layer. HSUBTOTAL additionally hides the categories that make up the subtotal. Either way, the default label is "Subtotal", use SUBTOTAL="*label*" or HSUBTOTAL="*label*" to specify a custom label.

The following example syntax and output show how to use TOTAL=YES and SUBTOTAL:

```
CTABLES
```

```
    /TABLE freqOfDriving
    /CATEGORIES VARIABLES=freqOfDriving [OTHERNM, SUBTOTAL='Valid Total',
                                         MISSING, SUBTOTAL='Missing Total']
                                        TOTAL=YES LABEL='Overall Total'.
```

Custom Tables

		Count
1. How often do you usually drive a car or other motor vehicle?	Every day	4667
	Several days a week	1274
	Once a week or less	361
	Only certain times a year	130
	Never	540
	Valid Total	6972
	Don't know	8
	Refused	19
	Missing Total	27
	Overall Total	6999

By default, or with `POSITION=AFTER`, totals are displayed in the output after the last category and subtotals apply to categories that precede them. With `POSITION=BEFORE`, totals come before the first category and subtotals apply to categories that follow them.

Only categorical variables may have totals and subtotals. Scalar variables may be "totaled" indirectly by enabling totals and subtotals on a categorical variable within which the scalar variable is summarized. For example, the following syntax produces a mean, count, and valid count across all data by adding a total on the categorical `region` variable, as shown:

```
CTABLES /TABLE=region > monthDaysMin1drink [MEAN, VALIDN]
    /CATEGORIES VARIABLES=region TOTAL=YES LABEL='All regions'.
```

Custom Tables

		Mean	Count	Valid N
20. On how many of the thirty days in this typical month did you have one or more alcoholic beverages to drink?	Region NE	5.6	1409	945
	MW	5.0	1654	1026
	S	6.0	2390	1285
	W	6.5	1546	953
	All regions	5.8	6999	4209

By default, PSPP uses the same summary functions for totals and subtotals as other categories. To summarize totals and subtotals differently, specify the summary functions for totals and subtotals after the ordinary summary functions inside a nested set of `[]` following `TOTALS`. For example, the following syntax displays `COUNT` for individual categories and totals and `VALIDN` for totals, as shown:

```
CTABLES
    /TABLE isLicensedDriver [COUNT, TOTALS[COUNT, VALIDN]]
    /CATEGORIES VARIABLES=isLicensedDriver TOTAL=YES MISSING=INCLUDE.
```

Custom Tables

```
+-------------------------------------------------------------+-----+------+
|                                                             |     | Valid|
|                                                             |Count|   N  |
+-------------------------------------------------------------+-----+------+
|D7a. Are you a licensed driver; that is, do you have a Yes   | 6379|      |
|valid driver's license?                                 No   |  572|      |
|                                                        Don't|    4|      |
|                                                        know |     |      |
|                                                        Refused|  44|      |
|                                                        Total | 6999|  6951|
+-------------------------------------------------------------+-----+------+
```

15.7.5.4 Categories Without Values

Some categories might not be included in the data set being analyzed. For example, our example data set has no cases in the "15 or younger" age group. By default, or with `EMPTY=INCLUDE`, PSPP includes these empty categories in output tables. To exclude them, specify `EMPTY=EXCLUDE`.

For implicit categories, empty categories potentially include all the values with value labels for a given variable; for explicit categories, they include all the values listed individually and all values with value labels that are covered by ranges or `MISSING` or `OTHERNM`.

The following example syntax and output show the effect of `EMPTY=EXCLUDE` for the `membersOver16` variable, in which 0 is labeled "None" but no cases exist with that value:

```
CTABLES /TABLE=membersOver16.
CTABLES /TABLE=membersOver16 /CATEGORIES VARIABLES=membersOver16 EMPTY=EXCLUDE.
```

```
                                Custom Tables
+---------------------------------------------------------------------+-----+
|                                                                     |Count|
+---------------------------------------------------------------------+-----+
|S1. Including yourself, how many members of this household are None |    0|
|age 16 or older?                                                1    | 1586|
|                                                                2    | 3031|
|                                                                3    |  505|
|                                                                4    |  194|
|                                                                5    |   55|
|                                                                6 or |   21|
|                                                                more |     |
+---------------------------------------------------------------------+-----+

                                Custom Tables
+---------------------------------------------------------------------+-----+
|                                                                     |Count|
+---------------------------------------------------------------------+-----+
|S1. Including yourself, how many members of this household are 1    | 1586|
|age 16 or older?                                                2    | 3031|
|                                                                3    |  505|
|                                                                4    |  194|
|                                                                5    |   55|
|                                                                6 or |   21|
|                                                                more |     |
+---------------------------------------------------------------------+-----+
```

15.7.6 Titles

`/TITLES`

[TITLE=*string*...]
[CAPTION=*string*...]
[CORNER=*string*...]

The TITLES subcommand sets the title, caption, and corner text for the table output for the previous TABLE subcommand. Any number of strings may be specified for each kind of text, with each string appearing on a separate line in the output. The title appears above the table, the caption below the table, and the corner text appears in the table's upper left corner. By default, the title is "Custom Tables" and the caption and corner text are empty. With some table output styles, the corner text is not displayed.

The strings provided in this subcommand may contain the following macro-like keywords that PSPP substitutes at the time that it runs the command:

)DATE The current date, e.g. MM/DD/YY. The format is locale-dependent.

)TIME The current time, e.g. HH:MM:SS. The format is locale-dependent.

)TABLE The expression specified on the TABLE command. Summary and measurement level specifications are omitted, and variable labels are used in place of variable names.

15.7.7 Table Formatting

/FORMAT
[MINCOLWIDTH={DEFAULT | *width*}]
[MAXCOLWIDTH={DEFAULT | *width*}]
[UNITS={POINTS | INCHES | CM}]
[EMPTY={ZERO | BLANK | *string*}]
[MISSING=*string*]

The FORMAT subcommand, which must precede the first TABLE subcommand, controls formatting for all the output tables. FORMAT and all of its settings are optional.

Use MINCOLWIDTH and MAXCOLWIDTH to control the minimum or maximum width of columns in output tables. By default, with DEFAULT, column width varies based on content. Otherwise, specify a number for either or both of these settings. If both are specified, MAXCOLWIDTH must be greater than or equal to MINCOLWIDTH. The default unit, or with UNITS=POINTS, is points (1/72 inch), or specify UNITS=INCHES to use inches or UNITS=CM for centimeters. PSPP does not currently honor any of these settings.

By default, or with EMPTY=ZERO, zero values are displayed in their usual format. Use EMPTY=BLANK to use an empty cell instead, or EMPTY="*string*" to use the specified string.

By default, missing values are displayed as '.', the same as in other tables. Specify MISSING="*string*" to instead use a custom string.

15.7.8 Display of Variable Labels

/VLABELS
VARIABLES=*variables*
DISPLAY={DEFAULT | NAME | LABEL | BOTH | NONE}

The VLABELS subcommand, which must precede the first TABLE subcommand, controls display of variable labels in all the output tables. VLABELS is optional. It may appear multiple times to adjust settings for different variables.

VARIABLES and DISPLAY are required. The value of DISPLAY controls how variable labels are displayed for the variables listed on VARIABLES. The supported values are:

DEFAULT Use the setting from SET TVARS (see [SET TVARS], page 271).

NAME Show only a variable name.

LABEL Show only a variable label.

BOTH Show variable name and label.

NONE Show nothing.

15.7.9 Missing Value Treatment

The TABLE subcommand on CTABLES specifies two different kinds of variables: variables that divide tables into cells (which are always categorical) and variables being summarized (which may be categorical or scale). PSPP treats missing values differently in each kind of variable, as described in the sections below.

15.7.9.1 Missing Values for Cell-Defining Variables

For variables that divide tables into cells, per-variable category options, as described in Section 15.7.5 [CTABLES Per-Variable Category Options], page 182, determine which data is analyzed. If any of the categories for such a variable would exclude a case, then that case is not included.

As an example, consider the following entirely artificial dataset, in which 'x' and 'y' are categorical variables with missing value 9, and 'z' is scale:

```
   Data List
+-+-+---------+
|x|y|    z    |
+-+-+---------+
|1|1|        1|
|1|2|       10|
|1|9|      100|
|2|1|     1000|
|2|2|    10000|
|2|9|   100000|
|9|1|  1000000|
|9|2| 10000000|
|9|9|100000000|
+-+-+---------+
```

Using 'x' and 'y' to define cells, and summarizing 'z', by default PSPP omits all the cases that have 'x' or 'y' (or both) missing:

```
CTABLES /TABLE x > y > z [SUM].
```

```
  Custom Tables
+---------+-----+
|         | Sum |
+---------+-----+
|x 1 y 1 z|    1|
|     ----+-----+
|      2 z|   10|
| --------+-----+
|  2 y 1 z| 1000|
|     ----+-----+
```

```
|      2 z|10000|
+---------+-----+
```

If, however, we add `CATEGORIES` specifications to include missing values for ‘`y`’ or for ‘`x`’ and ‘`y`’, the output table includes them, like so:

```
CTABLES /TABLE x > y > z [SUM] /CATEGORIES VARIABLES=y MISSING=INCLUDE.
CTABLES /TABLE x > y > z [SUM] /CATEGORIES VARIABLES=x y MISSING=INCLUDE.
```

```
   Custom Tables
+---------+------+
|         |  Sum |
+---------+------+
|x 1 y 1 z|     1|
|     ----+------+
|      2 z|    10|
|     ----+------+
|      9 z|   100|
| --------+------+
|  2 y 1 z|  1000|
|     ----+------+
|      2 z| 10000|
|     ----+------+
|      9 z|100000|
+---------+------+

    Custom Tables
+---------+---------+
|         |   Sum   |
+---------+---------+
|x 1 y 1 z|        1|
|     ----+---------+
|      2 z|       10|
|     ----+---------+
|      9 z|      100|
| --------+---------+
|  2 y 1 z|     1000|
|     ----+---------+
|      2 z|    10000|
|     ----+---------+
|      9 z|   100000|
| --------+---------+
|  9 y 1 z|  1000000|
|     ----+---------+
|      2 z| 10000000|
|     ----+---------+
|      9 z|100000000|
+---------+---------+
```

15.7.9.2 Missing Values for Summary Variables

For summary variables, values that are valid and in included categories are analyzed, and values that are missing or in excluded categories are not analyzed, with the following exceptions:

- The “`VALIDN`” summary functions (`VALIDN`, `EVALIDN`, `UVALIDN`, *`area`*`PCT.VALIDN`, and `U`*`area`*`PCT.VALIDN`) only count valid values in included categories (not missing values in included categories).

- The "TOTALN" summary functions (TOTALN, ETOTALN, UTOTALN, *area*PCT.TOTALN), and U*area*PCT.TOTALN count all values (valid and missing) in included categories and missing (but not valid) values in excluded categories.

For categorical variables, system-missing values are never in included categories. For scale variables, there is no notion of included and excluded categories, so all values are effectively included.

The following table provides another view of the above rules:

	VALIDN	**other**	TOTALN
Categorical variables:			
Valid values in included categories	yes	yes	yes
Missing values in included categories	—	yes	yes
Missing values in excluded categories	—	—	yes
Valid values in excluded categories	—	—	—
Scale variables:			
Valid values	yes	yes	yes
User- or system-missing values	—	yes	yes

15.7.9.3 Scale Missing Values

/SMISSING {VARIABLE | LISTWISE}

The SMISSING subcommand, which must precede the first TABLE subcommand, controls treatment of missing values for scalar variables in producing all the output tables. SMISSING is optional.

With SMISSING=VARIABLE, which is the default, missing values are excluded on a variable-by-variable basis. With SMISSING=LISTWISE, when stacked scalar variables are nested together with a categorical variable, a missing value for any of the scalar variables causes the case to be excluded for all of them.

As an example, consider the following dataset, in which 'x' is a categorical variable and 'y' and 'z' are scale:

```
   Data List
+-+-----+-----+
|x|  y  |  z  |
+-+-----+-----+
|1|    .|40.00|
|1|10.00|50.00|
|1|20.00|60.00|
|1|30.00|    .|
+-+-----+-----+
```

With the default missing-value treatment, 'x''s mean is 20, based on the values 10, 20, and 30, and 'y''s mean is 50, based on 40, 50, and 60:

```
CTABLES /TABLE (y + z) > x.
```

```
Custom Tables
+-----+-----+
|     | Mean|
+-----+-----+
|y x 1|20.00|
+-----+-----+
|z x 1|50.00|
+-----+-----+
```

By adding SMISSING=LISTWISE, only cases where 'y' and 'z' are both non-missing are considered, so 'x''s mean becomes 15, as the average of 10 and 20, and 'y''s mean becomes 55, the average of 50 and 60:

```
CTABLES /SMISSING LISTWISE /TABLE (y + z) > x.
```

```
Custom Tables
+-----+-----+
|     | Mean|
+-----+-----+
|y x 1|15.00|
+-----+-----+
|z x 1|55.00|
+-----+-----+
```

Even with SMISSING=LISTWISE, if 'y' and 'z' are separately nested with 'x', instead of using a single '>' operator, missing values revert to being considered on a variable-by-variable basis:

```
CTABLES /SMISSING LISTWISE /TABLE (y > x) + (z > x).
```

```
Custom Tables
+-----+-----+
|     | Mean|
+-----+-----+
|y x 1|20.00|
+-----+-----+
|z x 1|50.00|
+-----+-----+
```

15.7.10 Computed Categories

/PCOMPUTE &*postcompute*=EXPR(*expression*)
/PPROPERTIES &*postcompute*...
[LABEL=*string*]
[FORMAT=[*summary format*]...]
[HIDESOURCECATS={NO | YES}

Computed categories, also called *postcomputes*, are categories created using arithmetic on categories obtained from the data. The PCOMPUTE subcommand creates a postcompute, which may then be used on CATEGORIES within an explicit category list (see [CTABLES Explicit Category List], page 182). Optionally, PPROPERTIES refines how a postcompute is displayed. The following sections provide the details.

15.7.10.1 PCOMPUTE

/PCOMPUTE &*postcompute*=EXPR(*expression*)

The PCOMPUTE subcommand, which must precede the first TABLE command, defines computed categories. It is optional and may be used any number of times to define multiple postcomputes.

Each PCOMPUTE defines one postcompute. Its syntax consists of a name to identify the postcompute as a PSPP identifier prefixed by '&', followed by '=' and a postcompute expression enclosed in EXPR(...). A postcompute expression consists of:

[*category*]
This form evaluates to the summary statistic for *category*, e.g. [1] evaluates to the value of the summary statistic associated with category 1. The *category*

may be a number, a quoted string, or a quoted time or date value. All of the categories for a given postcompute must have the same form. The category must appear in all the CATEGORIES list in which the postcompute is used.

[*min* THRU *max*]
[LO THRU *max*]
[*min* THRU HI]
MISSING
OTHERNM
: These forms evaluate to the summary statistics for a category specified with the same syntax, as described in previous section (see [CTABLES Explicit Category List], page 182). The category must appear in all the CATEGORIES list in which the postcompute is used.

SUBTOTAL
: The summary statistic for the subtotal category. This form is allowed only if the CATEGORIES lists that include this postcompute have exactly one subtotal.

SUBTOTAL[*index*]
: The summary statistic for subtotal category *index*, where 1 is the first subtotal, 2 is the second, and so on. This form may be used for CATEGORIES lists with any number of subtotals.

TOTAL
: The summary statistic for the total. The CATEGORIES lsits that include this postcompute must have a total enabled.

a + *b*
a - *b*
a * *b*
a / *b*
a ** *b*
: These forms perform arithmetic on the values of postcompute expressions *a* and *b*. The usual operator precedence rules apply.

number
: Numeric constants may be used in postcompute expressions.

(*a*)
: Parentheses override operator precedence.

A postcompute is not associated with any particular variable. Instead, it may be referenced within CATEGORIES for any suitable variable (e.g. only a string variable is suitable for a postcompute expression that refers to a string category, only a variable with subtotals for an expression that refers to subtotals, . . .).

Normally a named postcompute is defined only once, but if a later PCOMPUTE redefines a postcompute with the same name as an earlier one, the later one take precedence.

The following syntax and output shows how PCOMPUTE can compute a total over subtotals, summing the "Frequent Drivers" and "Infrequent Drivers" subtotals to form an "All Drivers" postcompute. It also shows how to calculate and display a percentage, in this case the percentage of valid responses that report never driving. It uses PPROPERTIES (see Section 15.7.10.2 [CTABLES PPROPERTIES], page 193) to display the latter in PCT format.

```
CTABLES
    /PCOMPUTE &all_drivers=EXPR([1 THRU 2] + [3 THRU 4])
    /PPROPERTIES &all_drivers LABEL='All Drivers'
    /PCOMPUTE &pct_never=EXPR([5] / ([1 THRU 2] + [3 THRU 4] + [5]) * 100)
    /PPROPERTIES &pct_never LABEL='% Not Drivers' FORMAT=COUNT PCT40.1
```

```
/TABLE=freqOfDriving BY gender
/CATEGORIES VARIABLES=freqOfDriving
                            [1 THRU 2, SUBTOTAL='Frequent Drivers',
                             3 THRU 4, SUBTOTAL='Infrequent Drivers',
                             &all_drivers, 5, &pct_never,
                             MISSING, SUBTOTAL='Not Drivers or Missing'].
```

Custom Tables

		S3a. GENDER:	
		Male	Female
		Count	Count
1. How often do you usually drive a car or other motor vehicle?	Every day	2305	2362
	Several days a week	440	834
	Frequent Drivers	2745	3196
	Once a week or less	125	236
	Only certain times a year	58	72
	Infrequent Drivers	183	308
	All Drivers	2928	3504
	Never	192	348
	% Not Drivers	6.2%	9.0%
	Don't know	3	5
	Refused	9	10
	Not Drivers or Missing	204	363

15.7.10.2 PPROPERTIES

/PPROPERTIES &*postcompute*...
[LABEL=*string*]
[FORMAT=[*summary format*]...]
[HIDESOURCECATS={NO | YES}

The PPROPERTIES subcommand, which must appear before TABLE, sets properties for one or more postcomputes defined on prior PCOMPUTE subcommands. The subcommand syntax begins with the list of postcomputes, each prefixed with '&' as specified on PCOMPUTE.

All of the settings on PPROPERTIES are optional. Use LABEL to set the label shown for the postcomputes in table output. The default label for a postcompute is the expression used to define it.

A postcompute always uses same summary functions as the variable whose categories contain it, but FORMAT allows control over the format used to display their values. It takes a list of summary function names and format specifiers.

By default, or with HIDESOURCECATS=NO, categories referred to by computed categories are displayed like other categories. Use HIDESOURCECATS=YES to hide them.

The previous section provides an example for PPROPERTIES.

15.7.11 Effective Weight

/WEIGHT VARIABLE=*variable*

The `WEIGHT` subcommand is optional and must appear before `TABLE`. If it appears, it must name a numeric variable, known as the *effective weight* or *adjustment weight*. The effective weight variable stands in for the dictionary's weight variable (see Section 13.7 [WEIGHT], page 133), if any, in most calculations in `CTABLES`. The only exceptions are the `COUNT`, `TOTALN`, and `VALIDN` summary functions, which use the dictionary weight instead.

Weights obtained from the PSPP dictionary are rounded to the nearest integer at the case level. Effective weights are not rounded. Regardless of the weighting source, PSPP does not analyze cases with zero, missing, or negative effective weights.

15.7.12 Hiding Small Counts

```
/HIDESMALLCOUNTS COUNT=count
```

The `HIDESMALLCOUNTS` subcommand is optional. If it specified, then `COUNT`, `ECOUNT`, and `UCOUNT` values in output tables less than the value of *count* are shown as `<count` instead of their true values. The value of *count* must be an integer and must be at least 2.

The following syntax and example shows how to use `HIDESMALLCOUNTS`:

```
CTABLES /HIDESMALLCOUNTS COUNT=10 /TABLE placeOfLastDrinkBeforeDrive.
```

Custom Tables

		Count
37. Please think about the most recent occasion that you drove within two hours of drinking alcoholic beverages. Where did you drink on that occasion?	Other (list)	<10
	Your home	182
	Friend's home	264
	Bar/Tavern/Club	279
	Restaurant	495
	Work	21
	Bowling alley	<10
	Hotel/Motel	<10
	Country Club/	17
	Golf course	
	Drank in the car/On the road	<10
	Sporting event	15
	Movie theater	<10
	Shopping/Store/	<10
	Grocery store	
	Wedding	15
	Party at someone else's home	81
	Park/picnic	14
	Party at your house	<10

15.8 FACTOR

```
FACTOR {
    VARIABLES=var_list,
    MATRIX IN ({CORR,COV}={*,file_spec})
  }
```

[/METHOD = {CORRELATION, COVARIANCE}]

[/ANALYSIS=*var_list*]

[/EXTRACTION={PC, PAF}]

[/ROTATION={VARIMAX, EQUAMAX, QUARTIMAX, PROMAX[(*k*)], NOROTATE}]

[/PRINT=[INITIAL] [EXTRACTION] [ROTATION] [UNIVARIATE] [CORRELATION] [COVARIANCE] [DET] [KMO] [AIC] [SIG] [ALL] [DEFAULT]]

[/PLOT=[EIGEN]]

[/FORMAT=[SORT] [BLANK(*n*)] [DEFAULT]]

[/CRITERIA=[FACTORS(*n*)] [MINEIGEN(*l*)] [ITERATE(*m*)] [ECONVERGE (*delta*)] [DEFAULT]]

[/MISSING=[{LISTWISE, PAIRWISE}] [{INCLUDE, EXCLUDE}]]

The `FACTOR` command performs Factor Analysis or Principal Axis Factoring on a dataset. It may be used to find common factors in the data or for data reduction purposes.

The `VARIABLES` subcommand is required (unless the `MATRIX IN` subcommand is used). It lists the variables which are to partake in the analysis. (The `ANALYSIS` subcommand may optionally further limit the variables that participate; it is useful primarily in conjunction with `MATRIX IN`.)

If `MATRIX IN` instead of `VARIABLES` is specified, then the analysis is performed on a pre-prepared correlation or covariance matrix file instead of on individual data cases. Typically the matrix file will have been generated by `MATRIX DATA` (see Section 16.2 [MATRIX DATA], page 224) or provided by a third party. If specified, `MATRIX IN` must be followed by '`COV`' or '`CORR`', then by '`=`' and *file_spec* all in parentheses. *file_spec* may either be an asterisk, which indicates the currently loaded dataset, or it may be a file name to be loaded. See Section 16.2 [MATRIX DATA], page 224, for the expected format of the file.

The `/EXTRACTION` subcommand is used to specify the way in which factors (components) are extracted from the data. If `PC` is specified, then Principal Components Analysis is used. If `PAF` is specified, then Principal Axis Factoring is used. By default Principal Components Analysis is used.

The `/ROTATION` subcommand is used to specify the method by which the extracted solution is rotated. Three orthogonal rotation methods are available: `VARIMAX` (which is the default), `EQUAMAX`, and `QUARTIMAX`. There is one oblique rotation method, *viz*: `PROMAX`. Optionally you may enter the power of the promax rotation k, which must be enclosed in parentheses. The default value of k is 5. If you don't want any rotation to be performed, the word `NOROTATE` prevents the command from performing any rotation on the data.

The `/METHOD` subcommand should be used to determine whether the covariance matrix or the correlation matrix of the data is to be analysed. By default, the correlation matrix is analysed.

The `/PRINT` subcommand may be used to select which features of the analysis are reported:

- `UNIVARIATE` A table of mean values, standard deviations and total weights are printed.
- `INITIAL` Initial communalities and eigenvalues are printed.
- `EXTRACTION` Extracted communalities and eigenvalues are printed.
- `ROTATION` Rotated communalities and eigenvalues are printed.
- `CORRELATION` The correlation matrix is printed.
- `COVARIANCE` The covariance matrix is printed.
- `DET` The determinant of the correlation or covariance matrix is printed.
- `AIC` The anti-image covariance and anti-image correlation matrices are printed.
- `KMO` The Kaiser-Meyer-Olkin measure of sampling adequacy and the Bartlett test of sphericity is printed.
- `SIG` The significance of the elements of correlation matrix is printed.
- `ALL` All of the above are printed.
- `DEFAULT` Identical to `INITIAL` and `EXTRACTION`.

If `/PLOT=EIGEN` is given, then a "Scree" plot of the eigenvalues is printed. This can be useful for visualizing the factors and deciding which factors (components) should be retained.

The `/FORMAT` subcommand determined how data are to be displayed in loading matrices. If `SORT` is specified, then the variables are sorted in descending order of significance. If `BLANK(n)` is specified, then coefficients whose absolute value is less than n are not printed. If the keyword `DEFAULT` is specified, or if no `/FORMAT` subcommand is specified, then no sorting is performed, and all coefficients are printed.

You can use the `/CRITERIA` subcommand to specify how the number of extracted factors (components) are chosen. If `FACTORS(n)` is specified, where n is an integer, then n factors are extracted. Otherwise, the `MINEIGEN` setting is used. `MINEIGEN(l)` requests that all factors whose eigenvalues are greater than or equal to l are extracted. The default value of l is 1. The `ECONVERGE` setting has effect only when using iterative algorithms for factor extraction (such as Principal Axis Factoring). `ECONVERGE(delta)` specifies that iteration should cease when the maximum absolute value of the communality estimate between one iteration and the previous is less than *delta*. The default value of *delta* is 0.001.

The `ITERATE(m)` may appear any number of times and is used for two different purposes. It is used to set the maximum number of iterations (m) for convergence and also to set the maximum number of iterations for rotation. Whether it affects convergence or rotation depends upon which subcommand follows the `ITERATE` subcommand. If `EXTRACTION` follows, it affects convergence. If `ROTATION` follows, it affects rotation. If neither `ROTATION` nor `EXTRACTION` follow a `ITERATE` subcommand, then the entire subcommand is ignored. The default value of m is 25.

The `MISSING` subcommand determines the handling of missing variables. If `INCLUDE` is set, then user-missing values are included in the calculations, but system-missing values are not. If `EXCLUDE` is set, which is the default, user-missing values are excluded as well as system-missing values. This is the default. If `LISTWISE` is set, then the entire case

is excluded from analysis whenever any variable specified in the `VARIABLES` subcommand contains a missing value.

If `PAIRWISE` is set, then a case is considered missing only if either of the values for the particular coefficient are missing. The default is `LISTWISE`.

15.9 GLM

GLM *dependent_vars* BY *fixed_factors*
[/METHOD = SSTYPE(*type*)]
[/DESIGN = *interaction_0* [*interaction_1* [... *interaction_n*]]]
[/INTERCEPT = {INCLUDE|EXCLUDE}]
[/MISSING = {INCLUDE|EXCLUDE}]

The `GLM` procedure can be used for fixed effects factorial Anova.

The *dependent_vars* are the variables to be analysed. You may analyse several variables in the same command in which case they should all appear before the `BY` keyword.

The *fixed_factors* list must be one or more categorical variables. Normally it does not make sense to enter a scalar variable in the *fixed_factors* and doing so may cause PSPP to do a lot of unnecessary processing.

The `METHOD` subcommand is used to change the method for producing the sums of squares. Available values of *type* are 1, 2 and 3. The default is type 3.

You may specify a custom design using the `DESIGN` subcommand. The design comprises a list of interactions where each interaction is a list of variables separated by a '*'. For example the command

GLM subject BY sex age_group race
/DESIGN = age_group sex group age_group*sex age_group*race

specifies the model $subject = age_group + sex + race + age_group * sex + age_group * race$. If no `DESIGN` subcommand is specified, then the default is all possible combinations of the fixed factors. That is to say

GLM subject BY sex age_group race

implies the model $subject = age_group + sex + race + age_group * sex + age_group * race + sex * race + age_group * sex * race$.

The `MISSING` subcommand determines the handling of missing variables. If `INCLUDE` is set then, for the purposes of GLM analysis, only system-missing values are considered to be missing; user-missing values are not regarded as missing. If `EXCLUDE` is set, which is the default, then user-missing values are considered to be missing as well as system-missing values. A case for which any dependent variable or any factor variable has a missing value is excluded from the analysis.

15.10 LOGISTIC REGRESSION

LOGISTIC REGRESSION [VARIABLES =] *dependent_var* WITH *predictors*

[/CATEGORICAL = *categorical_predictors*]

[{/NOCONST | /ORIGIN | /NOORIGIN }]

[/PRINT = [SUMMARY] [DEFAULT] [CI(*confidence*)] [ALL]]

[/CRITERIA = [BCON(*min_delta*)] [ITERATE(*max_interations*)]
[LCON(*min_likelihood_delta*)] [EPS(*min_epsilon*)]
[CUT(*cut_point*)]]

[/MISSING = {INCLUDE|EXCLUDE}]

Bivariate Logistic Regression is used when you want to explain a dichotomous dependent variable in terms of one or more predictor variables.

The minimum command is

```
LOGISTIC REGRESSION y WITH x1 x2 ... xn.
```

Here, *y* is the dependent variable, which must be dichotomous and *x1* ... *xn* are the predictor variables whose coefficients the procedure estimates.

By default, a constant term is included in the model. Hence, the full model is $\mathbf{y} = b_0 + b_1\mathbf{x_1} + b_2\mathbf{x_2} + \ldots + b_n\mathbf{x_n}$

Predictor variables which are categorical in nature should be listed on the `/CATEGORICAL` subcommand. Simple variables as well as interactions between variables may be listed here.

If you want a model without the constant term b_0, use the keyword `/ORIGIN`. `/NOCONST` is a synonym for `/ORIGIN`.

An iterative Newton-Raphson procedure is used to fit the model. The `/CRITERIA` subcommand is used to specify the stopping criteria of the procedure, and other parameters. The value of *cut_point* is used in the classification table. It is the threshold above which predicted values are considered to be 1. Values of *cut_point* must lie in the range [0,1]. During iterations, if any one of the stopping criteria are satisfied, the procedure is considered complete. The stopping criteria are:

- The number of iterations exceeds *max_iterations*. The default value of *max_iterations* is 20.
- The change in the all coefficient estimates are less than *min_delta*. The default value of *min_delta* is 0.001.
- The magnitude of change in the likelihood estimate is less than *min_likelihood_delta*. The default value of *min_delta* is zero. This means that this criterion is disabled.
- The differential of the estimated probability for all cases is less than *min_epsilon*. In other words, the probabilities are close to zero or one. The default value of *min_epsilon* is 0.00000001.

The `PRINT` subcommand controls the display of optional statistics. Currently there is one such option, `CI`, which indicates that the confidence interval of the odds ratio should be displayed as well as its value. `CI` should be followed by an integer in parentheses, to indicate the confidence level of the desired confidence interval.

The `MISSING` subcommand determines the handling of missing variables. If `INCLUDE` is set, then user-missing values are included in the calculations, but system-missing values are not. If `EXCLUDE` is set, which is the default, user-missing values are excluded as well as system-missing values. This is the default.

15.11 MEANS

MEANS [TABLES =]
{*var_list*}
[BY {*var_list*} [BY {*var_list*} [BY {*var_list*} . . .]]]

[/{*var_list*}
[BY {*var_list*} [BY {*var_list*} [BY {*var_list*} . . .]]]]

[/CELLS = [MEAN] [COUNT] [STDDEV] [SEMEAN] [SUM] [MIN] [MAX] [RANGE]
[VARIANCE] [KURT] [SEKURT]
[SKEW] [SESKEW] [FIRST] [LAST]
[HARMONIC] [GEOMETRIC]
[DEFAULT]
[ALL]
[NONE]]

[/MISSING = [INCLUDE] [DEPENDENT]]

You can use the `MEANS` command to calculate the arithmetic mean and similar statistics, either for the dataset as a whole or for categories of data.

The simplest form of the command is

```
MEANS v.
```

which calculates the mean, count and standard deviation for *v*. If you specify a grouping variable, for example

```
MEANS v BY g.
```

then the means, counts and standard deviations for *v* after having been grouped by *g* are calculated. Instead of the mean, count and standard deviation, you could specify the statistics in which you are interested:

```
MEANS x y BY g
      /CELLS = HARMONIC SUM MIN.
```

This example calculates the harmonic mean, the sum and the minimum values of *x* and *y* grouped by *g*.

The `CELLS` subcommand specifies which statistics to calculate. The available statistics are:

- `MEAN` The arithmetic mean.
- `COUNT` The count of the values.
- `STDDEV` The standard deviation.
- `SEMEAN` The standard error of the mean.
- `SUM` The sum of the values.
- `MIN` The minimum value.
- `MAX` The maximum value.
- `RANGE` The difference between the maximum and minimum values.
- `VARIANCE` The variance.

- `FIRST` The first value in the category.
- `LAST` The last value in the category.
- `SKEW` The skewness.
- `SESKEW` The standard error of the skewness.
- `KURT` The kurtosis
- `SEKURT` The standard error of the kurtosis.
- `HARMONIC` The harmonic mean.
- `GEOMETRIC` The geometric mean.

In addition, three special keywords are recognized:

- `DEFAULT` This is the same as `MEAN COUNT STDDEV`.
- `ALL` All of the above statistics are calculated.
- `NONE` No statistics are calculated (only a summary is shown).

More than one *table* can be specified in a single command. Each table is separated by a '`/`'. For example

```
MEANS TABLES =
      c d e BY x
      /a b BY x y
      /f BY y BY z.
```

has three tables (the '`TABLE =`' is optional). The first table has three dependent variables c, d and e and a single categorical variable x. The second table has two dependent variables a and b, and two categorical variables x and y. The third table has a single dependent variables f and a categorical variable formed by the combination of y and z.

By default values are omitted from the analysis only if missing values (either system missing or user missing) for any of the variables directly involved in their calculation are encountered. This behaviour can be modified with the `/MISSING` subcommand. Three options are possible: `TABLE`, `INCLUDE` and `DEPENDENT`.

`/MISSING = INCLUDE` says that user missing values, either in the dependent variables or in the categorical variables should be taken at their face value, and not excluded.

`/MISSING = DEPENDENT` says that user missing values, in the dependent variables should be taken at their face value, however cases which have user missing values for the categorical variables should be omitted from the calculation.

15.11.1 Example Means

The dataset in `repairs.sav` contains the mean time between failures (**mtbf**) for a sample of artifacts produced by different factories and trialed under different operating conditions. Since there are four combinations of categorical variables, by simply looking at the list of data, it would be hard to how the scores vary for each category. Example 15.4 shows one way of tabulating the **mtbf** in a way which is easier to understand.

```
get file='repairs.sav'.

means tables = mtbf
      by factory by environment.
```

Example 15.4: Running MEANS on the **mtbf** score with categories **factory** and **environment**

The results are shown in Result 15.3. The figures shown indicate the mean, standard deviation and number of samples in each category. These figures however do not indicate whether the results are statistically significant. For that, you would need to use the procedures ONEWAY, GLM or T-TEST depending on the hypothesis being tested.

```
                    Case Processing Summary
+----------------------------+-------------------------------+
|                            |             Cases             |
|                            +----------+---------+----------+
|                            | Included | Excluded|   Total  |
|                            +--+-------+-+-------+--+-------+
|                            | N|Percent|N|Percent| N|Percent|
+----------------------------+--+-------+-+-------+--+-------+
|mtbf * factory * environment|30| 100.0%|0|    .0%|30| 100.0%|
+----------------------------+--+-------+-+-------+--+-------+

                                Report
+---------------------------------------------+-----+--+--------------+
|Manufacturing facility Operating Environment| Mean| N|Std. Deviation|
+---------------------------------------------+-----+--+--------------+
|0                      Temperate            | 7.26| 9|          2.57|
|                       Tropical             | 7.47| 7|          2.68|
|                       Total                | 7.35|16|          2.53|
+---------------------------------------------+-----+--+--------------+
|1                      Temperate            |13.38| 6|          7.77|
|                       Tropical             | 8.20| 8|          8.39|
|                       Total                |10.42|14|          8.26|
+---------------------------------------------+-----+--+--------------+
|Total                  Temperate            | 9.71|15|          5.91|
|                       Tropical             | 7.86|15|          6.20|
|                       Total                | 8.78|30|          6.03|
+---------------------------------------------+-----+--+--------------+
```

Result 15.3: The **mtbf** categorised by **factory** and **environment**

Note that there is no limit to the number of variables for which you can calculate statistics, nor to the number of categorical variables per layer, nor the number of layers. However, running MEANS on a large numbers of variables, or with categorical variables containing a large number of distinct values may result in an extremely large output, which will not be easy to interpret. So you should consider carefully which variables to select for participation in the analysis.

15.12 NPAR TESTS

NPAR TESTS

nonparametric test subcommands
.
.
.

[/STATISTICS={DESCRIPTIVES}]

[/MISSING={ANALYSIS, LISTWISE} {INCLUDE, EXCLUDE}]

[/METHOD=EXACT [TIMER [(*n*)]]]

`NPAR TESTS` performs nonparametric tests. Non parametric tests make very few assumptions about the distribution of the data. One or more tests may be specified by using the corresponding subcommand. If the `/STATISTICS` subcommand is also specified, then summary statistics are produces for each variable that is the subject of any test.

Certain tests may take a long time to execute, if an exact figure is required. Therefore, by default asymptotic approximations are used unless the subcommand `/METHOD=EXACT` is specified. Exact tests give more accurate results, but may take an unacceptably long time to perform. If the `TIMER` keyword is used, it sets a maximum time, after which the test is abandoned, and a warning message printed. The time, in minutes, should be specified in parentheses after the `TIMER` keyword. If the `TIMER` keyword is given without this figure, then a default value of 5 minutes is used.

15.12.1 Binomial test

[/BINOMIAL[(*p*)]=*var_list*[(*value1*[, *value2*)]]]

The `/BINOMIAL` subcommand compares the observed distribution of a dichotomous variable with that of a binomial distribution. The variable p specifies the test proportion of the binomial distribution. The default value of 0.5 is assumed if p is omitted.

If a single value appears after the variable list, then that value is used as the threshold to partition the observed values. Values less than or equal to the threshold value form the first category. Values greater than the threshold form the second category.

If two values appear after the variable list, then they are used as the values which a variable must take to be in the respective category. Cases for which a variable takes a value equal to neither of the specified values, take no part in the test for that variable.

If no values appear, then the variable must assume dichotomous values. If more than two distinct, non-missing values for a variable under test are encountered then an error occurs.

If the test proportion is equal to 0.5, then a two-tailed test is reported. For any other test proportion, a one-tailed test is reported. For one-tailed tests, if the test proportion is less than or equal to the observed proportion, then the significance of observing the observed proportion or more is reported. If the test proportion is more than the observed proportion, then the significance of observing the observed proportion or less is reported. That is to say, the test is always performed in the observed direction.

PSPP uses a very precise approximation to the gamma function to compute the binomial significance. Thus, exact results are reported even for very large sample sizes.

15.12.2 Chi-square Test

[/CHISQUARE=*var_list*[(*lo*,*hi*)] [/EXPECTED={EQUAL|*f1*, *f2* . . . *fn*}]]

The `/CHISQUARE` subcommand produces a chi-square statistic for the differences between the expected and observed frequencies of the categories of a variable. Optionally, a range of values may appear after the variable list. If a range is given, then non integer values are truncated, and values outside the specified range are excluded from the analysis.

The `/EXPECTED` subcommand specifies the expected values of each category. There must be exactly one non-zero expected value, for each observed category, or the `EQUAL` keyword must be specified. You may use the notation `n*f` to specify *n* consecutive expected categories all taking a frequency of *f*. The frequencies given are proportions, not absolute frequencies. The sum of the frequencies need not be 1. If no `/EXPECTED` subcommand is given, then equal frequencies are expected.

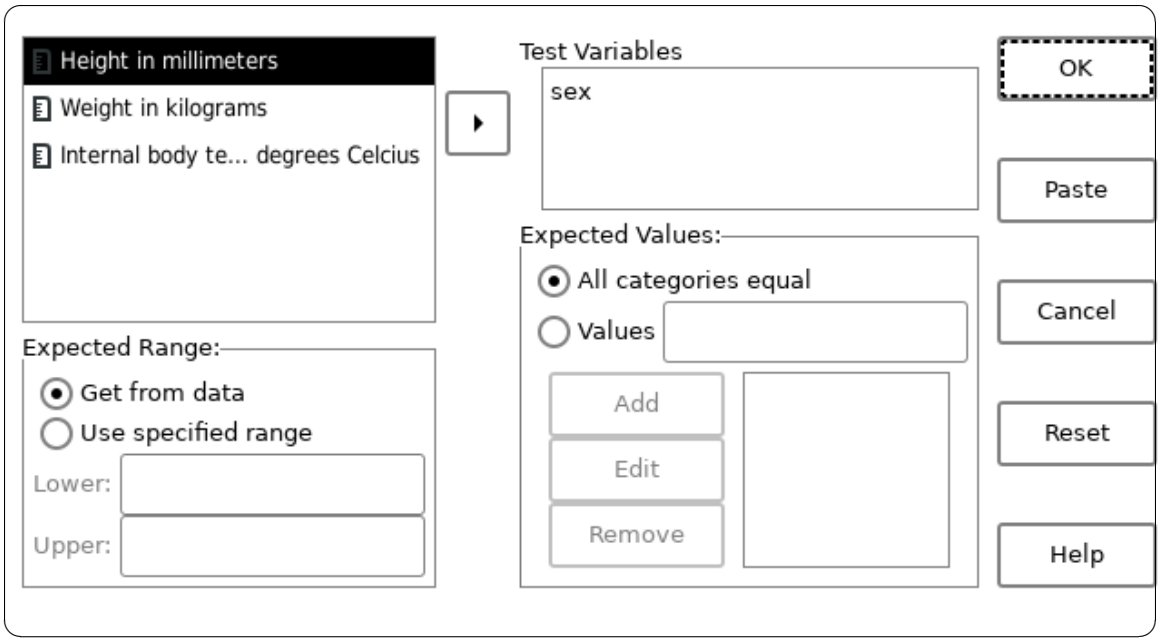
15.12.2.1 Chi-square Example

A researcher wishes to investigate whether there are an equal number of persons of each sex in a population. The sample chosen for invesigation is that from the `physiology.sav` dataset. The null hypothesis for the test is that the population comprises an equal number of males and females. The analysis is performed as shown in Example 15.5.

```
get file='physiology.sav'.

npar test
     /chisquare=sex.
```

Example 15.5: Performing a chi-square test to check for equal distribution of sexes

There is only one test variable, *viz:* **sex**. The other variables in the dataset are ignored.



Screenshot 15.4: Performing a chi-square test using the graphic user interface

In Result 15.4 the summary box shows that in the sample, there are more males than females. However the significance of chi-square result is greater than 0.05 — the most commonly accepted p-value — and therefore there is not enough evidence to reject the null hypothesis and one must conclude that the evidence does not indicate that there is an imbalance of the sexes in the population.

```
                Sex of subject
+------+----------+----------+--------+
|Value |Observed N|Expected N|Residual|
+------+----------+----------+--------+
|Male  |        22|     20.00|    2.00|
|Female|        18|     20.00|   -2.00|
|Total |        40|          |        |
+------+----------+----------+--------+

                Test Statistics
+--------------+----------+--+-----------+
|              |Chi-square|df|Asymp. Sig.|
+--------------+----------+--+-----------+
|Sex of subject|       .40| 1|       .527|
+--------------+----------+--+-----------+
```

Result 15.4: The results of running a chi-square test on **sex**

15.12.3 Cochran Q Test

[/COCHRAN = *var_list*]

The Cochran Q test is used to test for differences between three or more groups. The data for *var_list* in all cases must assume exactly two distinct values (other than missing values).

The value of Q is displayed along with its Asymptotic significance based on a chi-square distribution.

15.12.4 Friedman Test

[/FRIEDMAN = *var_list*]

The Friedman test is used to test for differences between repeated measures when there is no indication that the distributions are normally distributed.

A list of variables which contain the measured data must be given. The procedure prints the sum of ranks for each variable, the test statistic and its significance.

15.12.5 Kendall's W Test

[/KENDALL = *var_list*]

The Kendall test investigates whether an arbitrary number of related samples come from the same population. It is identical to the Friedman test except that the additional statistic W, Kendall's Coefficient of Concordance is printed. It has the range [0,1] — a value of zero indicates no agreement between the samples whereas a value of unity indicates complete agreement.

15.12.6 Kolmogorov-Smirnov Test

[/KOLMOGOROV-SMIRNOV ({NORMAL [*mu*, *sigma*], UNIFORM [*min*, *max*], POISSON [*lambda*], EXPONENTIAL [*scale*] }) = *var_list*]

The one-sample Kolmogorov-Smirnov subcommand is used to test whether or not a dataset is drawn from a particular distribution. Four distributions are supported, *viz:* Normal, Uniform, Poisson and Exponential.

Ideally you should provide the parameters of the distribution against which you wish to test the data. For example, with the normal distribution the mean (*mu*)and standard deviation (*sigma*) should be given; with the uniform distribution, the minimum (*min*)and maximum (*max*) value should be provided. However, if the parameters are omitted they are imputed from the data. Imputing the parameters reduces the power of the test so should be avoided if possible.

In the following example, two variables *score* and *age* are tested to see if they follow a normal distribution with a mean of 3.5 and a standard deviation of 2.0.

```
NPAR TESTS
      /KOLMOGOROV-SMIRNOV (normal 3.5 2.0) = score age.
```

If the variables need to be tested against different distributions, then a separate subcommand must be used. For example the following syntax tests *score* against a normal distribution with mean of 3.5 and standard deviation of 2.0 whilst *age* is tested against a normal distribution of mean 40 and standard deviation 1.5.

```
NPAR TESTS
      /KOLMOGOROV-SMIRNOV (normal 3.5 2.0) = score
      /KOLMOGOROV-SMIRNOV (normal 40 1.5) =  age.
```

The abbreviated subcommand `K-S` may be used in place of `KOLMOGOROV-SMIRNOV`.

15.12.7 Kruskal-Wallis Test

[/KRUSKAL-WALLIS = *var_list* BY var (*lower*, *upper*)]

The Kruskal-Wallis test is used to compare data from an arbitrary number of populations. It does not assume normality. The data to be compared are specified by *var_list*. The categorical variable determining the groups to which the data belongs is given by *var*. The limits *lower* and *upper* specify the valid range of *var*. If *upper* is smaller than *lower*, the PSPP will assume their values to be reversed. Any cases for which *var* falls outside [*lower*, *upper*] are ignored.

The mean rank of each group as well as the chi-squared value and significance of the test are printed. The abbreviated subcommand `K-W` may be used in place of `KRUSKAL-WALLIS`.

15.12.8 Mann-Whitney U Test

[/MANN-WHITNEY = *var_list* BY var (*group1*, *group2*)]

The Mann-Whitney subcommand is used to test whether two groups of data come from different populations. The variables to be tested should be specified in *var_list* and the grouping variable, that determines to which group the test variables belong, in *var*. *Var* may be either a string or an alpha variable. *Group1* and *group2* specify the two values of *var* which determine the groups of the test data. Cases for which the *var* value is neither *group1* or *group2* are ignored.

The value of the Mann-Whitney U statistic, the Wilcoxon W, and the significance are printed. You may abbreviated the subcommand `MANN-WHITNEY` to `M-W`.

15.12.9 McNemar Test

[/MCNEMAR *var_list* [WITH *var_list* [(PAIRED)]]]

Use McNemar's test to analyse the significance of the difference between pairs of correlated proportions.

If the `WITH` keyword is omitted, then tests for all combinations of the listed variables are performed. If the `WITH` keyword is given, and the `(PAIRED)` keyword is also given, then the number of variables preceding `WITH` must be the same as the number following it. In this case, tests for each respective pair of variables are performed. If the `WITH` keyword is given, but the `(PAIRED)` keyword is omitted, then tests for each combination of variable preceding `WITH` against variable following `WITH` are performed.

The data in each variable must be dichotomous. If there are more than two distinct variables an error will occur and the test will not be run.

15.12.10 Median Test

[/MEDIAN [(*value*)] = *var_list* BY *variable* (*value1*, *value2*)]

The median test is used to test whether independent samples come from populations with a common median. The median of the populations against which the samples are to be tested may be given in parentheses immediately after the `/MEDIAN` subcommand. If it is not given, the median is imputed from the union of all the samples.

The variables of the samples to be tested should immediately follow the '`=`' sign. The keyword `BY` must come next, and then the grouping variable. Two values in parentheses should follow. If the first value is greater than the second, then a 2 sample test is performed

using these two values to determine the groups. If however, the first variable is less than the second, then a k sample test is conducted and the group values used are all values encountered which lie in the range [*value1*,*value2*].

15.12.11 Runs Test

[/RUNS ({MEAN, MEDIAN, MODE, *value*}) = *var_list*]

The `/RUNS` subcommand tests whether a data sequence is randomly ordered.

It works by examining the number of times a variable's value crosses a given threshold. The desired threshold must be specified within parentheses. It may either be specified as a number or as one of `MEAN`, `MEDIAN` or `MODE`. Following the threshold specification comes the list of variables whose values are to be tested.

The subcommand shows the number of runs, the asymptotic significance based on the length of the data.

15.12.12 Sign Test

[/SIGN *var_list* [WITH *var_list* [(PAIRED)]]]

The `/SIGN` subcommand tests for differences between medians of the variables listed. The test does not make any assumptions about the distribution of the data.

If the `WITH` keyword is omitted, then tests for all combinations of the listed variables are performed. If the `WITH` keyword is given, and the `(PAIRED)` keyword is also given, then the number of variables preceding `WITH` must be the same as the number following it. In this case, tests for each respective pair of variables are performed. If the `WITH` keyword is given, but the `(PAIRED)` keyword is omitted, then tests for each combination of variable preceding `WITH` against variable following `WITH` are performed.

15.12.13 Wilcoxon Matched Pairs Signed Ranks Test

[/WILCOXON *var_list* [WITH *var_list* [(PAIRED)]]]

The `/WILCOXON` subcommand tests for differences between medians of the variables listed. The test does not make any assumptions about the variances of the samples. It does however assume that the distribution is symmetrical.

If the `WITH` keyword is omitted, then tests for all combinations of the listed variables are performed. If the `WITH` keyword is given, and the `(PAIRED)` keyword is also given, then the number of variables preceding `WITH` must be the same as the number following it. In this case, tests for each respective pair of variables are performed. If the `WITH` keyword is given, but the `(PAIRED)` keyword is omitted, then tests for each combination of variable preceding `WITH` against variable following `WITH` are performed.

15.13 T-TEST

T-TEST
  /MISSING={ANALYSIS,LISTWISE} {EXCLUDE,INCLUDE}
  /CRITERIA=CI(*confidence*)

(One Sample mode.)

TESTVAL=*test_value*
/VARIABLES=*var_list*

(Independent Samples mode.)
GROUPS=var(*value1* [, *value2*])
/VARIABLES=*var_list*

(Paired Samples mode.)
PAIRS=*var_list* [WITH *var_list* [(PAIRED)]]

The `T-TEST` procedure outputs tables used in testing hypotheses about means. It operates in one of three modes:

- One Sample mode.
- Independent Groups mode.
- Paired mode.

Each of these modes are described in more detail below. There are two optional subcommands which are common to all modes.

The `/CRITERIA` subcommand tells PSPP the confidence interval used in the tests. The default value is 0.95.

The `MISSING` subcommand determines the handling of missing variables. If `INCLUDE` is set, then user-missing values are included in the calculations, but system-missing values are not. If `EXCLUDE` is set, which is the default, user-missing values are excluded as well as system-missing values. This is the default.

If `LISTWISE` is set, then the entire case is excluded from analysis whenever any variable specified in the `/VARIABLES`, `/PAIRS` or `/GROUPS` subcommands contains a missing value. If `ANALYSIS` is set, then missing values are excluded only in the analysis for which they would be needed. This is the default.

15.13.1 One Sample Mode

The `TESTVAL` subcommand invokes the One Sample mode. This mode is used to test a population mean against a hypothesized mean. The value given to the `TESTVAL` subcommand is the value against which you wish to test. In this mode, you must also use the `/VARIABLES` subcommand to tell PSPP which variables you wish to test.

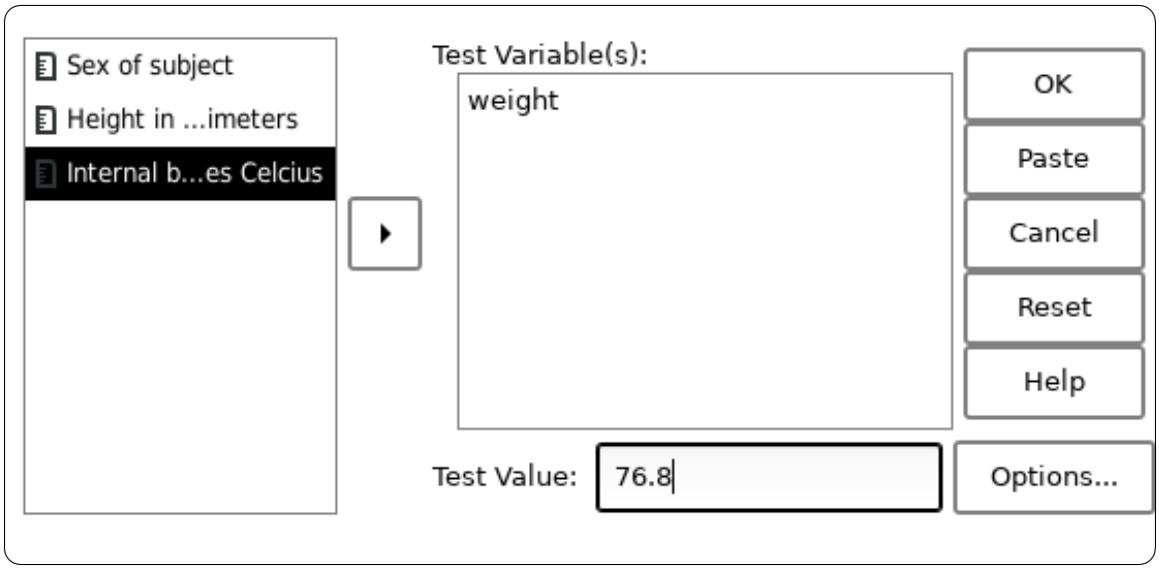
15.13.1.1 Example - One-Sample T-test

A researcher wishes to know whether the weight of persons in a population is different from the national average. The samples are drawn from the population under investigation and recorded in the file `physiology.sav`. From the Department of Health, she knows that the national average weight of healthy adults is 76.8kg. Accordingly the `TESTVAL` is set to 76.8. The null hypothesis therefore is that the mean average weight of the population from which the sample was drawn is 76.8kg.

As previously noted (see Section 5.2.1 [Identifying incorrect data], page 15), one sample in the dataset contains a weight value which is clearly incorrect. So this is excluded from the analysis using the `SELECT` command.

```
get file='physiology.sav'.

select if (weight > 0).

t-test testval = 76.8
          /variables = weight.
```

Example 15.6: Running a one-sample T-Test after excluding all non-positive values



Screenshot 15.5: Using the One-Sample T-Test dialog box to test **weight** for a mean of 76.8kg

Results 15.2 shows that the mean of our sample differs from the test value by -1.40kg. However the significance is very high (0.610). So one cannot reject the null hypothesis, and must conclude there is not enough evidence to suggest that the mean weight of the persons in our population is different from 76.8kg.

```
                 One-Sample Statistics
+-------------------+--+-----+--------------+---------+
|                   | N| Mean|Std. Deviation|S.E. Mean|
+-------------------+--+-----+--------------+---------+
|Weight in kilograms|39|75.40|         17.08|     2.73|
+-------------------+--+-----+--------------+---------+

                              One-Sample Test
+--------------+-------------------------------------------------------------+
|              |                       Test Value = 76.8                     |
|              +----+--+------------+------------+-----------------------------+
|              |    |  |            |            | 95% Confidence Interval of |
|              |    |  |            |            |       the Difference       |
|              |    |  |  Sig. (2-  |    Mean    +--------------+-------------+
|              |  t |df|   tailed)  | Difference |     Lower    |    Upper    |
+--------------+----+--+------------+------------+--------------+-------------+
|Weight in     |-.51|38|        .610|       -1.40|         -6.94|         4.13|
|kilograms     |    |  |            |            |              |             |
+--------------+----+--+------------+------------+--------------+-------------+
```

Results 15.2: The results of a one-sample T-test of **weight** using a test value of 76.8kg

15.13.2 Independent Samples Mode

The `GROUPS` subcommand invokes Independent Samples mode or 'Groups' mode. This mode is used to test whether two groups of values have the same population mean. In this mode, you must also use the `/VARIABLES` subcommand to tell PSPP the dependent variables you wish to test.

The variable given in the `GROUPS` subcommand is the independent variable which determines to which group the samples belong. The values in parentheses are the specific values of the independent variable for each group. If the parentheses are omitted and no values are given, the default values of 1.0 and 2.0 are assumed.

If the independent variable is numeric, it is acceptable to specify only one value inside the parentheses. If you do this, cases where the independent variable is greater than or equal to this value belong to the first group, and cases less than this value belong to the second group. When using this form of the `GROUPS` subcommand, missing values in the independent variable are excluded on a listwise basis, regardless of whether `/MISSING=LISTWISE` was specified.

15.13.2.1 Example - Independent Samples T-test

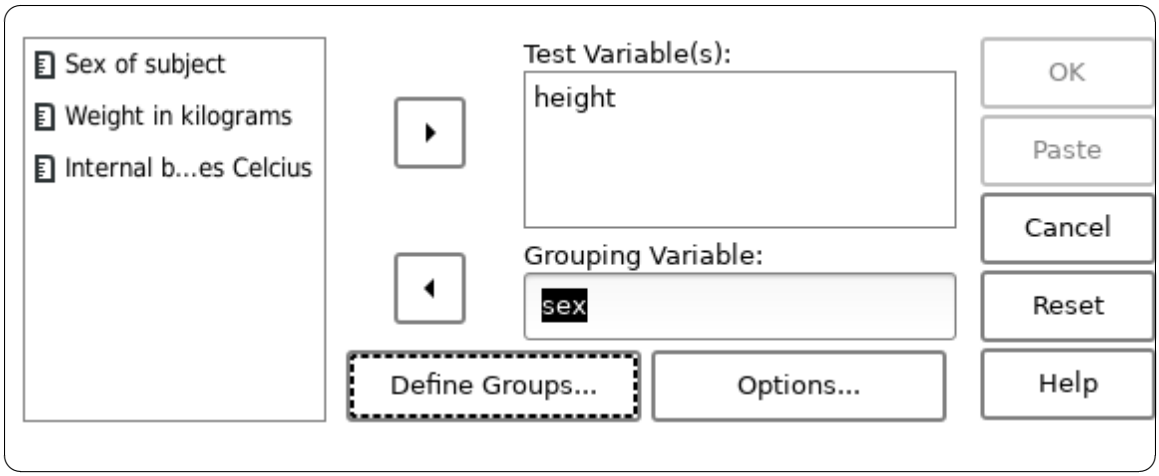
A researcher wishes to know whether within a population, adult males are taller than adult females. The samples are drawn from the population under investigation and recorded in the file `physiology.sav`.

As previously noted (see Section 5.2.1 [Identifying incorrect data], page 15), one sample in the dataset contains a height value which is clearly incorrect. So this is excluded from the analysis using the `SELECT` command.

```
get file='physiology.sav'.

select if (height >= 200).

t-test /variables = height
       /groups = sex(0,1).
```

Example 15.7: Running a independent samples T-Test after excluding all observations less than 200kg

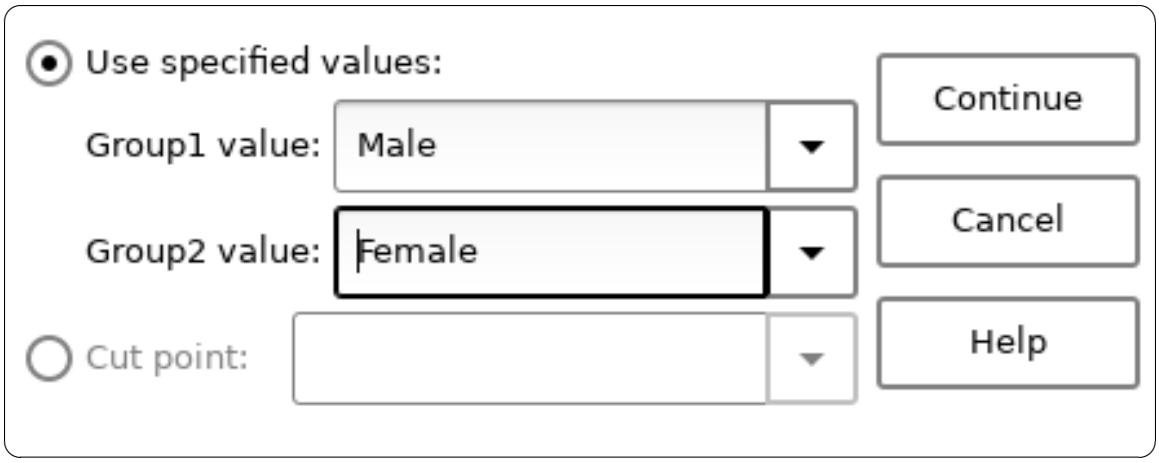
The null hypothesis is that both males and females are on average of equal height.



Screenshot 15.6: Using the Independent Sample T-test dialog, to test for differences of **height** between values of **sex**

In this case, the grouping variable is **sex**, so this is entered as the variable for the `GROUP` subcommand. The group values are 0 (male) and 1 (female).

If you are running the proceedure using syntax, then you need to enter the values corresponding to each group within parentheses. If you are using the graphic user interface, then you have to open the "Define Groups" dialog box and enter the values corresponding to each group as shown in Screenshot 15.7. If, as in this case, the dataset has defined value labels for the group variable, then you can enter them by label or by value.



Screenshot 15.7: Setting the values of the grouping variable for an Independent Samples T-test

From Result 15.5, one can clearly see that the *sample* mean height is greater for males than for females. However in order to see if this is a significant result, one must consult the T-Test table.

The T-Test table contains two rows; one for use if the variance of the samples in each group may be safely assumed to be equal, and the second row if the variances in each group may not be safely assumed to be equal.

In this case however, both rows show a 2-tailed significance less than 0.001 and one must therefore reject the null hypothesis and conclude that within the population the mean height of males and of females are unequal.

Group Statistics

	Group	N	Mean	Std. Deviation	S.E. Mean
Height in millimeters	Male	22	1796.49	49.71	10.60
	Female	17	1610.77	25.43	6.17

Independent Samples Test

		Levene's Test for Equality of Variances		T-Test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	
Height in millimeters	Equal variances assumed	.97	.331	14.02	37.00	.000	185.72	13.24	
	Equal variances not assumed			15.15	32.71	.000	185.72	12.26	

		95% Confidence Interval of the Difference	
		Lower	Upper
Height in millimeters	Equal variances assumed	158.88	212.55
	Equal variances not assumed	160.76	210.67

Result 15.5: The results of an independent samples T-test of **height** by **sex**

15.13.3 Paired Samples Mode

The PAIRS subcommand introduces Paired Samples mode. Use this mode when repeated measures have been taken from the same samples. If the WITH keyword is omitted, then tables for all combinations of variables given in the PAIRS subcommand are generated. If the WITH keyword is given, and the (PAIRED) keyword is also given, then the number of variables preceding WITH must be the same as the number following it. In this case, tables for each respective pair of variables are generated. In the event that the WITH keyword is given, but the (PAIRED) keyword is omitted, then tables for each combination of variable preceding WITH against variable following WITH are generated.

15.14 ONEWAY

ONEWAY
[/VARIABLES =] *var_list* BY *var*
/MISSING={ANALYSIS,LISTWISE} {EXCLUDE,INCLUDE}
/CONTRAST= *value1* [, *value2*] ... [,*valueN*]
/STATISTICS={DESCRIPTIVES,HOMOGENEITY}
/POSTHOC={BONFERRONI, GH, LSD, SCHEFFE, SIDAK, TUKEY, ALPHA ([*value*])}

The ONEWAY procedure performs a one-way analysis of variance of variables factored by a single independent variable. It is used to compare the means of a population divided into more than two groups.

The dependent variables to be analysed should be given in the VARIABLES subcommand. The list of variables must be followed by the BY keyword and the name of the independent (or factor) variable.

You can use the STATISTICS subcommand to tell PSPP to display ancillary information. The options accepted are:

- DESCRIPTIVES Displays descriptive statistics about the groups factored by the independent variable.
- HOMOGENEITY Displays the Levene test of Homogeneity of Variance for the variables and their groups.

The CONTRAST subcommand is used when you anticipate certain differences between the groups. The subcommand must be followed by a list of numerals which are the coefficients of the groups to be tested. The number of coefficients must correspond to the number of distinct groups (or values of the independent variable). If the total sum of the coefficients are not zero, then PSPP will display a warning, but will proceed with the analysis. The CONTRAST subcommand may be given up to 10 times in order to specify different contrast tests. The MISSING subcommand defines how missing values are handled. If LISTWISE is specified then cases which have missing values for the independent variable or any dependent variable are ignored. If ANALYSIS is specified, then cases are ignored if the independent variable is missing or if the dependent variable currently being analysed is missing. The default is ANALYSIS. A setting of EXCLUDE means that variables whose values are user-missing are to be excluded from the analysis. A setting of INCLUDE means they are to be included. The default is EXCLUDE.

Using the POSTHOC subcommand you can perform multiple pairwise comparisons on the data. The following comparison methods are available:

- LSD Least Significant Difference.
- TUKEY Tukey Honestly Significant Difference.
- BONFERRONI Bonferroni test.
- SCHEFFE Scheffé's test.
- SIDAK Sidak test.
- GH The Games-Howell test.

Use the optional syntax ALPHA(*value*) to indicate that ONEWAY should perform the posthoc tests at a confidence level of *value*. If ALPHA(*value*) is not specified, then the confidence level used is 0.05.

15.15 QUICK CLUSTER

QUICK CLUSTER *var_list*
[/CRITERIA=CLUSTERS(*k*) [MXITER(*max_iter*)] CONVERGE(*epsilon*) [NOINITIAL]]
[/MISSING={EXCLUDE,INCLUDE} {LISTWISE, PAIRWISE}]
[/PRINT={INITIAL} {CLUSTER}]
[/SAVE[=[CLUSTER[(*membership_var*)]] [DISTANCE[(*distance_var*)]]]

The QUICK CLUSTER command performs k-means clustering on the dataset. This is useful when you wish to allocate cases into clusters of similar values and you already know the number of clusters.

The minimum specification is 'QUICK CLUSTER' followed by the names of the variables which contain the cluster data. Normally you will also want to specify /CRITERIA=CLUSTERS(*k*) where *k* is the number of clusters. If this is not specified, then *k* defaults to 2.

If you use /CRITERIA=NOINITIAL then a naive algorithm to select the initial clusters is used. This will provide for faster execution but less well separated initial clusters and hence possibly an inferior final result.

QUICK CLUSTER uses an iterative algorithm to select the clusters centers. The subcommand /CRITERIA=MXITER(*max_iter*) sets the maximum number of iterations. During classification, PSPP will continue iterating until until *max_iter* iterations have been done or the convergence criterion (see below) is fulfilled. The default value of *max_iter* is 2.

If however, you specify /CRITERIA=NOUPDATE then after selecting the initial centers, no further update to the cluster centers is done. In this case, *max_iter*, if specified. is ignored.

The subcommand /CRITERIA=CONVERGE(*epsilon*) is used to set the convergence criterion. The value of convergence criterion is *epsilon* times the minimum distance between the *initial* cluster centers. Iteration stops when the mean cluster distance between one iteration and the next is less than the convergence criterion. The default value of *epsilon* is zero.

The MISSING subcommand determines the handling of missing variables. If INCLUDE is set, then user-missing values are considered at their face value and not as missing values. If EXCLUDE is set, which is the default, user-missing values are excluded as well as system-missing values.

If LISTWISE is set, then the entire case is excluded from the analysis whenever any of the clustering variables contains a missing value. If PAIRWISE is set, then a case is considered missing only if all the clustering variables contain missing values. Otherwise it is clustered on the basis of the non-missing values. The default is LISTWISE.

The PRINT subcommand requests additional output to be printed. If INITIAL is set, then the initial cluster memberships will be printed. If CLUSTER is set, the cluster memberships of the individual cases are displayed (potentially generating lengthy output).

You can specify the subcommand SAVE to ask that each case's cluster membership and the euclidean distance between the case and its cluster center be saved to a new variable in the active dataset. To save the cluster membership use the CLUSTER keyword and to save the distance use the DISTANCE keyword. Each keyword may optionally be followed by a variable name in parentheses to specify the new variable which is to contain the saved parameter. If no variable name is specified, then PSPP will create one.

15.16 RANK

RANK
[VARIABLES=] *var_list* [{A,D}] [BY *var_list*]
/TIES={MEAN,LOW,HIGH,CONDENSE}
/FRACTION={BLOM,TUKEY,VW,RANKIT}
/PRINT[={YES,NO}
/MISSING={EXCLUDE,INCLUDE}

/RANK [INTO *var_list*]
/NTILES(k) [INTO *var_list*]
/NORMAL [INTO *var_list*]
/PERCENT [INTO *var_list*]
/RFRACTION [INTO *var_list*]
/PROPORTION [INTO *var_list*]
/N [INTO *var_list*]
/SAVAGE [INTO *var_list*]

The RANK command ranks variables and stores the results into new variables.

The VARIABLES subcommand, which is mandatory, specifies one or more variables whose values are to be ranked. After each variable, 'A' or 'D' may appear, indicating that the variable is to be ranked in ascending or descending order. Ascending is the default. If a BY keyword appears, it should be followed by a list of variables which are to serve as group variables. In this case, the cases are gathered into groups, and ranks calculated for each group.

The TIES subcommand specifies how tied values are to be treated. The default is to take the mean value of all the tied cases.

The FRACTION subcommand specifies how proportional ranks are to be calculated. This only has any effect if NORMAL or PROPORTIONAL rank functions are requested.

The PRINT subcommand may be used to specify that a summary of the rank variables created should appear in the output.

The function subcommands are RANK, NTILES, NORMAL, PERCENT, RFRACTION, PROPORTION and SAVAGE. Any number of function subcommands may appear. If none

are given, then the default is RANK. The `NTILES` subcommand must take an integer specifying the number of partitions into which values should be ranked. Each subcommand may be followed by the `INTO` keyword and a list of variables which are the variables to be created and receive the rank scores. There may be as many variables specified as there are variables named on the `VARIABLES` subcommand. If fewer are specified, then the variable names are automatically created.

The `MISSING` subcommand determines how user missing values are to be treated. A setting of `EXCLUDE` means that variables whose values are user-missing are to be excluded from the rank scores. A setting of `INCLUDE` means they are to be included. The default is `EXCLUDE`.

15.17 REGRESSION

The `REGRESSION` procedure fits linear models to data via least-squares estimation. The procedure is appropriate for data which satisfy those assumptions typical in linear regression:

- The data set contains n observations of a dependent variable, say $Y_1, \ldots, Y_n$, and n observations of one or more explanatory variables. Let $X_{11}, X_{12}, \ldots, X_{1n}$ denote the n observations of the first explanatory variable; $X_{21}, \ldots, X_{2n}$ denote the n observations of the second explanatory variable; $X_{k1}, \ldots, X_{kn}$ denote the n observations of the kth explanatory variable.
- The dependent variable Y has the following relationship to the explanatory variables: $Y_i = b_0 + b_1 X_{1i} + ... + b_k X_{ki} + Z_i$ where $b_0, b_1, \ldots, b_k$ are unknown coefficients, and $Z_1, \ldots, Z_n$ are independent, normally distributed *noise* terms with mean zero and common variance. The noise, or *error* terms are unobserved. This relationship is called the *linear model*.

The `REGRESSION` procedure estimates the coefficients $b_0, \ldots, b_k$ and produces output relevant to inferences for the linear model.

15.17.1 Syntax

```
REGRESSION
      /VARIABLES=var_list
      /DEPENDENT=var_list
    /STATISTICS={ALL, DEFAULTS, R, COEFF, ANOVA, BCOV, CI[conf, TOL]}
      { /ORIGIN | /NOORIGIN }
      /SAVE={PRED, RESID}
```

The `REGRESSION` procedure reads the active dataset and outputs statistics relevant to the linear model specified by the user.

The `VARIABLES` subcommand, which is required, specifies the list of variables to be analyzed. Keyword `VARIABLES` is required. The `DEPENDENT` subcommand specifies the dependent variable of the linear model. The `DEPENDENT` subcommand is required. All variables listed in the `VARIABLES` subcommand, but not listed in the `DEPENDENT` subcommand, are treated as explanatory variables in the linear model.

All other subcommands are optional:

The `STATISTICS` subcommand specifies which statistics are to be displayed. The following keywords are accepted:

`ALL` All of the statistics below.

`R` The ratio of the sums of squares due to the model to the total sums of squares for the dependent variable.

`COEFF` A table containing the estimated model coefficients and their standard errors.

`CI (`*conf*`)` This item is only relevant if COEFF has also been selected. It specifies that the confidence interval for the coefficients should be printed. The optional value *conf*, which must be in parentheses, is the desired confidence level expressed as a percentage.

`ANOVA` Analysis of variance table for the model.

`BCOV` The covariance matrix for the estimated model coefficients.

`TOL` The variance inflation factor and its reciprocal. This has no effect unless COEFF is also given.

`DEFAULT` The same as if R, COEFF, and ANOVA had been selected. This is what you get if the /STATISTICS command is not specified, or if it is specified without any parameters.

The `ORIGIN` and `NOORIGIN` subcommands are mutually exclusive. `ORIGIN` indicates that the regression should be performed through the origin. You should use this option if, and only if you have reason to believe that the regression does indeed pass through the origin — that is to say, the value b_0 above, is zero. The default is `NOORIGIN`.

The `SAVE` subcommand causes PSPP to save the residuals or predicted values from the fitted model to the active dataset. PSPP will store the residuals in a variable called '`RES1`' if no such variable exists, '`RES2`' if '`RES1`' already exists, '`RES3`' if '`RES1`' and '`RES2`' already exist, etc. It will choose the name of the variable for the predicted values similarly, but with '`PRED`' as a prefix. When `SAVE` is used, PSPP ignores `TEMPORARY`, treating temporary transformations as permanent.

15.17.2 Examples

The following PSPP syntax will generate the default output and save the predicted values and residuals to the active dataset.

```
title 'Demonstrate REGRESSION procedure'.
data list / v0 1-2 (A) v1 v2 3-22 (10).
begin data.
b  7.735648 -23.97588
b  6.142625 -19.63854
a  7.651430 -25.26557
c  6.125125 -16.57090
a  8.245789 -25.80001
c  6.031540 -17.56743
a  9.832291 -28.35977
c  5.343832 -16.79548
a  8.838262 -29.25689
b  6.200189 -18.58219
end data.
```

```
list.
regression /variables=v0 v1 v2 /statistics defaults /dependent=v2
           /save pred resid /method=enter.
```

15.18 RELIABILITY

RELIABILITY
  /VARIABLES=*var_list*
  /SCALE (*name*) = {*var_list*, ALL}
  /MODEL={ALPHA, SPLIT[(*n*)]}
  /SUMMARY={TOTAL,ALL}
  /MISSING={EXCLUDE,INCLUDE}

The `RELIABILITY` command performs reliability analysis on the data.

The `VARIABLES` subcommand is required. It determines the set of variables upon which analysis is to be performed.

The `SCALE` subcommand determines the variables for which reliability is to be calculated. If `SCALE` is omitted, then analysis for all variables named in the `VARIABLES` subcommand are used. Optionally, the *name* parameter may be specified to set a string name for the scale.

The `MODEL` subcommand determines the type of analysis. If `ALPHA` is specified, then Cronbach's Alpha is calculated for the scale. If the model is `SPLIT`, then the variables are divided into 2 subsets. An optional parameter *n* may be given, to specify how many variables to be in the first subset. If *n* is omitted, then it defaults to one half of the variables in the scale, or one half minus one if there are an odd number of variables. The default model is `ALPHA`.

By default, any cases with user missing, or system missing values for any variables given in the `VARIABLES` subcommand are omitted from the analysis. The `MISSING` subcommand determines whether user missing values are included or excluded in the analysis.

The `SUMMARY` subcommand determines the type of summary analysis to be performed. Currently there is only one type: `SUMMARY=TOTAL`, which displays per-item analysis tested against the totals.

15.18.1 Example - Reliability

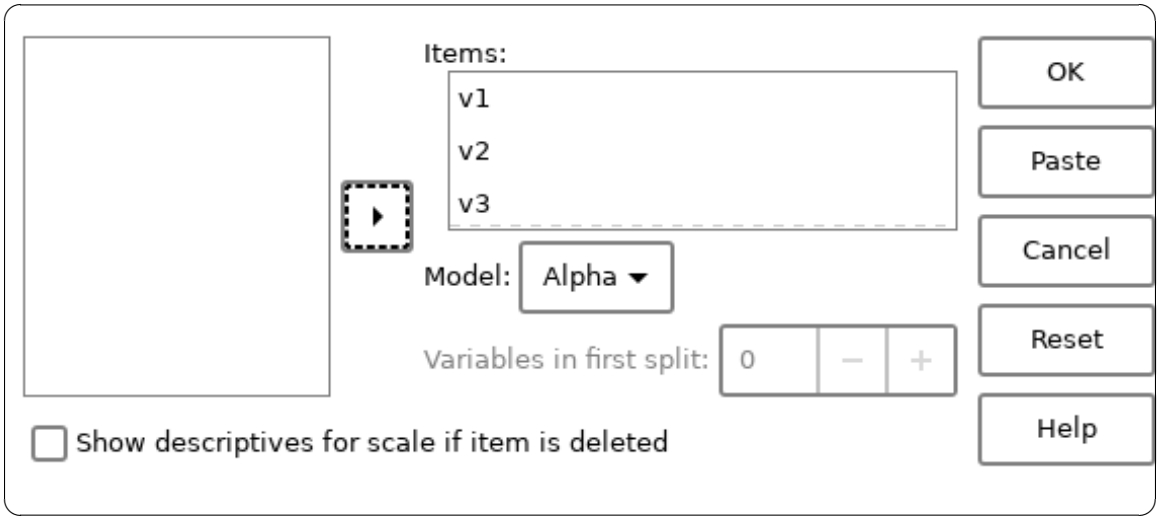
Before analysing the results of a survey – particularly for a multiple choice survey – it is desireable to know whether the respondents have considered their answers or simply provided random answers.

In the following example the survey results from the file `hotel.sav` are used. All five survey questions are included in the reliability analysis. However, before running the analysis, the data must be preprocessed. An examination of the survey questions reveals that two questions, *viz:* v3 and v5 are negatively worded, whereas the others are positively worded. All questions must be based upon the same scale for the analysis to be meaningful. One could use the `RECODE` command (see Section 12.7 [RECODE], page 121), however a simpler way is to use `COMPUTE` (see Section 12.3 [COMPUTE], page 113) and this is what is done in Example 15.8.

```
get file="hotel.sav".

* Recode V3 and V5 inverting the sense of the values.
compute v3 = 6 - v3.
compute v5 = 6 - v5.

reliability
          /variables= all
          /model=alpha.
```

Example 15.8: Investigating the reliability of survey responses

In this case, all variables in the data set are used. So we can use the special keyword '`ALL`' (see Section 6.10 [BNF], page 43).



Screenshot 15.8: Reliability dialog box with all variables selected

Result 15.6 shows that Cronbach's Alpha is 0.11 which is a value normally considered too low to indicate consistency within the data. This is possibly due to the small number of survey questions. The survey should be redesigned before serious use of the results are applied.

```
Scale: ANY

Case Processing Summary
+--------+--+-------+
|Cases   | N|Percent|
+--------+--+-------+
|Valid   |17| 100.0%|
|Excluded| 0|    .0%|
|Total   |17| 100.0%|
+--------+--+-------+

    Reliability Statistics
+----------------+----------+
|Cronbach's Alpha|N of Items|
+----------------+----------+
|             .11|         5|
+----------------+----------+
```

Result 15.6: The results of the reliability command on `hotel.sav`

15.19 ROC

ROC *var_list* BY *state_var* (*state_value*)
/PLOT = { CURVE [(REFERENCE)], NONE }
/PRINT = [SE] [COORDINATES]
/CRITERIA = [CUTOFF({INCLUDE,EXCLUDE})]
[TESTPOS ({LARGE,SMALL})]
[CI (*confidence*)]
[DISTRIBUTION ({FREE, NEGEXPO })]
/MISSING={EXCLUDE,INCLUDE}

The `ROC` command is used to plot the receiver operating characteristic curve of a dataset, and to estimate the area under the curve. This is useful for analysing the efficacy of a variable as a predictor of a state of nature.

The mandatory *var_list* is the list of predictor variables. The variable *state_var* is the variable whose values represent the actual states, and *state_value* is the value of this variable which represents the positive state.

The optional subcommand `PLOT` is used to determine if and how the `ROC` curve is drawn. The keyword `CURVE` means that the `ROC` curve should be drawn, and the optional keyword `REFERENCE`, which should be enclosed in parentheses, says that the diagonal reference line should be drawn. If the keyword `NONE` is given, then no `ROC` curve is drawn. By default, the curve is drawn with no reference line.

The optional subcommand `PRINT` determines which additional tables should be printed. Two additional tables are available. The `SE` keyword says that standard error of the area under the curve should be printed as well as the area itself. In addition, a p-value for the null hypothesis that the area under the curve equals 0.5 is printed. The `COORDINATES` keyword says that a table of coordinates of the `ROC` curve should be printed.

The `CRITERIA` subcommand has four optional parameters:

- The `TESTPOS` parameter may be `LARGE` or `SMALL`. `LARGE` is the default, and says that

larger values in the predictor variables are to be considered positive. `SMALL` indicates that smaller values should be considered positive.

- The `CI` parameter specifies the confidence interval that should be printed. It has no effect if the `SE` keyword in the `PRINT` subcommand has not been given.
- The `DISTRIBUTION` parameter determines the method to be used when estimating the area under the curve. There are two possibilities, *viz*: `FREE` and `NEGEXPO`. The `FREE` method uses a non-parametric estimate, and the `NEGEXPO` method a bi-negative exponential distribution estimate. The `NEGEXPO` method should only be used when the number of positive actual states is equal to the number of negative actual states. The default is `FREE`.
- The `CUTOFF` parameter is for compatibility and is ignored.

The `MISSING` subcommand determines whether user missing values are to be included or excluded in the analysis. The default behaviour is to exclude them. Cases are excluded on a listwise basis; if any of the variables in *var_list* or if the variable *state_var* is missing, then the entire case is excluded.

16 Matrices

Some PSPP procedures work with matrices by producing numeric matrices that report results of data analysis, or by consuming matrices as a basis for further analysis. This chapter documents the format of data files that store these matrices and commands for working with them, as well as PSPP's general-purpose facility for matrix operations.

16.1 Matrix Files

A matrix file is an SPSS system file that conforms to the dictionary and case structure described in this section. Procedures that read matrices from files expect them to be in the matrix file format. Procedures that write matrices also use this format.

Text files that contain matrices can be converted to matrix file format. See Section 16.2 [MATRIX DATA], page 224, for a command to read a text file as a matrix file.

A matrix file's dictionary must have the following variables in the specified order:

1. Zero or more numeric split variables. These are included by procedures when `SPLIT FILE` is active. `MATRIX DATA` assigns split variables format F4.0.
2. `ROWTYPE_`, a string variable with width 8. This variable indicates the kind of matrix or vector that a given case represents. The supported row types are listed below.
3. Zero or more numeric factor variables. These are included by procedures that divide data into cells. For within-cell data, factor variables are filled with non-missing values; for pooled data, they are missing. `MATRIX DATA` assigns factor variables format F4.0.
4. `VARNAME_`, a string variable. Matrix data includes one row per continuous variable (see below), naming each continuous variable in order. This column is blank for vector data. `MATRIX DATA` makes `VARNAME_` wide enough for the name of any of the continuous variables, but at least 8 bytes.
5. One or more numeric continuous variables. These are the variables whose data was analyzed to produce the matrices. `MATRIX DATA` assigns continuous variables format F10.4.

Case weights are ignored in matrix files.

Row Types

Matrix files support a fixed set of types of matrix and vector data. The `ROWTYPE_` variable in each case of a matrix file indicates its row type.

The supported matrix row types are listed below. Each type is listed with the keyword that identifies it in `ROWTYPE_`. All supported types of matrices are square, meaning that each matrix must include one row per continuous variable, with the `VARNAME_` variable indicating each continuous variable in turn in the same order as the dictionary.

`CORR` Correlation coefficients.

`COV` Covariance coefficients.

`MAT` General-purpose matrix.

`N_MATRIX` Counts.

`PROX` Proximities matrix.

The supported vector row types are listed below, along with their associated keyword. Vector row types only require a single row, whose `VARNAME_` is blank:

`COUNT` Unweighted counts.

`DFE` Degrees of freedom.

`MEAN` Means.

`MSE` Mean squared errors.

`N` Counts.

`STDDEV` Standard deviations.

Only the row types listed above may appear in matrix files. The `MATRIX DATA` command, however, accepts the additional row types listed below, which it changes into matrix file row types as part of its conversion process:

`N_VECTOR` Synonym for `N`.

`SD` Synonym for `STDDEV`.

`N_SCALAR` Accepts a single number from the `MATRIX DATA` input and writes it as an `N` row with the number replicated across all the continuous variables.

16.2 MATRIX DATA

```
MATRIX DATA
    VARIABLES=variables
    [FILE={'file_name' | INLINE}
    [/FORMAT=[{LIST | FREE}]
        [{UPPER | LOWER | FULL}]
        [{DIAGONAL | NODIAGONAL}]]
    [/SPLIT=split_vars]
    [/FACTORS=factor_vars]
    [/N=n]

The following subcommands are only needed when ROWTYPE_ is not
specified on the VARIABLES subcommand:
    [/CONTENTS={CORR,COUNT,COV,DFE,MAT,MEAN,MSE,
        N_MATRIX,N|N_VECTOR,N_SCALAR,PROX,SD|STDDEV}]
    [/CELLS=n_cells]
```

The `MATRIX DATA` command convert matrices and vectors from text format into the matrix file format (See Section 16.1 [Matrix Files], page 223) for use by procedures that read matrices. It reads a text file or inline data and outputs to the active file, replacing any data already in the active dataset. The matrix file may then be used by other commands directly from the active file, or it may be written to a `.sav` file using the `SAVE` command.

The text data read by `MATRIX DATA` can be delimited by spaces or commas. A plus or minus sign, except immediately following a '`d`' or '`e`', also begins a new value. Optionally, values may be enclosed in single or double quotes.

`MATRIX DATA` can read the types of matrix and vector data supported in matrix files (see [Matrix File Row Types], page 223).

The FILE subcommand specifies the source of the command's input. To read input from a text file, specify its name in quotes. To supply input inline, omit FILE or specify INLINE. Inline data must directly follow MATRIX DATA, inside BEGIN DATA (see Section 8.1 [BEGIN DATA], page 62).

VARIABLES is the only required subcommand. It names the variables present in each input record in the order that they appear. (MATRIX DATA reorders the variables in the matrix file it produces, if needed to fit the matrix file format.) The variable list must include split variables and factor variables, if they are present in the data, in addition to the continuous variables that form matrix rows and columns. It may also include a special variable named ROWTYPE_.

Matrix data may include split variables or factor variables or both. List split variables, if any, on the SPLIT subcommand and factor variables, if any, on the FACTORS subcommand. Split and factor variables must be numeric. Split and factor variables must also be listed on VARIABLES, with one exception: if VARIABLES does not include ROWTYPE_, then SPLIT may name a single variable that is not in VARIABLES (see [MATRIX DATA Example 8], page 229).

The FORMAT subcommand accepts settings to describe the format of the input data:

LIST (default)
FREE
: LIST requires each row to begin at the start of a new input line. FREE allows rows to begin in the middle of a line. Either setting allows a single row to continue across multiple input lines.

LOWER (default)
UPPER
FULL
: With LOWER, only the lower triangle is read from the input data and the upper triangle is mirrored across the main diagonal. UPPER behaves similarly for the upper triangle. FULL reads the entire matrix.

DIAGONAL (default)
NODIAGONAL
: With DIAGONAL, the main diagonal is read from the input data. With NODIAGONAL, which is incompatible with FULL, the main diagonal is not read from the input data but instead set to 1 for correlation matrices and system-missing for others.

The N subcommand is a way to specify the size of the population. It is equivalent to specifying an N vector with the specified value for each split file.

MATRIX DATA supports two different ways to indicate the kinds of matrices and vectors present in the data, depending on whether a variable with the special name ROWTYPE_ is present in VARIABLES. The following subsections explain MATRIX DATA syntax and behavior in each case.

16.2.1 With ROWTYPE_

If VARIABLES includes ROWTYPE_, each case's ROWTYPE_ indicates the type of data contained in the row. See [Matrix File Row Types], page 223, for a list of supported row types.

Example 1: Defaults with ROWTYPE_

This example shows a simple use of MATRIX DATA with ROWTYPE_ plus 8 variables named var01 through var08.

Because ROWTYPE_ is the first variable in VARIABLES, it appears first on each line. The first three lines in the example data have ROWTYPE_ values of 'MEAN', 'SD', and 'N'. These indicate that these lines contain vectors of means, standard deviations, and counts, respectively, for var01 through var08 in order.

The remaining 8 lines have a ROWTYPE_ of 'CORR' which indicates that the values are correlation coefficients. Each of the lines corresponds to a row in the correlation matrix: the first line is for var01, the next line for var02, and so on. The input only contains values for the lower triangle, including the diagonal, since FORMAT=LOWER DIAGONAL is the default.

With ROWTYPE_, the CONTENTS subcommand is optional and the CELLS subcommand may not be used.

```
MATRIX DATA
    VARIABLES=ROWTYPE_ var01 TO var08.
BEGIN DATA.
MEAN  24.3   5.4  69.7  20.1  13.4   2.7  27.9   3.7
SD     5.7   1.5  23.5   5.8   2.8   4.5   5.4   1.5
N       92    92    92    92    92    92    92    92
CORR  1.00
CORR   .18  1.00
CORR  -.22  -.17  1.00
CORR   .36   .31  -.14  1.00
CORR   .27   .16  -.12   .22  1.00
CORR   .33   .15  -.17   .24   .21  1.00
CORR   .50   .29  -.20   .32   .12   .38  1.00
CORR   .17   .29  -.05   .20   .27   .20   .04  1.00
END DATA.
```

Example 2: FORMAT=UPPER NODIAGONAL

This syntax produces the same matrix file as example 1, but it uses FORMAT=UPPER NODIAGONAL to specify the upper triangle and omit the diagonal. Because the matrix's ROWTYPE_ is CORR, PSPP automatically fills in the diagonal with 1.

```
MATRIX DATA
    VARIABLES=ROWTYPE_ var01 TO var08
    /FORMAT=UPPER NODIAGONAL.
BEGIN DATA.
MEAN  24.3   5.4  69.7  20.1  13.4   2.7  27.9   3.7
SD     5.7   1.5  23.5   5.8   2.8   4.5   5.4   1.5
N       92    92    92    92    92    92    92    92
CORR         .17   .50  -.33   .27   .36  -.22   .18
CORR               .29   .29  -.20   .32   .12   .38
CORR                     .05   .20  -.15   .16   .21
CORR                           .20   .32  -.17   .12
CORR                                 .27   .12  -.24
```

```
CORR                                        -.20  -.38
CORR                                               .04
END DATA.
```

Example 3: N subcommand

This syntax uses the N subcommand in place of an N vector. It produces the same matrix file as examples 1 and 2.

```
MATRIX DATA
    VARIABLES=ROWTYPE_ var01 TO var08
    /FORMAT=UPPER NODIAGONAL
    /N 92.
BEGIN DATA.
MEAN  24.3   5.4  69.7  20.1  13.4   2.7  27.9   3.7
SD     5.7   1.5  23.5   5.8   2.8   4.5   5.4   1.5
CORR         .17   .50  -.33   .27   .36  -.22   .18
CORR               .29   .29  -.20   .32   .12   .38
CORR                     .05   .20  -.15   .16   .21
CORR                           .20   .32  -.17   .12
CORR                                 .27   .12  -.24
CORR                                      -.20  -.38
CORR                                             .04
END DATA.
```

Example 4: Split variables

This syntax defines two matrices, using the variable 's1' to distinguish between them. Notice how the order of variables in the input matches their order on VARIABLES. This example also uses FORMAT=FULL.

```
MATRIX DATA
    VARIABLES=s1 ROWTYPE_  var01 TO var04
    /SPLIT=s1
    /FORMAT=FULL.
BEGIN DATA.
0 MEAN 34 35 36 37
0 SD   22 11 55 66
0 N    99 98 99 92
0 CORR  1 .9 .8 .7
0 CORR .9  1 .6 .5
0 CORR .8 .6  1 .4
0 CORR .7 .5 .4  1
1 MEAN 44 45 34 39
1 SD   23 15 51 46
1 N    98 34 87 23
1 CORR  1 .2 .3 .4
1 CORR .2  1 .5 .6
1 CORR .3 .5  1 .7
1 CORR .4 .6 .7  1
```

```
END DATA.
```

Example 5: Factor variables

This syntax defines a matrix file that includes a factor variable ‘f1’. The data includes mean, standard deviation, and count vectors for two values of the factor variable, plus a correlation matrix for pooled data.

```
MATRIX DATA
    VARIABLES=ROWTYPE_ f1 var01 TO var04
    /FACTOR=f1.
BEGIN DATA.
MEAN 0 34 35 36 37
SD   0 22 11 55 66
N    0 99 98 99 92
MEAN 1 44 45 34 39
SD   1 23 15 51 46
N    1 98 34 87 23
CORR .  1
CORR . .9  1
CORR . .8 .6  1
CORR . .7 .5 .4  1
END DATA.
```

16.2.2 Without ROWTYPE_

If VARIABLES does not contain ROWTYPE_, the CONTENTS subcommand defines the row types that appear in the file and their order. If CONTENTS is omitted, CONTENTS=CORR is assumed.

Factor variables without ROWTYPE_ introduce special requirements, illustrated below in Examples 8 and 9.

Example 6: Defaults without ROWTYPE_

This example shows a simple use of MATRIX DATA with 8 variables named var01 through var08, without ROWTYPE_. This yields the same matrix file as Example 1 (see [MATRIX DATA Example 1], page 226).

```
MATRIX DATA
    VARIABLES=var01 TO var08
   /CONTENTS=MEAN SD N CORR.
BEGIN DATA.
24.3   5.4  69.7  20.1  13.4   2.7  27.9   3.7
 5.7   1.5  23.5   5.8   2.8   4.5   5.4   1.5
  92    92    92    92    92    92    92    92
1.00
 .18  1.00
-.22  -.17  1.00
 .36   .31  -.14  1.00
 .27   .16  -.12   .22  1.00
 .33   .15  -.17   .24   .21  1.00
 .50   .29  -.20   .32   .12   .38  1.00
```

```
 .17   .29  -.05   .20   .27   .20   .04  1.00
END DATA.
```

Example 7: Split variables with explicit values

This syntax defines two matrices, using the variable `s1` to distinguish between them. Each line of data begins with `s1`. This yields the same matrix file as Example 4 (see [MATRIX DATA Example 4], page 227).

```
MATRIX DATA
    VARIABLES=s1 var01 TO var04
    /SPLIT=s1
    /FORMAT=FULL
    /CONTENTS=MEAN SD N CORR.
BEGIN DATA.
0 34 35 36 37
0 22 11 55 66
0 99 98 99 92
0  1 .9 .8 .7
0 .9  1 .6 .5
0 .8 .6  1 .4
0 .7 .5 .4  1
1 44 45 34 39
1 23 15 51 46
1 98 34 87 23
1  1 .2 .3 .4
1 .2  1 .5 .6
1 .3 .5  1 .7
1 .4 .6 .7  1
END DATA.
```

Example 8: Split variable with sequential values

Like this previous example, this syntax defines two matrices with split variable `s1`. In this case, though, `s1` is not listed in `VARIABLES`, which means that its value does not appear in the data. Instead, `MATRIX DATA` reads matrix data until the input is exhausted, supplying 1 for the first split, 2 for the second, and so on.

```
MATRIX DATA
    VARIABLES=var01 TO var04
    /SPLIT=s1
    /FORMAT=FULL
    /CONTENTS=MEAN SD N CORR.
BEGIN DATA.
34 35 36 37
22 11 55 66
99 98 99 92
 1 .9 .8 .7
.9  1 .6 .5
.8 .6  1 .4
```

```
.7 .5 .4  1
44 45 34 39
23 15 51 46
98 34 87 23
 1 .2 .3 .4
.2  1 .5 .6
.3 .5  1 .7
.4 .6 .7  1
END DATA.
```

16.2.2.1 Factor variables without ROWTYPE_

Without ROWTYPE_, factor variables introduce two new wrinkles to MATRIX DATA syntax. First, the CELLS subcommand must declare the number of combinations of factor variables present in the data. If there is, for example, one factor variable for which the data contains three values, one would write CELLS=3; if there are two (or more) factor variables for which the data contains five combinations, one would use CELLS=5; and so on.

Second, the CONTENTS subcommand must distinguish within-cell data from pooled data by enclosing within-cell row types in parentheses. When different within-cell row types for a single factor appear in subsequent lines, enclose the row types in a single set of parentheses; when different factors' values for a given within-cell row type appear in subsequent lines, enclose each row type in individual parentheses.

Without ROWTYPE_, input lines for pooled data do not include factor values, not even as missing values, but input lines for within-cell data do.

The following examples aim to clarify this syntax.

Example 9: Factor variables, grouping within-cell records by factor

This syntax defines the same matrix file as Example 5 (see [MATRIX DATA Example 5], page 228), without using ROWTYPE_. It declares CELLS=2 because the data contains two values (0 and 1) for factor variable f1. Within-cell vector row types MEAN, SD, and N are in a single set of parentheses on CONTENTS because they are grouped together in subsequent lines for a single factor value. The data lines with the pooled correlation matrix do not have any factor values.

```
MATRIX DATA
    VARIABLES=f1 var01 TO var04
    /FACTOR=f1
    /CELLS=2
    /CONTENTS=(MEAN SD N) CORR.
BEGIN DATA.
0 34 35 36 37
0 22 11 55 66
0 99 98 99 92
1 44 45 34 39
1 23 15 51 46
1 98 34 87 23
   1
```

```
  .9  1
  .8 .6  1
  .7 .5 .4  1
END DATA.
```

Example 10: Factor variables, grouping within-cell records by row type

This syntax defines the same matrix file as the previous example. The only difference is that the within-cell vector rows are grouped differently: two rows of means (one for each factor), followed by two rows of standard deviations, followed by two rows of counts.

```
MATRIX DATA
    VARIABLES=f1 var01 TO var04
    /FACTOR=f1
    /CELLS=2
    /CONTENTS=(MEAN) (SD) (N) CORR.
BEGIN DATA.
0 34 35 36 37
1 44 45 34 39
0 22 11 55 66
1 23 15 51 46
0 99 98 99 92
1 98 34 87 23
   1
  .9  1
  .8 .6  1
  .7 .5 .4  1
END DATA.
```

16.3 MCONVERT

MCONVERT
  [[MATRIX=]
   [IN({'*'|'*file*'})]
   [OUT({'*'|'*file*'})]]
  [/{REPLACE,APPEND}].

The `MCONVERT` command converts matrix data from a correlation matrix and a vector of standard deviations into a covariance matrix, or vice versa.

By default, `MCONVERT` both reads and writes the active file. Use the `MATRIX` subcommand to specify other files. To read a matrix file, specify its name inside parentheses following `IN`. To write a matrix file, specify its name inside parentheses following `OUT`. Use '`*`' to explicitly specify the active file for input or output.

When `MCONVERT` reads the input, by default it substitutes a correlation matrix and a vector of standard deviations each time it encounters a covariance matrix, and vice versa. Specify `/APPEND` to instead have `MCONVERT` add the other form of data without removing the existing data. Use `/REPLACE` to explicitly request removing the existing data.

The MCONVERT command requires its input to be a matrix file. Use MATRIX DATA to convert text input into matrix file format. See Section 16.2 [MATRIX DATA], page 224, for details.

16.4 MATRIX

```
MATRIX.
...matrix commands...
END MATRIX.
```

The following basic matrix commands are supported:

```
COMPUTE variable[(index[,index])]=expression.
CALL procedure(argument, ...).
PRINT [expression]
    [/FORMAT=format]
    [/TITLE=title]
    [/SPACE={NEWPAGE | n}]
    [{/RLABELS=string... | /RNAMES=expression}]
    [{/CLABELS=string... | /CNAMES=expression}].
```

The following matrix commands offer support for flow control:

```
DO IF expression.
  ...matrix commands...
[ELSE IF expression.
  ...matrix commands...]...
[ELSE
  ...matrix commands...]
END IF.

LOOP [var=first TO last [BY step]] [IF expression].
  ...matrix commands...
END LOOP [IF expression].

BREAK.
```

The following matrix commands support matrix input and output:

```
READ variable[(index[,index])]
   [/FILE=file]
   /FIELD=first TO last [BY width]
   [/FORMAT=format]
   [/SIZE=expression]
   [/MODE={RECTANGULAR | SYMMETRIC}]
   [/REREAD].
WRITE expression
    [/OUTFILE=file]
    /FIELD=first TO last [BY width]
    [/MODE={RECTANGULAR | TRIANGULAR}]
    [/HOLD]
    [/FORMAT=format].
```

```
GET variable[(index[,index])]
   [/FILE={file | *}]
   [/VARIABLES=variable...]
   [/NAMES=expression]
   [/MISSING={ACCEPT | OMIT | number}]
   [/SYSMIS={OMIT | number}].
SAVE expression
    [/OUTFILE={file | *}]
    [/VARIABLES=variable...]
    [/NAMES=expression]
    [/STRINGS=variable...].
MGET [/FILE=file]
    [/TYPE={COV | CORR | MEAN | STDDEV | N | COUNT}].
MSAVE expression
     /TYPE={COV | CORR | MEAN | STDDEV | N | COUNT}
     [/OUTFILE=file]
     [/VARIABLES=variable...]
     [/SNAMES=variable...]
     [/SPLIT=expression]
     [/FNAMES=variable...]
     [/FACTOR=expression].
```

The following matrix commands provide additional support:

```
DISPLAY [{DICTIONARY | STATUS}].
RELEASE variable....
```

`MATRIX` and `END MATRIX` enclose a special PSPP sub-language, called the matrix language. The matrix language does not require an active dataset to be defined and only a few of the matrix language commands work with any datasets that are defined. Each instance of `MATRIX...END MATRIX` is a separate program whose state is independent of any instance, so that variables declared within a matrix program are forgotten at its end.

The matrix language works with matrices, where a *matrix* is a rectangular array of real numbers. An $n \times m$ matrix has n rows and m columns. Some special cases are important: a $n \times 1$ matrix is a *column vector*, a $1 \times n$ is a *row vector*, and a 1×1 matrix is a *scalar*.

The matrix language also has limited support for matrices that contain 8-byte strings instead of numbers. Strings longer than 8 bytes are truncated, and shorter strings are padded with spaces. String matrices are mainly useful for labeling rows and columns when printing numerical matrices with the `MATRIX PRINT` command. Arithmetic operations on string matrices will not produce useful results. The user should not mix strings and numbers within a matrix.

The matrix language does not work with cases. A variable in the matrix language represents a single matrix.

The matrix language does not support missing values.

`MATRIX` is a procedure, so it cannot be enclosed inside `DO IF`, `LOOP`, etc.

Macros may be used within a matrix program, and macros may expand to include entire matrix programs. The `DEFINE` command may not appear within a matrix program. See Section 14.2 [DEFINE], page 135, for more information about macros.

The following sections describe the details of the matrix language: first, the syntax of matrix expressions, then each of the supported commands. The `COMMENT` command (see Section 17.4 [COMMENT], page 260) is also supported.

16.4.1 Matrix Expressions

Many matrix commands use expressions. A matrix expression may use the following operators, listed in descending order of operator precedence. Within a single level, operators associate from left to right.

- Function call `()` and matrix construction `{}`
- Indexing `()`
- Unary `+` and `-`
- Integer sequence `:`
- Exponentiation `**` and `&**`
- Multiplication `*` and `&*`, and division `/` and `&/`
- Addition `+` and subtraction `-`
- Relational `< <= = >= > <>`
- Logical `NOT`
- Logical `AND`
- Logical `OR` and `XOR`

See Section 16.4.2 [Matrix Functions], page 238, for the available matrix functions. The remaining operators are described in more detail below.

Expressions appear in the matrix language in some contexts where there would be ambiguity whether '`/`' is an operator or a separator between subcommands. In these contexts, only the operators with higher precedence than '`/`' are allowed outside parentheses. Later sections call these *restricted expressions*.

16.4.1.1 Matrix Construction Operator {}

Use the `{}` operator to construct matrices. Within the curly braces, commas separate elements within a row and semicolons separate rows. The following examples show a 2×3 matrix, a 1×4 row vector, a 3×1 column vector, and a scalar.

`{1, 2, 3; 4, 5, 6}` $\Rightarrow \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}$

`{3.14, 6.28, 9.24, 12.57}` $\Rightarrow \begin{pmatrix} 3.14 & 6.28 & 9.42 & 12.57 \end{pmatrix}$

`{1.41; 1.73; 2}` $\Rightarrow \begin{pmatrix} 1.41 & 1.73 & 2.00 \end{pmatrix}$

`{5}` $\Rightarrow 5$

Curly braces are not limited to holding numeric literals. They can contain calculations, and they can paste together matrices and vectors in any way as long as the result is rectangular. For example, if '`m`' is matrix `{1, 2; 3, 4}`, '`r`' is row vector `{5, 6}`, and '`c`' is column vector `{7, 8}`, then curly braces can be used as follows:

`{m, c; r, 10}` $\Rightarrow \begin{pmatrix} 1 & 2 & 7 \\ 3 & 4 & 8 \\ 5 & 6 & 10 \end{pmatrix}$

`{c, 2 * c, T(r)}` $\Rightarrow \begin{pmatrix} 7 & 14 & 5 \\ 8 & 16 & 6 \end{pmatrix}$

The final example above uses the transposition function `T`.

16.4.1.2 Integer Sequence Operator ':'

The syntax *`first:last:step`* yields a row vector of consecutive integers from *first* to *last* counting by *step*. The final *`:step`* is optional and defaults to 1 when omitted.

Each of *first*, *last*, and *step* must be a scalar and should be an integer (any fractional part is discarded). Because ':' has a high precedence, operands other than numeric literals must usually be parenthesized.

When *step* is positive (or omitted) and *end* < *start*, or if *step* is negative and *end* > *start*, then the result is an empty matrix. If *step* is 0, then PSPP reports an error.

Here are some examples:

```
1:6                          ⇒  {1, 2, 3, 4, 5, 6}
1:6:2                        ⇒  {1, 3, 5}
-1:-5:-1                     ⇒  {-1, -2, -3, -4, -5}
-1:-5                        ⇒  {}
2:1:0                        ⇒  (error)
```

16.4.1.3 Index Operator ()

The result of the submatrix or indexing operator, written *`m(rindex, cindex)`*, contains the rows of *m* whose indexes are given in vector *rindex* and the columns whose indexes are given in vector *cindex*.

In the simplest case, if *rindex* and *cindex* are both scalars, the result is also a scalar:

```
{10, 20; 30, 40}(1, 1)       ⇒  10
{10, 20; 30, 40}(1, 2)       ⇒  20
{10, 20; 30, 40}(2, 1)       ⇒  30
{10, 20; 30, 40}(2, 2)       ⇒  40
```

If the index arguments have multiple elements, then the result includes multiple rows or columns:

```
{10, 20; 30, 40}(1:2, 1)     ⇒  {10; 30}
{10, 20; 30, 40}(2, 1:2)     ⇒  {30, 40}
{10, 20; 30, 40}(1:2, 1:2)   ⇒  {10, 20; 30, 40}
```

The special argument ':' may stand in for all the rows or columns in the matrix being indexed, like this:

```
{10, 20; 30, 40}(:, 1)       ⇒  {10; 30}
{10, 20; 30, 40}(2, :)       ⇒  {30, 40}
{10, 20; 30, 40}(:, :)       ⇒  {10, 20; 30, 40}
```

The index arguments do not have to be in order, and they may contain repeated values, like this:

```
{10, 20; 30, 40}({2, 1}, 1)  ⇒  {30; 10}
{10, 20; 30, 40}(2, {2; 2; 1})  ⇒  {40, 40, 30}
{10, 20; 30, 40}(2:1:-1, :)  ⇒  {30, 40; 10, 20}
```

When the matrix being indexed is a row or column vector, only a single index argument is needed, like this:

```
{11, 12, 13, 14, 15}(2:4)        ⇒  {12, 13, 14}
{11; 12; 13; 14; 15}(2:4)        ⇒  {12; 13; 14}
```

When an index is not an integer, PSPP discards the fractional part. It is an error for an index to be less than 1 or greater than the number of rows or columns:

```
{11, 12, 13, 14}({2.5, 4.6})     ⇒  {12, 14}
{11; 12; 13; 14}(0)              ⇒  (error)
```

16.4.1.4 Unary Operators

The unary operators take a single operand of any dimensions and operate on each of its elements independently. The unary operators are:

`-` Inverts the sign of each element.

`+` No change.

`NOT` Logical inversion: each positive value becomes 0 and each zero or negative value becomes 1.

Examples:

```
-{1, -2; 3, -4}                  ⇒  {-1, 2; -3, 4}
+{1, -2; 3, -4}                  ⇒  {1, -2; 3, -4}
NOT {1, 0; -1, 1}                ⇒  {0, 1; 1, 0}
```

16.4.1.5 Elementwise Binary Operators

The elementwise binary operators require their operands to be matrices with the same dimensions. Alternatively, if one operand is a scalar, then its value is treated as if it were duplicated to the dimensions of the other operand. The result is a matrix of the same size as the operands, in which each element is the result of the applying the operator to the corresponding elements of the operands.

The elementwise binary operators are listed below.

- The arithmetic operators, for familiar arithmetic operations:

  `+` Addition.

  `-` Subtraction.

  `*` Multiplication, if one operand is a scalar. (Otherwise this is matrix multiplication, described below.)

  `/` or `&/` Division.

  `&*` Multiplication.

  `&**` Exponentiation.

- The relational operators, whose results are 1 when a comparison is true and 0 when it is false:

  `<` or `LT` Less than.

  `<=` or `LE` Less than or equal.

  `=` or `EQ` Equal.

`>` or `GT` Greater than.

`>=` or `GE` Greater than or equal.

`<>` or `~=` or `NE`
Not equal.

- The logical operators, which treat positive operands as true and nonpositive operands as false. They yield 0 for false and 1 for true:

  `AND` True if both operands are true.

  `OR` True if at least one operand is true.

  `XOR` True if exactly one operand is true.

Examples:

```
1 + 2                          ⇒  3
1 + {3; 4}                     ⇒  {4; 5}
{66, 77; 88, 99} + 5           ⇒  {71, 82; 93, 104}
{4, 8; 3, 7} + {1, 0; 5, 2}    ⇒  {5, 8; 8, 9}
{1, 2; 3, 4} < {4, 3; 2, 1}    ⇒  {1, 1; 0, 0}
{1, 3; 2, 4} >= 3              ⇒  {0, 1; 0, 1}
{0, 0; 1, 1} AND {0, 1; 0, 1}  ⇒  {0, 0; 0, 1}
```

16.4.1.6 Matrix Multiplication Operator '*'

If `A` is an $m \times n$ matrix and `B` is an $n \times p$ matrix, then `A*B` is the $m \times p$ matrix multiplication product `C`. PSPP reports an error if the number of columns in `A` differs from the number of rows in `B`.

The `*` operator performs elementwise multiplication (see above) if one of its operands is a scalar.

No built-in operator yields the inverse of matrix multiplication. Instead, multiply by the result of `INV` or `GINV`.

Some examples:

```
{1, 2, 3} * {4; 5; 6}          ⇒  32
{4; 5; 6} * {1, 2, 3}          ⇒  {4,  8, 12;
                                   5, 10, 15;
                                   6, 12, 18}
```

16.4.1.7 Matrix Exponentiation Operator **

The result of `A**B` is defined as follows when `A` is a square matrix and `B` is an integer scalar:

- For `B > 0`, `A**B` is `A*...*A`, where there are `B` 'A's. (PSPP implements this efficiently for large `B`, using exponentiation by squaring.)
- For `B < 0`, `A**B` is `INV(A**(-B))`.
- For `B = 0`, `A**B` is the identity matrix.

PSPP reports an error if `A` is not square or `B` is not an integer.

Examples:

```
{2, 5; 1, 4}**3                ⇒  {48, 165; 33, 114}
{2, 5; 1, 4}**0                ⇒  {1, 0; 0, 1}
10*{4, 7; 2, 6}**-1            ⇒  {6, -7; -2, 4}
```

16.4.2 Matrix Functions

The matrix language support numerous functions in multiple categories. The following subsections document each of the currently supported functions. The first letter of each parameter's name indicate the required argument type:

s A scalar.

n A nonnegative integer scalar. (Non-integers are accepted and silently rounded down to the nearest integer.)

V A row or column vector.

M A matrix.

16.4.2.1 Elementwise Functions

These functions act on each element of their argument independently, like the elementwise operators (see Section 16.4.1.5 [Matrix Elementwise Binary Operators], page 236).

`ABS` (*M*) [Matrix Function]

Takes the absolute value of each element of *M*.

`ABS({-1, 2; -3, 0})` ⇒ `{1, 2; 3, 0}`

`ARSIN` (*M*) [Matrix Function]
`ARTAN` (*M*) [Matrix Function]

Computes the inverse sine or tangent, respectively, of each element in *M*. The results are in radians, between $-\pi/2$ and $+\pi/2$, inclusive.

The value of π can be computed as `4*ARTAN(1)`.

`ARSIN({-1, 0, 1})` ⇒ `{-1.57, 0, 1.57}` (approximately)

`ARTAN({-5, -1, 1, 5})` ⇒ `{-1.37, -.79, .79, 1.37}` (approximately)

`COS` (*M*) [Matrix Function]
`SIN` (*M*) [Matrix Function]

Computes the cosine or sine, respectively, of each element in *M*, which must be in radians.

`COS({0.785, 1.57; 3.14, 1.57 + 3.14})` ⇒ `{.71, 0; -1, 0}` (approximately)

`EXP` (*M*) [Matrix Function]

Computes e^x for each element x in *M*.

`EXP({2, 3; 4, 5})` ⇒ `{7.39, 20.09; 54.6, 148.4}` (approximately)

`LG10` (*M*) [Matrix Function]
`LN` (*M*) [Matrix Function]

Takes the logarithm with base 10 or base e, respectively, of each element in *M*.

`LG10({1, 10, 100, 1000})` ⇒ `{0, 1, 2, 3}`
`LG10(0)` ⇒ (error)

`LN({EXP(1), 1, 2, 3, 4})` ⇒ `{1, 0, .69, 1.1, 1.39}` (approximately)
`LN(0)` ⇒ (error)

MOD (*M*, *s*) [Matrix Function]

Takes each element in *M* modulo nonzero scalar value *s*, that is, the remainder of division by *s*. The sign of the result is the same as the sign of the dividend.

```
MOD({5, 4, 3, 2, 1, 0}, 3) ⇒ {2, 1, 0, 2, 1, 0}
MOD({5, 4, 3, 2, 1, 0}, -3) ⇒ {2, 1, 0, 2, 1, 0}
MOD({-5, -4, -3, -2, -1, 0}, 3) ⇒ {-2, -1, 0, -2, -1, 0}
MOD({-5, -4, -3, -2, -1, 0}, -3) ⇒ {-2, -1, 0, -2, -1, 0}
MOD({5, 4, 3, 2, 1, 0}, 1.5) ⇒ {.5, 1.0, .0, .5, 1.0, .0}
MOD({5, 4, 3, 2, 1, 0}, 0) ⇒ (error)
```

RND (*M*) [Matrix Function]
TRUNC (*M*) [Matrix Function]

Rounds each element of *M* to an integer. RND rounds to the nearest integer, with halves rounded to even integers, and TRUNC rounds toward zero.

```
RND({-1.6, -1.5, -1.4}) ⇒ {-2, -2, -1}
RND({-.6, -.5, -.4}) ⇒ {-1, 0, 0}
RND({.4, .5, .6} ⇒ {0, 0, 1}
RND({1.4, 1.5, 1.6}) ⇒ {1, 2, 2}
```

```
TRUNC({-1.6, -1.5, -1.4}) ⇒ {-1, -1, -1}
TRUNC({-.6, -.5, -.4}) ⇒ {0, 0, 0}
TRUNC({.4, .5, .6} ⇒ {0, 0, 0}
TRUNC({1.4, 1.5, 1.6}) ⇒ {1, 1, 1}
```

SQRT (*M*) [Matrix Function]

Takes the square root of each element of *M*, which must not be negative.

```
SQRT({0, 1, 2, 4, 9, 81}) ⇒ {0, 1, 1.41, 2, 3, 9} (approximately)
SQRT(-1) ⇒ (error)
```

16.4.2.2 Logical Functions

ALL (*M*) [Matrix Function]

Returns a scalar with value 1 if all of the elements in *M* are nonzero, or 0 if at least one element is zero.

```
ALL({1, 2, 3} < {2, 3, 4}) ⇒ 1
ALL({2, 2, 3} < {2, 3, 4}) ⇒ 0
ALL({2, 3, 3} < {2, 3, 4}) ⇒ 0
ALL({2, 3, 4} < {2, 3, 4}) ⇒ 0
```

ANY (*M*) [Matrix Function]

Returns a scalar with value 1 if any of the elements in *M* is nonzero, or 0 if all of them are zero.

```
ANY({1, 2, 3} < {2, 3, 4}) ⇒ 1
ANY({2, 2, 3} < {2, 3, 4}) ⇒ 1
ANY({2, 3, 3} < {2, 3, 4}) ⇒ 1
ANY({2, 3, 4} < {2, 3, 4}) ⇒ 0
```

16.4.2.3 Matrix Construction Functions

BLOCK (*M1*, . . . , *Mn*) [Matrix Function]

Returns a block diagonal matrix with as many rows as the sum of its arguments' row counts and as many columns as the sum of their columns. Each argument matrix is placed along the main diagonal of the result, and all other elements are zero.

```
BLOCK({1, 2; 3, 4}, 5, {7; 8; 9}, {10, 11}) ⇒
   1   2   0   0   0   0
   3   4   0   0   0   0
   0   0   5   0   0   0
   0   0   0   7   0   0
   0   0   0   8   0   0
   0   0   0   9   0   0
   0   0   0   0  10  11
```

IDENT (*n*) [Matrix Function]

IDENT (*nr*, *nc*) [Matrix Function]

Returns an identity matrix, whose main diagonal elements are one and whose other elements are zero. The returned matrix has n rows and columns or nr rows and nc columns, respectively.

```
IDENT(1) ⇒ 1
IDENT(2) ⇒
  1  0
  0  1
IDENT(3, 5) ⇒
  1  0  0  0  0
  0  1  0  0  0
  0  0  1  0  0
IDENT(5, 3) ⇒
  1  0  0
  0  1  0
  0  0  1
  0  0  0
  0  0  0
```

MAGIC (*n*) [Matrix Function]

Returns an $n \times n$ matrix that contains each of the integers $1 \ldots n$ once, in which each column, each row, and each diagonal sums to $n(n^2 + 1)/2$. There are many magic squares with given dimensions, but this function always returns the same one for a given value of n.

```
MAGIC(3) ⇒ {8, 1, 6; 3, 5, 7; 4, 9, 2}
MAGIC(4) ⇒ {1, 5, 12, 16; 15, 11, 6, 2; 14, 8, 9, 3; 4, 10, 7, 13}
```

MAKE (*nr*, *nc*, *s*) [Matrix Function]

Returns an $nr \times nc$ matrix whose elements are all s.

```
MAKE(1, 2, 3) ⇒ {3, 3}
MAKE(2, 1, 4) ⇒ {4; 4}
MAKE(2, 3, 5) ⇒ {5, 5, 5; 5, 5, 5}
```

MDIAG (*V*) [Matrix Function]

Given n-element vector V, returns a $n \times n$ matrix whose main diagonal is copied from V. The other elements in the returned vector are zero.

Use CALL SETDIAG (see [CALL SETDIAG], page 248) to replace the main diagonal of a matrix in-place.

```
MDIAG({1, 2, 3, 4}) ⇒
  1  0  0  0
  0  2  0  0
  0  0  3  0
  0  0  0  4
```

RESHAPE (*M*, *nr*, *nc*) [Matrix Function]

Returns an $nr \times nc$ matrix whose elements come from M, which must have the same number of elements as the new matrix, copying elements from M to the new matrix row by row.

```
RESHAPE(1:12, 1, 12) ⇒
   1   2   3   4   5   6   7   8   9  10  11  12
RESHAPE(1:12, 2, 6) ⇒
   1   2   3   4   5   6
   7   8   9  10  11  12
RESHAPE(1:12, 3, 4) ⇒
   1   2   3   4
   5   6   7   8
   9  10  11  12
RESHAPE(1:12, 4, 3) ⇒
   1   2   3
   4   5   6
   7   8   9
  10  11  12
```

T (*M*) [Matrix Function]

TRANSPOS (*M*) [Matrix Function]

Returns M with rows exchanged for columns.

```
T({1, 2, 3}) ⇒ {1; 2; 3}
T({1; 2; 3}) ⇒ {1, 2, 3}
```

UNIFORM (*nr*, *nc*) [Matrix Function]

Returns a $nr \times nc$ matrix in which each element is randomly chosen from a uniform distribution of real numbers between 0 and 1. Random number generation honors the current seed setting (see [SET SEED], page 269).

The following example shows one possible output, but of course every result will be different (given different seeds):

```
UNIFORM(4, 5)*10 ⇒
  7.71  2.99   .21  4.95  6.34
  4.43  7.49  8.32  4.99  5.83
  2.25   .25  1.98  7.09  7.61
  2.66  1.69  2.64   .88  1.50
```

16.4.2.4 Minimum, Maximum, and Sum Functions

CMIN (*M*) [Matrix Function]
CMAX (*M*) [Matrix Function]
CSUM (*M*) [Matrix Function]
CSSQ (*M*) [Matrix Function]

Returns a row vector with the same number of columns as *M*, in which each element is the minimum, maximum, sum, or sum of squares, respectively, of the elements in the same column of *M*.

```
CMIN({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ {1, 2, 3}
CMAX({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ {7, 8, 9}
CSUM({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ {12, 15, 18}
CSSQ({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ {66, 93, 126}
```

MMIN (*M*) [Matrix Function]
MMAX (*M*) [Matrix Function]
MSUM (*M*) [Matrix Function]
MSSQ (*M*) [Matrix Function]

Returns the minimum, maximum, sum, or sum of squares, respectively, of the elements of *M*.

```
MMIN({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ 1
MMAX({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ 9
MSUM({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ 45
MSSQ({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ 285
```

RMIN (*M*) [Matrix Function]
RMAX (*M*) [Matrix Function]
RSUM (*M*) [Matrix Function]
RSSQ (*M*) [Matrix Function]

Returns a column vector with the same number of rows as *M*, in which each element is the minimum, maximum, sum, or sum of squares, respectively, of the elements in the same row of *M*.

```
RMIN({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ {1; 4; 7}
RMAX({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ {3; 6; 9}
RSUM({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ {6; 15; 24}
RSSQ({1, 2, 3; 4, 5, 6; 7, 8, 9} ⇒ {14; 77; 194}
```

SSCP (*M*) [Matrix Function]

Returns $M^T \times M$.

```
SSCP({1, 2, 3; 4, 5, 6}) ⇒ {17, 22, 27; 22, 29, 36; 27, 36, 45}
```

TRACE (*M*) [Matrix Function]

Returns the sum of the elements along *M*'s main diagonal, equivalent to `MSUM(DIAG(M))`.

```
TRACE(MDIAG(1:5)) ⇒ 15
```

16.4.2.5 Matrix Property Functions

`NROW` (*M*) [Matrix Function]
`NCOL` (*M*) [Matrix Function]

Returns the number of row or columns, respectively, in *M*.

```
NROW({1, 0; -2, -3; 3, 3}) ⇒ 3
NROW(1:5) ⇒ 1

NCOL({1, 0; -2, -3; 3, 3}) ⇒ 2
NCOL(1:5) ⇒ 5
```

`DIAG` (*M*) [Matrix Function]

Returns a column vector containing a copy of *M*'s main diagonal. The vector's length is the lesser of `NCOL(M)` and `NROW(M)`.

```
DIAG({1, 0; -2, -3; 3, 3}) ⇒ {1; -3}
```

16.4.2.6 Matrix Rank Ordering Functions

The `GRADE` and `RANK` functions each take a matrix M and return a matrix r with the same dimensions. Each element in r ranges between 1 and the number of elements n in M, inclusive. When the elements in M all have unique values, both of these functions yield the same results: the smallest element in M corresponds to value 1 in r, the next smallest to 2, and so on, up to the largest to n. When multiple elements in M have the same value, these functions use different rules for handling the ties.

`GRADE` (*M*) [Matrix Function]

Returns a ranking of *M*, turning duplicate values into sequential ranks. The returned matrix always contains each of the integers 1 through the number of elements in the matrix exactly once.

```
GRADE({1, 0, 3; 3, 1, 2; 3, 0, 5}) ⇒ {3, 1, 6; 7, 4, 5; 8, 2, 9}
```

`RNKORDER` (*M*) [Matrix Function]

Returns a ranking of *M*, turning duplicate values into the mean of their sequential ranks.

```
RNKORDER({1, 0, 3; 3, 1, 2; 3, 0, 5})
 ⇒ {3.5, 1.5, 7; 7, 3.5, 5; 7, 1.5, 9}
```

One may use `GRADE` to sort a vector:

```
COMPUTE v(GRADE(v))=v.   /* Sort v in ascending order.
COMPUTE v(GRADE(-v))=v.  /* Sort v in descending order.
```

16.4.2.7 Matrix Algebra Functions

`CHOL` (*M*) [Matrix Function]

Matrix M must be an $n \times n$ symmetric positive-definite matrix. Returns an $n \times n$ matrix B such that $B^T \times B = M$.

```
CHOL({4, 12, -16; 12, 37, -43; -16, -43, 98}) ⇒
  2  6 -8
  0  1  5
  0  0  3
```

`DESIGN` (*M*) [Matrix Function]

Returns a design matrix for M. The design matrix has the same number of rows as M. Each column c in M, from left to right, yields a group of columns in the output. For each unique value v in c, from top to bottom, add a column to the output in which v becomes 1 and other values become 0.

PSPP issues a warning if a column only contains a single unique value.

```
DESIGN({1; 2; 3}) ⇒ {1, 0, 0; 0, 1, 0; 0, 0, 1}
DESIGN({5; 8; 5}) ⇒ {1, 0; 0, 1; 1, 0}
DESIGN({1, 5; 2, 8; 3, 5})
 ⇒ {1, 0, 0, 1, 0; 0, 1, 0, 0, 1; 0, 0, 1, 1, 0}
DESIGN({5; 5; 5}) ⇒ (warning)
```

`DET` (*M*) [Matrix Function]

Returns the determinant of square matrix M.

```
DET({3, 7; 1, -4}) ⇒ -19
```

`EVAL` (*M*) [Matrix Function]

Returns a column vector containing the eigenvalues of symmetric matrix M, sorted in ascending order.

Use `CALL EIGEN` (see [CALL EIGEN], page 247) to compute eigenvalues and eigenvectors of a matrix.

```
EVAL({2, 0, 0; 0, 3, 4; 0, 4, 9}) ⇒ {11; 2; 1}
```

`GINV` (*M*) [Matrix Function]

Returns the $k \times n$ matrix A that is the *generalized inverse* of $n \times k$ matrix M, defined such that $M \times A \times M = M$ and $A \times M \times A = A$.

```
GINV({1, 2}) ⇒ {.2; .4} (approximately)
{1:9} * GINV(1:9) * {1:9} ⇒ {1:9} (approximately)
```

`GSCH` (*M*) [Matrix Function]

M must be a $n \times m$ matrix, $m \geq n$, with rank n. Returns an $n \times n$ orthonormal basis for M, obtained using the Gram-Schmidt process.

```
GSCH({3, 2; 1, 2}) * SQRT(10) ⇒ {3, -1; 1, 3} (approximately)
```

`INV` (*M*) [Matrix Function]

Returns the $n \times n$ matrix A that is the inverse of $n \times n$ matrix M, defined such that $M \times A = A \times M = I$, where I is the identity matrix. M must not be singular, that is, $\det(M) \neq 0$.

```
INV({4, 7; 2, 6}) ⇒ {.6, -.7; -.2, .4} (approximately)
```

`KRONEKER` (*Ma*, *Mb*) [Matrix Function]

Returns the $pm \times qn$ matrix P that is the *Kroneker product* of $m \times n$ matrix Ma and $p \times q$ matrix Mb. One may view P as the concatenation of multiple $p \times q$ blocks, each of which is the scalar product of Mb by a different element of Ma. For example, when `A` is a 2×2 matrix, `KRONEKER(A, B)` is equivalent to `{A(1,1)*B, A(1,2)*B; A(2,1)*B, A(2,2)*B}`.

```
KRONEKER({1, 2; 3, 4}, {0, 5; 6, 7}) ⇒
```

```
   0   5   0  10
   6   7  12  14
   0  15   0  20
  18  21  24  28
```

RANK (*M*) [Matrix Function]

Returns the rank of matrix M, an integer scalar whose value is the dimension of the vector space spanned by its columns or, equivalently, by its rows.

```
RANK({1, 0, 1; -2, -3, 1; 3, 3, 0}) ⇒ 2
RANK({1, 1, 0, 2; -1, -1, 0, -2}) ⇒ 1
RANK({1, -1; 1, -1; 0, 0; 2, -2}) ⇒ 1
RANK({1, 2, 1; -2, -3, 1; 3, 5, 0}) ⇒ 2
RANK({1, 0, 2; 2, 1, 0; 3, 2, 1}) ⇒ 3
```

SOLVE (*Ma*, *Mb*) [Matrix Function]

Ma must be an $n \times n$ matrix, with $\det(Ma) \neq 0$, and Mb an $n \times k$ matrix. Returns an $n \times k$ matrix X such that $Ma \times X = Mb$.

All of the following examples show approximate results:

```
SOLVE({2, 3; 4, 9}, {6, 2; 15, 5}) ⇒
   1.50    .50
   1.00    .33
SOLVE({1, 3, -2; 3, 5, 6; 2, 4, 3}, {5; 7; 8}) ⇒
 -15.00
   8.00
   2.00
SOLVE({2, 1, -1; -3, -1, 2; -2, 1, 2}, {8; -11; -3}) ⇒
   2.00
   3.00
  -1.00
```

SVAL (*M*) [Matrix Function]

Given $n \times k$ matrix M, returns a $\min(n, k)$-element column vector containing the singular values of M in descending order.

Use `CALL SVD` (see [CALL SVD], page 248) to compute the full singular value decomposition of a matrix.

```
SVAL({1, 1; 0, 0}) ⇒ {1.41; .00}
SVAL({1, 0, 1; 0, 1, 1; 0, 0, 0}) ⇒ {1.73; 1.00; .00}
SVAL({2, 4; 1, 3; 0, 0; 0, 0}) ⇒ {5.46; .37}
```

SWEEP (*M*, *nk*) [Matrix Function]

Given $r \times c$ matrix M and integer scalar $k = nk$ such that $1 \leq k \leq \min(r, c)$, returns the $r \times c$ sweep matrix A.

If $M_{kk} \neq 0$, then:

$$\begin{aligned}
A_{kk} &= 1/M_{kk}, \\
A_{ik} &= -M_{ik}/M_{kk} \text{ for } i \neq k, \\
A_{kj} &= M_{kj}/M_{kk} \text{ for } j \neq k, \text{ and} \\
A_{ij} &= M_{ij} - M_{ik}M_{kj}/M_{kk} \text{ for } i \neq k \text{ and } j \neq k.
\end{aligned}$$

If $M_{kk} = 0$, then:

$$A_{ik} = A_{ki} = 0 \text{ and}$$
$$A_{ij} = M_{ij}, \text{ for } i \neq k \text{ and } j \neq k.$$

Given `M = {0, 1, 2; 3, 4, 5; 6, 7, 8}`, then (approximately):

```
SWEEP(M, 1) ⇒
   .00   .00   .00
   .00  4.00  5.00
   .00  7.00  8.00
SWEEP(M, 2) ⇒
  -.75  -.25   .75
   .75   .25  1.25
   .75 -1.75  -.75
SWEEP(M, 3) ⇒
 -1.50  -.75  -.25
  -.75  -.38  -.63
   .75   .88   .13
```

16.4.2.8 Matrix Statistical Distribution Functions

The matrix language can calculate several functions of standard statistical distributions using the same syntax and semantics as in PSPP transformation expressions. See Section 7.7.10 [Statistical Distribution Functions], page 55, for details.

The matrix language extends the PDF, CDF, SIG, IDF, NPDF, and NCDF functions by allowing the first parameters to each of these functions to be a vector or matrix with any dimensions. In addition, `CDF.BVNOR` and `PDF.BVNOR` allow either or both of their first two parameters to be vectors or matrices; if both are non-scalar then they must have the same dimensions. In each case, the result is a matrix or vector with the same dimensions as the input populated with elementwise calculations.

16.4.2.9 EOF Function

This function works with files being used on the `READ` statement.

`EOF (`*`file`*`)` [Matrix Function]

Given a file handle or file name *file*, returns an integer scalar 1 if the last line in the file has been read or 0 if more lines are available. Determining this requires attempting to read another line, which means that `REREAD` on the next `READ` command following `EOF` on the same file will be ineffective.

The `EOF` function gives a matrix program the flexibility to read a file with text data without knowing the length of the file in advance. For example, the following program will read all the lines of data in `data.txt`, each consisting of three numbers, as rows in matrix `data`:

```
MATRIX.
COMPUTE data={}.
LOOP IF NOT EOF('data.txt').
  READ row/FILE='data.txt'/FIELD=1 TO 1000/SIZE={1,3}.
  COMPUTE data={data; row}.
```

```
END LOOP.
PRINT data.
END MATRIX.
```

16.4.3 The COMPUTE Command

COMPUTE *variable*[(*index*[,*index*])]=*expression*.

The COMPUTE command evaluates an expression and assigns the result to a variable or a submatrix of a variable. Assigning to a submatrix uses the same syntax as the index operator (see Section 16.4.1.3 [Matrix Index Operator], page 235).

16.4.4 The CALL Command

A matrix function returns a single result. The CALL command implements procedures, which take a similar syntactic form to functions but yield results by modifying their arguments rather than returning a value.

Output arguments to a CALL procedure must be a single variable name.

The following procedures are implemented via CALL to allow them to return multiple results. For these procedures, the output arguments need not name existing variables; if they do, then their previous values are replaced:

CALL EIGEN(*M*, *evec*, *eval*)

Computes the eigenvalues and eigenvector of symmetric $n \times n$ matrix M. Assigns the eigenvectors of M to the columns of $n \times n$ matrix *evec* and the eigenvalues in descending order to n-element column vector *eval*.

Use the EVAL function (see [EVAL], page 244) to compute just the eigenvalues of a symmetric matrix.

For example, the following matrix language commands:

```
CALL EIGEN({1, 0; 0, 1}, evec, eval).
PRINT evec.
PRINT eval.

CALL EIGEN({3, 2, 4; 2, 0, 2; 4, 2, 3}, evec2, eval2).
PRINT evec2.
PRINT eval2.
```

yield this output:

```
evec
  1  0
  0  1

eval
  1
  1

evec2
  -.6666666667   .0000000000   .7453559925
```

```
  -.3333333333  -.8944271910  -.2981423970
  -.6666666667   .4472135955  -.5962847940

eval2
  8.0000000000
 -1.0000000000
 -1.0000000000
```

`CALL SVD(`*M*`, `*U*`, `*S*`, `*V*`)`

Computes the singular value decomposition of $n \times k$ matrix M, assigning S a $n \times k$ diagonal matrix and to U and V unitary $k \times k$ matrices such that $M = U \times S \times V^T$. The main diagonal of Q contains the singular values of M.

Use the `SVAL` function (see [SVAL], page 245) to compute just the singular values of a matrix.

For example, the following matrix program:

```
CALL SVD({3, 2, 2; 2, 3, -2}, u, s, v).
PRINT (u * s * T(v))/FORMAT F5.1.
```

yields this output:

```
(u * s * T(v))
   3.0   2.0   2.0
   2.0   3.0  -2.0
```

The final procedure is implemented via `CALL` to allow it to modify a matrix instead of returning a modified version. For this procedure, the output argument must name an existing variable.

`CALL SETDIAG(`*M*`, `*V*`)`

Replaces the main diagonal of $n \times p$ matrix M by the contents of k-element vector V. If $k = 1$, so that V is a scalar, replaces all of the diagonal elements of M by V. If $k < \min(n, p)$, only the upper k diagonal elements are replaced; if $k > \min(n, p)$, then the extra elements of V are ignored.

Use the `MDIAG` function (see [MDIAG], page 241) to construct a new matrix with a specified main diagonal.

For example, this matrix program:

```
COMPUTE x={1, 2, 3; 4, 5, 6; 7, 8, 9}.
CALL SETDIAG(x, 10).
PRINT x.
```

outputs the following:

```
x
  10   2   3
   4  10   6
   7   8  10
```

16.4.5 The `PRINT` Command

`PRINT` [*expression*]
  [`/FORMAT=`*format*]

[/TITLE=*title*]
[/SPACE={NEWPAGE | *n*}]
[{/RLABELS=*string*... | /RNAMES=*expression*}]
[{/CLABELS=*string*... | /CNAMES=*expression*}].

The PRINT command is commonly used to display a matrix. It evaluates the restricted *expression*, if present, and outputs it either as text or a pivot table, depending on the setting of MDISPLAY (see [SET MDISPLAY], page 269).

Use the FORMAT subcommand to specify a format, such as F8.2, for displaying the matrix elements. FORMAT is optional for numerical matrices. When it is omitted, PSPP chooses how to format entries automatically using m, the magnitude of the largest-magnitude element in the matrix to be displayed:

1. If $m < 10^{11}$ and the matrix's elements are all integers, PSPP chooses the narrowest F format that fits m plus a sign. For example, if the matrix is {1:10}, then $m = 10$, which fits in 3 columns with room for a sign, the format is F3.0.
2. Otherwise, if $m \geq 10^9$ or $m \leq 10^{-4}$, PSPP scales all of the numbers in the matrix by 10^x, where x is the exponent that would be used to display m in scientific notation. For example, for $m = 5.123 \times 10^{20}$, the scale factor is 10^{20}. PSPP displays the scaled values in format F13.10 and notes the scale factor in the output.
3. Otherwise, PSPP displays the matrix values, without scaling, in format F13.10.

The optional TITLE subcommand specifies a title for the output text or table, as a quoted string. When it is omitted, the syntax of the matrix expression is used as the title.

Use the SPACE subcommand to request extra space above the matrix output. With a numerical argument, it adds the specified number of lines of blank space above the matrix. With NEWPAGE as an argument, it prints the matrix at the top of a new page. The SPACE subcommand has no effect when a matrix is output as a pivot table.

The RLABELS and RNAMES subcommands, which are mutually exclusive, can supply a label to accompany each row in the output. With RLABELS, specify the labels as comma-separated strings or other tokens. With RNAMES, specify a single expression that evaluates to a vector of strings. Either way, if there are more labels than rows, the extra labels are ignored, and if there are more rows than labels, the extra rows are unlabeled. For output to a pivot table with RLABELS, the labels can be any length; otherwise, the labels are truncated to 8 bytes.

The CLABELS and CNAMES subcommands work for labeling columns as RLABELS and RNAMES do for labeling rows.

When the *expression* is omitted, PRINT does not output a matrix. Instead, it outputs only the text specified on TITLE, if any, preceded by any space specified on the SPACE subcommand, if any. Any other subcommands are ignored, and the command acts as if MDISPLAY is set to TEXT regardless of its actual setting.

The following syntax demonstrates two different ways to label the rows and columns of a matrix with PRINT:

```
MATRIX.
COMPUTE m={1, 2, 3; 4, 5, 6; 7, 8, 9}.
PRINT m/RLABELS=a, b, c/CLABELS=x, y, z.
```

```
COMPUTE rlabels={"a", "b", "c"}.
COMPUTE clabels={"x", "y", "z"}.
PRINT m/RNAMES=rlabels/CNAMES=clabels.
END MATRIX.
```

With MDISPLAY=TEXT (the default), this program outputs the following (twice):

```
m
                x        y        z
a               1        2        3
b               4        5        6
c               7        8        9
```

With 'SET MDISPLAY=TABLES.' added above 'MATRIX.', the output becomes the following (twice):

```
    m
+-+-+-+-+
| |x|y|z|
+-+-+-+-+
|a|1|2|3|
|b|4|5|6|
|c|7|8|9|
+-+-+-+-+
```

16.4.6 The DO IF Command

DO IF *expression*.
  . . . *matrix commands* . . .
[ELSE IF *expression*.
  . . . *matrix commands* . . .] . . .
[ELSE
  . . . *matrix commands* . . .]
END IF.

A DO IF command evaluates its expression argument. If the DO IF expression evaluates to true, then PSPP executes the associated commands. Otherwise, PSPP evaluates the expression on each ELSE IF clause (if any) in order, and executes the commands associated with the first one that yields a true value. Finally, if the DO IF and all the ELSE IF expressions all evaluate to false, PSPP executes the commands following the ELSE clause (if any).

Each expression on DO IF and ELSE IF must evaluate to a scalar. Positive scalars are considered to be true, and scalars that are zero or negative are considered to be false.

The following matrix language fragment sets 'b' to the term following 'a' in the Juggler sequence (https://en.wikipedia.org/wiki/Juggler_sequence):

```
DO IF MOD(a, 2) = 0.
  COMPUTE b = TRUNC(a &** (1/2)).
ELSE.
  COMPUTE b = TRUNC(a &** (3/2)).
END IF.
```

16.4.7 The LOOP and BREAK Commands

LOOP [*var*=*first* TO *last* [BY *step*]] [IF *expression*].

```
  ...matrix commands...
END LOOP [IF expression].

BREAK.
```

The LOOP command executes a nested group of matrix commands, called the loop's *body*, repeatedly. It has three optional clauses that control how many times the loop body executes. Regardless of these clauses, the global MXLOOPS setting, which defaults to 40, also limits the number of iterations of a loop. To iterate more times, raise the maximum with SET MXLOOPS outside of the MATRIX command (see [SET MXLOOPS], page 268).

The optional index clause causes *var* to be assigned successive values on each trip through the loop: first *first*, then *first* + *step*, then *first* + 2 × *step*, and so on. The loop ends when *var* > *last*, for positive *step*, or *var* < *last*, for negative *step*. If *step* is not specified, it defaults to 1. All the index clause expressions must evaluate to scalars, and non-integers are rounded toward zero. If *step* evaluates as zero (or rounds to zero), then the loop body never executes.

The optional IF on LOOP is evaluated before each iteration through the loop body. If its expression, which must evaluate to a scalar, is zero or negative, then the loop terminates without executing the loop body.

The optional IF on END LOOP is evaluated after each iteration through the loop body. If its expression, which must evaluate to a scalar, is zero or negative, then the loop terminates.

The following computes and prints $l(n)$, whose value is the number of steps in the Juggler sequence (https://en.wikipedia.org/wiki/Juggler_sequence) for n, for n from 2 to 10 inclusive:

```
COMPUTE l = {}.
LOOP n = 2 TO 10.
  COMPUTE a = n.
  LOOP i = 1 TO 100.
    DO IF MOD(a, 2) = 0.
      COMPUTE a = TRUNC(a &** (1/2)).
    ELSE.
      COMPUTE a = TRUNC(a &** (3/2)).
    END IF.
  END LOOP IF a = 1.
  COMPUTE l = {l; i}.
END LOOP.
PRINT l.
```

16.4.7.1 The BREAK Command

The BREAK command may be used inside a loop body, ordinarily within a DO IF command. If it is executed, then the loop terminates immediately, jumping to the command just following END LOOP. When multiple LOOP commands nest, BREAK terminates the innermost loop.

The following example is a revision of the one above that shows how BREAK could substitute for the index and IF clauses on LOOP and END LOOP:

```
COMPUTE l = {}.
```

```
LOOP n = 2 TO 10.
  COMPUTE a = n.
  COMPUTE i = 1.
  LOOP.
    DO IF MOD(a, 2) = 0.
      COMPUTE a = TRUNC(a &** (1/2)).
    ELSE.
      COMPUTE a = TRUNC(a &** (3/2)).
    END IF.
    DO IF a = 1.
      BREAK.
    END IF.
    COMPUTE i = i + 1.
  END LOOP.
  COMPUTE l = {l; i}.
END LOOP.
PRINT l.
```

16.4.8 The READ and WRITE Commands

The READ and WRITE commands perform matrix input and output with text files. They share the following syntax for specifying how data is divided among input lines:

/FIELD=*first* TO *last* [BY *width*]
[/FORMAT=*format*]

Both commands require the FIELD subcommand. It specifies the range of columns, from *first* to *last*, inclusive, that the data occupies on each line of the file. The leftmost column is column 1. The columns must be literal numbers, not expressions. To use entire lines, even if they might be very long, specify a column range such as 1 TO 100000.

The FORMAT subcommand is optional for numerical matrices. For string matrix input and output, specify an A format. In addition to FORMAT, the optional BY specification on FIELD determine the meaning of each text line:

- With neither BY nor FORMAT, the numbers in the text file are in F format separated by spaces or commas. For WRITE, PSPP uses as many digits of precision as needed to accurately represent the numbers in the matrix.
- BY *width* divides the input area into fixed-width fields with the given *width*. The input area must be a multiple of *width* columns wide. Numbers are read or written as F*width*.0 format.
- FORMAT="*count*F" divides the input area into integer *count* equal-width fields per line. The input area must be a multiple of *count* columns wide. Another format type may be substituted for F.
- FORMAT=F*w*[.*d*] divides the input area into fixed-width fields with width *w*. The input area must be a multiple of *w* columns wide. Another format type may be substituted for F. The READ command disregards *d*.
- FORMAT=F specifies format F without indicating a field width. Another format type may be substituted for F. The WRITE command accepts this form, but it has no effect unless BY is also used to specify a field width.

If BY and FORMAT both specify or imply a field width, then they must indicate the same field width.

16.4.8.1 The READ Command

READ *variable*[(*index*[,*index*])]
[/FILE=*file*]
/FIELD=*first* TO *last* [BY *width*]
[/FORMAT=*format*]
[/SIZE=*expression*]
[/MODE={RECTANGULAR | SYMMETRIC}]
[/REREAD].

The READ command reads from a text file into a matrix variable. Specify the target variable just after the command name, either just a variable name to create or replace an entire variable, or a variable name followed by an indexing expression to replace a submatrix of an existing variable.

The FILE subcommand is required in the first READ command that appears within MATRIX. It specifies the text file to be read, either as a file name in quotes or a file handle previously declared on FILE HANDLE (see Section 8.8 [FILE HANDLE], page 68). Later READ commands (in syntax order) use the previous referenced file if FILE is omitted.

The FIELD and FORMAT subcommands specify how input lines are interpreted. FIELD is required, but FORMAT is optional. See Section 16.4.8 [Matrix READ and WRITE Commands], page 252, for details.

The SIZE subcommand is required for reading into an entire variable. Its restricted expression argument should evaluate to a 2-element vector {*n*, *m*} or {*n*; *m*}, which indicates a $n \times m$ matrix destination. A scalar n is also allowed and indicates a $n \times 1$ column vector destination. When the destination is a submatrix, SIZE is optional, and if it is present then it must match the size of the submatrix.

By default, or with MODE=RECTANGULAR, the command reads an entry for every row and column. With MODE=SYMMETRIC, the command reads only the entries on and below the matrix's main diagonal, and copies the entries above the main diagonal from the corresponding symmetric entries below it. Only square matrices may use MODE=SYMMETRIC.

Ordinarily, each READ command starts from a new line in the text file. Specify the REREAD subcommand to instead start from the last line read by the previous READ command. This has no effect for the first READ command to read from a particular file. It is also ineffective just after a command that uses the EOF matrix function (see [EOF Matrix Function], page 246) on a particular file, because EOF has to try to read the next line from the file to determine whether the file contains more input.

Example 1: Basic Use

The following matrix program reads the same matrix {1, 2, 4; 2, 3, 5; 4, 5, 6} into matrix variables v, w, and x:

```
READ v /FILE='input.txt' /FIELD=1 TO 100 /SIZE={3, 3}.
READ w /FIELD=1 TO 100 /SIZE={3; 3} /MODE=SYMMETRIC.
READ x /FIELD=1 TO 100 BY 1/SIZE={3, 3} /MODE=SYMMETRIC.
```

given that `input.txt` contains the following:

```
1, 2, 4
2, 3, 5
4, 5, 6
1
2 3
4 5 6
1
23
456
```

The `READ` command will read as many lines of input as needed for a particular row, so it's also acceptable to break any of the lines above into multiple lines. For example, the first line `1, 2, 4` could be written with a line break following either or both commas.

Example 2: Reading into a Submatrix

The following reads a 5×5 matrix from `input2.txt`, reversing the order of the rows:

```
COMPUTE m = MAKE(5, 5, 0).
LOOP r = 5 TO 1 BY -1.
  READ m(r, :) /FILE='input2.txt' /FIELD=1 TO 100.
END LOOP.
```

Example 3: Using `REREAD`

Suppose each of the 5 lines in a file `input3.txt` starts with an integer *count* followed by *count* numbers, e.g.:

```
1 5
3 1 2 3
5 6 -1 2 5 1
2 8 9
3 1 3 2
```

Then, the following reads this file into a matrix `m`:

```
COMPUTE m = MAKE(5, 5, 0).
LOOP i = 1 TO 5.
  READ count /FILE='input3.txt' /FIELD=1 TO 1 /SIZE=1.
  READ m(i, 1:count) /FIELD=3 TO 100 /REREAD.
END LOOP.
```

16.4.8.2 The `WRITE` Command

`WRITE` *expression*
  [`/OUTFILE=`*file*]
  `/FIELD=`*first* `TO` *last* [`BY` *width*]
  [`/FORMAT=`*format*]
  [`/MODE={RECTANGULAR | TRIANGULAR}`]
  [`/HOLD`].

The `WRITE` command evaluates *expression* and writes its value to a text file in a specified format. Write the expression to evaluate just after the command name.

The OUTFILE subcommand is required in the first WRITE command that appears within MATRIX. It specifies the text file to be written, either as a file name in quotes or a file handle previously declared on FILE HANDLE (see Section 8.8 [FILE HANDLE], page 68). Later WRITE commands (in syntax order) use the previous referenced file if FILE is omitted.

The FIELD and FORMAT subcommands specify how output lines are formed. FIELD is required, but FORMAT is optional. See Section 16.4.8 [Matrix READ and WRITE Commands], page 252, for details.

By default, or with MODE=RECTANGULAR, the command writes an entry for every row and column. With MODE=TRIANGULAR, the command writes only the entries on and below the matrix's main diagonal. Entries above the diagonal are not written. Only square matrices may be written with MODE=TRIANGULAR.

Ordinarily, each WRITE command writes complete lines to the output file. With HOLD, the final line written by WRITE will be held back for the next WRITE command to augment. This can be useful to write more than one matrix on a single output line.

Example 1: Basic Usage

This matrix program:

```
WRITE {1, 2; 3, 4} /OUTFILE='matrix.txt' /FIELD=1 TO 80.
```

writes the following to matrix.txt:

```
1 2
3 4
```

Example 2: Triangular Matrix

This matrix program:

```
WRITE MAGIC(5) /OUTFILE='matrix.txt' /FIELD=1 TO 80 BY 5 /MODE=TRIANGULAR.
```

writes the following to matrix.txt:

```
17
23    5
 4    6   13
10   12   19   21
11   18   25    2    9
```

16.4.9 The GET Command

GET *variable*[(*index*[,*index*])]
[/FILE={*file* | *}]
[/VARIABLES=*variable*...]
[/NAMES=*variable*]
[/MISSING={ACCEPT | OMIT | *number*}]
[/SYSMIS={OMIT | *number*}].

The READ command reads numeric data from an SPSS system file, SPSS/PC+ system file, or SPSS portable file into a matrix variable or submatrix:

- To read data into a variable, specify just its name following GET. The variable need not already exist; if it does, it is replaced. The variable will have as many columns as there are variables specified on the VARIABLES subcommand and as many rows as there are cases in the input file.

- To read data into a submatrix, specify the name of an existing variable, followed by an indexing expression, just after GET. The submatrix must have as many columns as variables specified on VARIABLES and as many rows as cases in the input file.

Specify the name or handle of the file to be read on FILE. Use '*', or simply omit the FILE subcommand, to read from the active file. Reading from the active file is only permitted if it was already defined outside MATRIX.

List the variables to be read as columns in the matrix on the VARIABLES subcommand. The list can use TO for collections of variables or ALL for all variables. If VARIABLES is omitted, all variables are read. Only numeric variables may be read.

If a variable is named on NAMES, then the names of the variables read as data columns are stored in a string vector within the given name, replacing any existing matrix variable with that name. Variable names are truncated to 8 bytes.

The MISSING and SYSMIS subcommands control the treatment of missing values in the input file. By default, any user- or system-missing data in the variables being read from the input causes an error that prevents GET from executing. To accept missing values, specify one of the following settings on MISSING:

ACCEPT Accept user-missing values with no change.

By default, system-missing values still yield an error. Use the SYSMIS subcommand to change this treatment:

OMIT Skip any case that contains a system-missing value.

number Recode the system-missing value to *number*.

OMIT Skip any case that contains any user- or system-missing value.

number Recode all user- and system-missing values to *number*.

The SYSMIS subcommand has an effect only with MISSING=ACCEPT.

16.4.10 The SAVE Command

SAVE *expression*
[/OUTFILE={*file* | *}]
[/VARIABLES=*variable*...]
[/NAMES=*expression*]
[/STRINGS=*variable*...].

The SAVE matrix command evaluates *expression* and writes the resulting matrix to an SPSS system file. In the system file, each matrix row becomes a case and each column becomes a variable.

Specify the name or handle of the SPSS system file on the OUTFILE subcommand, or '*' to write the output as the new active file. The OUTFILE subcommand is required on the first SAVE command, in syntax order, within MATRIX. For SAVE commands after the first, the default output file is the same as the previous.

When multiple SAVE commands write to one destination within a single MATRIX, the later commands append to the same output file. All the matrices written to the file must have the same number of columns. The VARIABLES, NAMES, and STRINGS subcommands are honored only for the first SAVE command that writes to a given file.

By default, SAVE names the variables in the output file COL1 through COL*n*. Use VARIABLES or NAMES to give the variables meaningful names. The VARIABLES subcommand accepts a comma-separated list of variable names. Its alternative, NAMES, instead accepts an expression that must evaluate to a row or column string vector of names. The number of names need not exactly match the number of columns in the matrix to be written: extra names are ignored; extra columns use default names.

By default, SAVE assumes that the matrix to be written is all numeric. To write string columns, specify a comma-separated list of the string columns' variable names on STRINGS.

16.4.11 The MGET Command

MGET [/FILE=*file*]
[/TYPE={COV | CORR | MEAN | STDDEV | N | COUNT}].

The MGET command reads the data from a matrix file (see Section 16.1 [Matrix Files], page 223) into matrix variables.

All of MGET's subcommands are optional. Specify the name or handle of the matrix file to be read on the FILE subcommand; if it is omitted, then the command reads the active file.

By default, MGET reads all of the data from the matrix file. Specify a space-delimited list of matrix types on TYPE to limit the kinds of data to the one specified:

COV Covariance matrix.

CORR Correlation coefficient matrix.

MEAN Vector of means.

STDDEV Vector of standard deviations.

N Vector of case counts.

COUNT Vector of counts.

MGET reads the entire matrix file and automatically names, creates, and populates matrix variables using its contents. It constructs the name of each variable by concatenating the following:

- A 2-character prefix that identifies the type of the matrix:

  CV Covariance matrix.

  CR Correlation coefficient matrix.

  MN Vector of means.

  SD Vector of standard deviations.

  NC Vector of case counts.

  CN Vector of counts.
- If the matrix file has factor variables, F*n*, where *n* is a number identifying a group of factors: F1 for the first group, F2 for the second, and so on. This part is omitted for pooled data (where the factors all have the system-missing value).
- If the matrix file has split file variables, S*n*, where *n* is a number identifying a split group: S1 for the first group, S2 for the second, and so on.

If MGET chooses the name of an existing variable, it issues a warning and does not change the variable.

16.4.12 The MSAVE Command

```
MSAVE expression
    /TYPE={COV | CORR | MEAN | STDDEV | N | COUNT}
    [/FACTOR=expression]
    [/SPLIT=expression]
    [/OUTFILE=file]
    [/VARIABLES=variable...]
    [/SNAMES=variable...]
    [/FNAMES=variable...].
```

The MSAVE command evaluates the *expression* specified just after the command name, and writes the resulting matrix to a matrix file (see Section 16.1 [Matrix Files], page 223).

The TYPE subcommand is required. It specifies the ROWTYPE_ to write along with this matrix.

The FACTOR and SPLIT subcommands are required on the first MSAVE if and only if the matrix file has factor or split variables, respectively. After that, their values are carried along from one MSAVE command to the next in syntax order as defaults. Each one takes an expression that must evaluate to a vector with the same number of entries as the matrix has factor or split variables, respectively. Each MSAVE only writes data for a single combination of factor and split variables, so many MSAVE commands (or one inside a loop) may be needed to write a complete set.

The remaining MSAVE subcommands define the format of the matrix file. All of the MSAVE commands within a given matrix program write to the same matrix file, so these subcommands are only meaningful on the first MSAVE command within a matrix program. (If they are given again on later MSAVE commands, then they must have the same values as on the first.)

The OUTFILE subcommand specifies the name or handle of the matrix file to be written. Output must go to an external file, not a data set or the active file.

The VARIABLES subcommand specifies a comma-separated list of the names of the continuous variables to be written to the matrix file. The TO keyword can be used to define variables named with consecutive integer suffixes. These names become column names and names that appear in VARNAME_ in the matrix file. ROWTYPE_ and VARNAME_ are not allowed on VARIABLES. If VARIABLES is omitted, then PSPP uses the names COL1, COL2, and so on.

The FNAMES subcommand may be used to supply a comma-separated list of factor variable names. The default names are FAC1, FAC2, and so on.

The SNAMES subcommand can supply a comma-separated list of split variable names. The default names are SPL1, SPL2, and so on.

16.4.13 The DISPLAY Command

```
DISPLAY [{DICTIONARY | STATUS}].
```

The DISPLAY command makes PSPP display a table with the name and dimensions of each matrix variable. The DICTIONARY and STATUS keywords are accepted but have no effect.

16.4.14 The RELEASE Command

RELEASE *variable*. . . .

The RELEASE command accepts a comma-separated list of matrix variable names. It deletes each variable and releases the memory associated with it.

The END MATRIX command releases all matrix variables.

17 Utilities

Commands that don't fit any other category are placed here.

Most of these commands are not affected by commands like `IF` and `LOOP`: they take effect only once, unconditionally, at the time that they are encountered in the input.

17.1 ADD DOCUMENT

ADD DOCUMENT
  'line one' 'line two' . . . 'last line' .

`ADD DOCUMENT` adds one or more lines of descriptive commentary to the active dataset. Documents added in this way are saved to system files. They can be viewed using `SYSFILE INFO` or `DISPLAY DOCUMENTS`. They can be removed from the active dataset with `DROP DOCUMENTS`.

Each line of documentary text must be enclosed in quotation marks, and may not be more than 80 bytes long. See Section 17.5 [DOCUMENT], page 261.

17.2 CACHE

CACHE.

This command is accepted, for compatibility, but it has no effect.

17.3 CD

CD 'new directory' .

`CD` changes the current directory. The new directory becomes that specified by the command.

17.4 COMMENT

Comment commands:
  COMMENT comment text . . . .
  *comment text . . . .

Comments within a line of syntax:
  FREQUENCIES /VARIABLES=v0 v1 v2. /* All our categorical variables.

`COMMENT` is ignored. It is used to provide information to the author and other readers of the PSPP syntax file.

`COMMENT` can extend over any number of lines. It ends at a dot at the end of a line or a blank line. The comment may contain any characters.

PSPP also supports comments within a line of syntax, introduced with '`/*`'. These comments end at the first '`*/`' or at the end of the line, whichever comes first. A line that contains just this kind of comment is considered blank and ends the current command.

17.5 DOCUMENT

DOCUMENT *documentary_text*.

`DOCUMENT` adds one or more lines of descriptive commentary to the active dataset. Documents added in this way are saved to system files. They can be viewed using `SYSFILE INFO` or `DISPLAY DOCUMENTS`. They can be removed from the active dataset with `DROP DOCUMENTS`.

Specify the *documentary text* following the `DOCUMENT` keyword. It is interpreted literally—any quotes or other punctuation marks are included in the file. You can extend the documentary text over as many lines as necessary, including blank lines to separate paragraphs. Lines are truncated at 80 bytes. Don't forget to terminate the command with a dot at the end of a line. See Section 17.1 [ADD DOCUMENT], page 260.

17.6 DISPLAY DOCUMENTS

DISPLAY DOCUMENTS.

`DISPLAY DOCUMENTS` displays the documents in the active dataset. Each document is preceded by a line giving the time and date that it was added. See Section 17.5 [DOCUMENT], page 261.

17.7 DISPLAY FILE LABEL

DISPLAY FILE LABEL.

`DISPLAY FILE LABEL` displays the file label contained in the active dataset, if any. See Section 17.12 [FILE LABEL], page 262.

This command is a PSPP extension.

17.8 DROP DOCUMENTS

DROP DOCUMENTS.

`DROP DOCUMENTS` removes all documents from the active dataset. New documents can be added with `DOCUMENT` (see Section 17.5 [DOCUMENT], page 261).

`DROP DOCUMENTS` changes only the active dataset. It does not modify any system files stored on disk.

17.9 ECHO

ECHO 'arbitrary text' .

Use `ECHO` to write arbitrary text to the output stream. The text should be enclosed in quotation marks following the normal rules for string tokens (see Section 6.1 [Tokens], page 25).

17.10 ERASE

ERASE FILE *file_name*.

`ERASE FILE` deletes a file from the local file system. *file_name* must be quoted. This command cannot be used if the SAFER (see Section 17.20 [SET], page 265) setting is active.

17.11 EXECUTE

EXECUTE.

`EXECUTE` causes the active dataset to be read and all pending transformations to be executed.

17.12 FILE LABEL

FILE LABEL *file_label*.

`FILE LABEL` provides a title for the active dataset. This title is saved into system files and portable files that are created during this PSPP run.

file_label should not be quoted. If quotes are included, they are literally interpreted and become part of the file label.

17.13 FINISH

FINISH.

`FINISH` terminates the current PSPP session and returns control to the operating system.

17.14 HOST

In the syntax below, the square brackets must be included in the command syntax and do not indicate that that their contents are optional.

HOST COMMAND=['*command*'...]
TIMELIMIT=*secs*.

`HOST` executes one or more commands, each provided as a string in the required `COMMAND` subcommand, in the shell of the underlying operating system. PSPP runs each command in a separate shell process and waits for it to finish before running the next one. If a command fails (with a nonzero exit status, or because it is killed by a signal), then PSPP does not run any remaining commands.

PSPP provides `/dev/null` as the shell's standard input. If a process needs to read from stdin, redirect from a file or device, or use a pipe.

PSPP displays the shell's standard output and standard error as PSPP output. Redirect to a file or `/dev/null` or another device if this is not desired.

The following example runs `rsync` to copy a file from a remote server to the local file `data.txt`, writing `rsync`'s own output to `rsync-log.txt`. PSPP displays the command's error output, if any. If `rsync` needs to prompt the user (*e.g.* to obtain a password), the command fails. Only if the `rsync` succeeds, PSPP then runs the `sha512sum` command.

```
HOST COMMAND=['rsync remote:data.txt data.txt > rsync-log.txt'
              'sha512sum -c data.txt.sha512sum].
```

By default, PSPP waits as long as necessary for the series of commands to complete. Use the optional `TIMELIMIT` subcommand to limit the execution time to the specified number of seconds.

PSPP built for mingw does not support all the features of `HOST`.

PSPP rejects this command if the SAFER (see Section 17.20 [SET], page 265) setting is active.

17.15 INCLUDE

INCLUDE [FILE=]'*file_name*' [ENCODING='*encoding*'].

INCLUDE causes the PSPP command processor to read an additional command file as if it were included bodily in the current command file. If errors are encountered in the included file, then command processing stops and no more commands are processed. Include files may be nested to any depth, up to the limit of available memory.

The INSERT command (see Section 17.16 [INSERT], page 263) is a more flexible alternative to INCLUDE. An INCLUDE command acts the same as INSERT with ERROR=STOP CD=NO SYNTAX=BATCH specified.

The optional ENCODING subcommand has the same meaning as with INSERT.

17.16 INSERT

INSERT [FILE=]'*file_name*'
[CD={NO,YES}]
[ERROR={CONTINUE,STOP}]
[SYNTAX={BATCH,INTERACTIVE}]
[ENCODING={LOCALE, '*charset_name*'}].

INSERT is similar to INCLUDE (see Section 17.15 [INCLUDE], page 263) but somewhat more flexible. It causes the command processor to read a file as if it were embedded in the current command file.

If CD=YES is specified, then before including the file, the current directory becomes the directory of the included file. The default setting is 'CD=NO'. Note that this directory remains current until it is changed explicitly (with the CD command, or a subsequent INSERT command with the 'CD=YES' option). It does not revert to its original setting even after the included file is finished processing.

If ERROR=STOP is specified, errors encountered in the inserted file causes processing to immediately cease. Otherwise processing continues at the next command. The default setting is ERROR=CONTINUE.

If SYNTAX=INTERACTIVE is specified then the syntax contained in the included file must conform to interactive syntax conventions. See Section 6.3 [Syntax Variants], page 27. The default setting is SYNTAX=BATCH.

ENCODING optionally specifies the character set used by the included file. Its argument, which is not case-sensitive, must be in one of the following forms:

LOCALE
: The encoding used by the system locale, or as overridden by the SET command (see Section 17.20 [SET], page 265). On GNU/Linux and other Unix-like systems, environment variables, *e.g.* LANG or LC_ALL, determine the system locale.

charset_name
: One of the character set names listed by IANA at http://www.iana.org/assignments/character-sets. Some examples are ASCII (United States), ISO-8859-1 (western Europe), EUC-JP (Japan), and windows-1252 (Windows). Not all systems support all character sets.

`Auto,`*`encoding`*

Automatically detects whether a syntax file is encoded in an Unicode encoding such as UTF-8, UTF-16, or UTF-32. If it is not, then PSPP generally assumes that the file is encoded in *encoding* (an IANA character set name). However, if *encoding* is UTF-8, and the syntax file is not valid UTF-8, PSPP instead assumes that the file is encoded in `windows-1252`.

For best results, *encoding* should be an ASCII-compatible encoding (the most common locale encodings are all ASCII-compatible), because encodings that are not ASCII compatible cannot be automatically distinguished from UTF-8.

`Auto`

`Auto,Locale`

Automatic detection, as above, with the default encoding taken from the system locale or the setting on `SET LOCALE`.

When ENCODING is not specified, the default is taken from the `--syntax-encoding` command option, if it was specified, and otherwise it is `Auto`.

17.17 OUTPUT

OUTPUT MODIFY
  /SELECT TABLES
  /TABLECELLS SELECT = [*class...*]
    FORMAT = *fmt_spec*.

Please note: In the above synopsis the characters '`[`' and '`]`' are literals. They must appear in the syntax to be interpreted.

`OUTPUT` changes the appearance of the tables in which results are printed. In particular, it can be used to set the format and precision to which results are displayed.

After running this command, the default table appearance parameters will have been modified and each new output table generated uses the new parameters.

Following `/TABLECELLS SELECT =` a list of cell classes must appear, enclosed in square brackets. This list determines the classes of values should be selected for modification. Each class can be:

RESIDUAL

Residual values. Default: `F40.2`.

CORRELATION

Correlations. Default: `F40.3`.

PERCENT

Percentages. Default: `PCT40.1`.

SIGNIFICANCE

Significance of tests (p-values). Default: `F40.3`.

COUNT Counts or sums of weights. For a weighted data set, the default is the weight variable's print format. For an unweighted data set, the default is F40.0.

For most other numeric values that appear in tables, `SET FORMAT` may be used to specify the format (see [SET FORMAT], page 267).

The value of *fmt_spec* must be a valid output format (see Section 6.7.4 [Input and Output Formats], page 32). Note that not all possible formats are meaningful for all classes.

17.18 PERMISSIONS

PERMISSIONS
    FILE='*file_name*'
    /PERMISSIONS = {READONLY,WRITEABLE}.

`PERMISSIONS` changes the permissions of a file. There is one mandatory subcommand which specifies the permissions to which the file should be changed. If you set a file's permission to `READONLY`, then the file will become unwritable either by you or anyone else on the system. If you set the permission to `WRITEABLE`, then the file becomes writeable by you; the permissions afforded to others are unchanged. This command cannot be used if the `SAFER` (see Section 17.20 [SET], page 265) setting is active.

17.19 PRESERVE and RESTORE

PRESERVE.
. . .
RESTORE.

`PRESERVE` saves all of the settings that `SET` (see Section 17.20 [SET], page 265) can adjust. A later `RESTORE` command restores those settings.

`PRESERVE` can be nested up to five levels deep.

17.20 SET

SET

(data input)
    /BLANKS={SYSMIS,'.',number}
    /DECIMAL={DOT,COMMA}
    /FORMAT=*fmt_spec*
    /EPOCH={AUTOMATIC,*year*}
    /RIB={NATIVE,MSBFIRST,LSBFIRST,VAX}
    /RRB={NATIVE,ISL,ISB,IDL,IDB,VF,VD,VG,ZS,ZL}

(interaction)
    /MXERRS=*max_errs*
    /MXWARNS=*max_warnings*
    /WORKSPACE=*workspace_size*

(syntax execution)
    /LOCALE='*locale*'
    /MXLOOPS=*max_loops*
    /SEED={RANDOM,*seed_value*}

/UNDEFINED={WARN,NOWARN}
/FUZZBITS=*fuzzbits*
/SCALEMIN=*count*

(data output)
/CC{A,B,C,D,E}={'*npre*,*pre*,*suf*,*nsuf*','*npre*.*pre*.*suf*.*nsuf*'}
/DECIMAL={DOT,COMMA}
/FORMAT=*fmt_spec*
/LEADZERO={ON,OFF}
/MDISPLAY={TEXT,TABLES}
/SMALL=*number*
/SUMMARY={NONE,*comment*}
/WIB={NATIVE,MSBFIRST,LSBFIRST,VAX}
/WRB={NATIVE,ISL,ISB,IDL,IDB,VF,VD,VG,ZS,ZL}

(output routing)
/ERRORS={ON,OFF,TERMINAL,LISTING,BOTH,NONE}
/MESSAGES={ON,OFF,TERMINAL,LISTING,BOTH,NONE}
/PRINTBACK={ON,OFF,TERMINAL,LISTING,BOTH,NONE}
/RESULTS={ON,OFF,TERMINAL,LISTING,BOTH,NONE}

(output driver options)
/HEADERS={NO,YES,BLANK}
/LENGTH={NONE,*n_lines*}
/WIDTH={NARROW,WIDTH,*n_characters*}
/TNUMBERS={VALUES,LABELS,BOTH}
/TVARS={NAMES,LABELS,BOTH}
/TLOOK={NONE,*file*}

(logging)
/JOURNAL={ON,OFF} ['*file_name*']

(system files)
/SCOMPRESSION={ON,OFF}

(miscellaneous)
/SAFER=ON
/LOCALE='*string*'

(macros)
/MEXPAND={ON,OFF}
/MPRINT={ON,OFF}
/MITERATE=*number*
/MNEST=*number*

(settings not yet implemented, but accepted and ignored)
/BASETEXTDIRECTION={AUTOMATIC,RIGHTTOLEFT,LEFTTORIGHT}

/BLOCK='*c*'
/BOX={'*xxx*','*xxxxxxxxxxx*'}
/CACHE={ON,OFF}
/CELLSBREAK=*number*
/COMPRESSION={ON,OFF}
/CMPTRANS={ON,OFF}
/HEADER={NO,YES,BLANK}

`SET` allows the user to adjust several parameters relating to PSPP's execution. Since there are many subcommands to this command, its subcommands are examined in groups.

For subcommands that take boolean values, `ON` and `YES` are synonymous, as are `OFF` and `NO`, when used as subcommand values.

The data input subcommands affect the way that data is read from data files. The data input subcommands are

BLANKS This is the value assigned to an item data item that is empty or contains only white space. An argument of SYSMIS or '.' causes the system-missing value to be assigned to null items. This is the default. Any real value may be assigned.

DECIMAL

This value may be set to `DOT` or `COMMA`. Setting it to `DOT` causes the decimal point character to be '`.`' and the grouping character to be '`,`'. Setting it to `COMMA` causes the decimal point character to be '`,`' and the grouping character to be '`.`'. If the setting is `COMMA`, then '`,`' is not treated as a field separator in the `DATA LIST` command (see Section 8.5 [DATA LIST], page 64). The default value is determined from the system locale.

FORMAT Allows the default numeric input/output format to be specified. The default is F8.2. See Section 6.7.4 [Input and Output Formats], page 32.

EPOCH Specifies the range of years used when a 2-digit year is read from a data file or used in a date construction expression (see Section 7.7.8.4 [Date Construction], page 52). If a 4-digit year is specified for the epoch, then 2-digit years are interpreted starting from that year, known as the epoch. If `AUTOMATIC` (the default) is specified, then the epoch begins 69 years before the current date.

RIB

PSPP extension to set the byte ordering (endianness) used for reading data in IB or PIB format (see Section 6.7.4.4 [Binary and Hexadecimal Numeric Formats], page 37). In `MSBFIRST` ordering, the most-significant byte appears at the left end of a IB or PIB field. In `LSBFIRST` ordering, the least-significant byte appears at the left end. `VAX` ordering is like `MSBFIRST`, except that each pair of bytes is in reverse order. `NATIVE`, the default, is equivalent to `MSBFIRST` or `LSBFIRST` depending on the native format of the machine running PSPP.

RRB

PSPP extension to set the floating-point format used for reading data in RB format (see Section 6.7.4.4 [Binary and Hexadecimal Numeric Formats], page 37). The possibilities are:

NATIVE The native format of the machine running PSPP. Equivalent to either IDL or IDB.

ISL 32-bit IEEE 754 single-precision floating point, in little-endian byte order.

ISB 32-bit IEEE 754 single-precision floating point, in big-endian byte order.

IDL 64-bit IEEE 754 double-precision floating point, in little-endian byte order.

IDB 64-bit IEEE 754 double-precision floating point, in big-endian byte order.

VF 32-bit VAX F format, in VAX-endian byte order.

VD 64-bit VAX D format, in VAX-endian byte order.

VG 64-bit VAX G format, in VAX-endian byte order.

ZS 32-bit IBM Z architecture short format hexadecimal floating point, in big-endian byte order.

ZL 64-bit IBM Z architecture long format hexadecimal floating point, in big-endian byte order.

Z architecture also supports IEEE 754 floating point. The ZS and ZL formats are only for use with very old input files.

The default is NATIVE.

Interaction subcommands affect the way that PSPP interacts with an online user. The interaction subcommands are

MXERRS The maximum number of errors before PSPP halts processing of the current command file. The default is 50.

MXWARNS
The maximum number of warnings + errors before PSPP halts processing the current command file. The special value of zero means that all warning situations should be ignored. No warnings are issued, except a single initial warning advising you that warnings will not be given. The default value is 100.

Syntax execution subcommands control the way that PSPP commands execute. The syntax execution subcommands are

LOCALE Overrides the system locale for the purpose of reading and writing syntax and data files. The argument should be a locale name in the general form `language_country.encoding`, where *language* and *country* are 2-character language and country abbreviations, respectively, and *encoding* is an IANA character set name. Example locales are `en_US.UTF-8` (UTF-8 encoded English as spoken in the United States) and `ja_JP.EUC-JP` (EUC-JP encoded Japanese as spoken in Japan).

MXLOOPS
The maximum number of iterations for an uncontrolled loop (see Section 14.5 [LOOP], page 148), and for any loop in the matrix language (see Section 16.4.7 [Matrix LOOP and BREAK Commands], page 250). The default *max_loops* is 40.

SEED The initial pseudo-random number seed. Set it to a real number or to RANDOM, to obtain an initial seed from the current time of day.

UNDEFINED
Currently not used.

FUZZBITS
The maximum number of bits of errors in the least-significant places to accept for rounding up a value that is almost halfway between two possibilities for rounding with the RND operator (see Section 7.7.2 [Miscellaneous Mathematics], page 46). The default *fuzzbits* is 6.

SCALEMIN
The minimum number of distinct valid values for PSPP to assume that a variable has a scale measurement level. See [Measurement Level], page 30.

WORKSPACE
The maximum amount of memory (in kilobytes) that PSPP uses to store data being processed. If memory in excess of the workspace size is required, then PSPP starts to use temporary files to store the data. Setting a higher value means that procedures run faster, but may cause other applications to run slower. On platforms without virtual memory management, setting a very large workspace may cause PSPP to abort.

Data output subcommands affect the format of output data. These subcommands are

CCA
CCB
CCC
CCD
CCE

Set up custom currency formats. See Section 6.7.4.2 [Custom Currency Formats], page 35, for details.

DECIMAL
The default `DOT` setting causes the decimal point character to be '`.`'. A setting of `COMMA` causes the decimal point character to be '`,`'.

FORMAT Allows the default numeric input/output format to be specified. The default is F8.2. See Section 6.7.4 [Input and Output Formats], page 32.

LEADZERO
Controls whether numbers with magnitude less than one are displayed with a zero before the decimal point. For example, with `SET LEADZERO=OFF`, which is the default, one-half is shown as 0.5, and with `SET LEADZERO=ON`, it is shown as .5. This setting affects only the `F`, `COMMA`, and `DOT` formats.

MDISPLAY
Controls how the `PRINT` command within `MATRIX...END MATRIX` outputs matrices. With the default `TEXT`, `PRINT` outputs matrices as text. Change this setting to `TABLES` to instead output matrices as pivot tables. See Section 16.4.5 [Matrix PRINT Command], page 248, for more information.

SMALL This controls how PSPP formats small numbers in pivot tables, in cases where PSPP does not otherwise have a well-defined format for the numbers. When such a number has a magnitude less than the value set here, PSPP formats the number in scientific notation; otherwise, it formats it in standard notation. The default is 0.0001. Set a value of 0 to disable scientific notation.

SUMMARY

The `SUMMARY` option sets the comment string which will appear in all generated tables until the next `SUMMARY` is issued. If the special value `NONE` is specified, then no comment will appear. These comment strings can be seen in the graphical user interface by placing the pointer over the table. If *comment* contains any of the following substrings, they will be subsituted as follows:

`\n` A line break.

`)DATE` The current date in the form '`dd-mmm-yyyy`'

`)ADATE` The current date in the form '`mm/dd/yyyy`'

`)SDATE` The current date in the form '`yyyy/mm/dd`'

`)EDATE` The current date in the form '`dd.mm.yyyy`'

`)TIME` The current 12 hour clock time in the form '`hh:mm:ss`'

`)ETIME` The current 24 hour clock time in the form '`hh:mm:ss`'

WIB

PSPP extension to set the byte ordering (endianness) used for writing data in IB or PIB format (see Section 6.7.4.4 [Binary and Hexadecimal Numeric Formats], page 37). In `MSBFIRST` ordering, the most-significant byte appears at the left end of a IB or PIB field. In `LSBFIRST` ordering, the least-significant byte appears at the left end. `VAX` ordering is like `MSBFIRST`, except that each pair of bytes is in reverse order. `NATIVE`, the default, is equivalent to `MSBFIRST` or `LSBFIRST` depending on the native format of the machine running PSPP.

WRB

PSPP extension to set the floating-point format used for writing data in RB format (see Section 6.7.4.4 [Binary and Hexadecimal Numeric Formats], page 37). The choices are the same as `SET RIB`. The default is `NATIVE`.

In the PSPP text-based interface, the output routing subcommands affect where output is sent. The following values are allowed for each of these subcommands:

OFF

NONE Discard this kind of output.

TERMINAL

Write this output to the terminal, but not to listing files and other output devices.

LISTING Write this output to listing files and other output devices, but not to the terminal.

ON
BOTH Write this type of output to all output devices.

These output routing subcommands are:

ERRORS Applies to error and warning messages. The default is `BOTH`.

MESSAGES
Applies to notes. The default is `BOTH`.

PRINTBACK
Determines whether the syntax used for input is printed back as part of the output. The default is `NONE`.

RESULTS Applies to everything not in one of the above categories, such as the results of statistical procedures. The default is `BOTH`.

These subcommands have no effect on output in the PSPP GUI environment.

Output driver option subcommands affect output drivers' settings. These subcommands are

HEADERS
LENGTH
WIDTH
TNUMBERS
The `TNUMBERS` option sets the way in which values are displayed in output tables. The valid settings are `VALUES`, `LABELS` and `BOTH`. If `TNUMBERS` is set to `VALUES`, then all values are displayed with their literal value (which for a numeric value is a number and for a string value an alphanumeric string). If `TNUMBERS` is set to `LABELS`, then values are displayed using their assigned labels if any. (See Section 11.11 [VALUE LABELS], page 101.) If the value has no label, then the literal value is used for display. If `TNUMBERS` is set to `BOTH`, then values are displayed with both their label (if any) and their literal value in parentheses.

TVARS The `TVARS` option sets the way in which variables are displayed in output tables. The valid settings are `NAMES`, `LABELS` and `BOTH`. If `TVARS` is set to `NAMES`, then all variables are displayed using their names. If `TVARS` is set to `LABELS`, then variables are displayed using their label if one has been set. If no label has been set, then the name is used. (See Section 11.7 [VARIABLE LABELS], page 100.) If `TVARS` is set to `BOTH`, then variables are displayed with both their label (if any) and their name in parentheses.

TLOOK The `TLOOK` option sets the style used for subsequent table output. Specifying `NONE` makes PSPP use the default built-in style. Otherwise, specifying *file* makes PSPP search for an `.stt` or `.tlo` file in the same way as specifying `--table-look=`*`file`* the PSPP command line (see Section 3.1 [Main Options], page 3).

These subcommands affect journaling, also called logging. When journaling is enabled, PSPP writes the commands that it executes, plus any errors or other diagostics that it outputs, to a text file, called the *journal* file.

PSPP enables journaling by default when it runs interactively in a terminal or in the PSPPIRE GUI. In the GUI, use Edit → Options... to view or override the default location

or to disable journaling. From syntax, use `SHOW JOURNAL` to see the journal's location and whether it is enabled.

JOURNAL
LOG Specify `ON` to enable the journal and `OFF` to disable it. Specify a file name to set the name of the journal file.

System file subcommands affect the default format of system files produced by PSPP. These subcommands are

SCOMPRESSION
Whether system files created by `SAVE` or `XSAVE` are compressed by default. The default is `ON`.

Security subcommands affect the operations that commands are allowed to perform. The security subcommands are

SAFER Setting this option disables the following operations:

- The `ERASE` command.
- The `HOST` command.
- The `PERMISSIONS` command.
- Pipes (file names beginning or ending with '`|`').

Be aware that this setting does not guarantee safety (commands can still overwrite files, for instance) but it is an improvement. When set, this setting cannot be reset during the same session, for obvious security reasons.

LOCALE This item is used to set the default character encoding. The encoding may be specified either as an encoding name or alias (see `http://www.iana.org/assignments/character-sets`), or as a locale name. If given as a locale name, only the character encoding of the locale is relevant.

System files written by PSPP use this encoding. System files read by PSPP, for which the encoding is unknown, are interpreted using this encoding.

The full list of valid encodings and locale names/alias are operating system dependent. The following are all examples of acceptable syntax on common GNU/Linux systems.

```
SET LOCALE='iso-8859-1'.

SET LOCALE='ru_RU.cp1251'.

SET LOCALE='japanese'.
```

Contrary to intuition, this command does not affect any aspect of the system's locale.

The following subcommands affect the interpretation of macros.

MEXPAND
Controls whether macros are expanded. The default is ON.

MPRINT Controls whether the expansion of macros is included in output. This is separate from whether command syntax in general is included in output. The default is OFF.

MITERATE
: Limits the number of iterations executed in `!DO` loops within macros. This does not affect other language constructs such as `LOOP`. This must be set to a positive integer. The default is 1000.

MNEST
: Limits the number of levels of nested macro expansions. This must be set to a positive integer. The default is 50.

The following subcommands are not yet implemented, but PSPP accepts them and ignores the settings.

BASETEXTDIRECTION
BLOCK
BOX
CACHE
CELLSBREAK
COMPRESSION
CMPTRANS
HEADER

17.21 SHOW

SHOW
[ALL]
[BLANKS]
[CC]
[CCA]
[CCB]
[CCC]
[CCD]
[CCE]
[COPYING]
[DECIMAL]
[DIRECTORY]
[ENVIRONMENT]
[FORMAT]
[FUZZBITS]
[LENGTH]
[MEXPAND]
[MPRINT]
[MITERATE]
[MNEST]
[MXERRS]
[MXLOOPS]
[MXWARNS]
[N]
[SCOMPRESSION]
[SYSTEM]
[TEMPDIR]

[UNDEFINED]
[VERSION]
[WARRANTY]
[WEIGHT]
[WIDTH]

SHOW can be used to display the current state of PSPP's execution parameters. Parameters that can be changed using SET (see Section 17.20 [SET], page 265), can be examined using SHOW using the subcommand with the same name. SHOW supports the following additional subcommands:

ALL Show all settings.

CC Show all custom currency settings (CCA through CCE).

DIRECTORY
Shows the current working directory.

ENVIRONMENT
Shows the operating system details.

N Reports the number of cases in the active dataset. The reported number is not weighted. If no dataset is defined, then 'Unknown' is reported.

SYSTEM Shows information about how PSPP was built. This information is useful in bug reports. See Chapter 22 [Bugs], page 288, for details.

TEMPDIR Shows the path of the directory where temporary files are stored.

VERSION Shows the version of this installation of PSPP.

WARRANTY Show details of the lack of warranty for PSPP.

COPYING / LICENSE
Display the terms of PSPP's copyright licence (see Chapter 2 [License], page 2).

Specifying SHOW without any subcommands is equivalent to SHOW ALL.

17.22 SUBTITLE

SUBTITLE '*subtitle_string*'.
or
SUBTITLE *subtitle_string*.

SUBTITLE provides a subtitle to a particular PSPP run. This subtitle appears at the top of each output page below the title, if headers are enabled on the output device.

Specify a subtitle as a string in quotes. The alternate syntax that did not require quotes is now obsolete. If it is used then the subtitle is converted to all uppercase.

17.23 TITLE

TITLE '*title_string*'.
or
TITLE *title_string*.

`TITLE` provides a title to a particular PSPP run. This title appears at the top of each output page, if headers are enabled on the output device.

Specify a title as a string in quotes. The alternate syntax that did not require quotes is now obsolete. If it is used then the title is converted to all uppercase.

18 Invoking pspp-convert

pspp-convert is a command-line utility accompanying PSPP. It reads an SPSS or SPSS/PC+ system file or SPSS portable file or encrypted SPSS syntax file *input* and writes a copy of it to another *output* in a different format. Synopsis:

```
pspp-convert [options] input output

pspp-convert --help

pspp-convert --version
```

The format of *input* is automatically detected, when possible. The character encoding of old SPSS system files cannot always be guessed correctly, and SPSS/PC+ system files do not include any indication of their encoding. Use -e *encoding* to specify the encoding in this case.

By default, the intended format for *output* is inferred based on its extension:

csv
txt — Comma-separated value. Each value is formatted according to its variable's print format. The first line in the file contains variable names.

sav

sys — SPSS system file.

por — SPSS portable file.

sps — SPSS syntax file. (Only encrypted syntax files may be converted to this format.)

pspp-convert can convert most input formats to most output formats. Encrypted SPSS file formats are exceptions: if the input file is in an encrypted format, then the output file will be the same format (decrypted). To decrypt such a file, specify the encrypted file as *input*. The output will be the equivalent plaintext file. Options for the output format are ignored in this case.

The password for encrypted files can be specified a few different ways. If the password is known, use the -p option (documented below) or allow pspp-convert to prompt for it. If the password is unknown, use the -a and -l options to specify how to search for it, or --password-list to specify a file of passwords to try.

Use -O *format* to override the inferred format or to specify the format for unrecognized extensions.

pspp-convert accepts the following general options:

-O *format*
--output-format=*format*
: Sets the output format, where *format* is one of the extensions listed above, *e.g.*: -O csv. Use --help to list the supported output formats.

-c *maxcases*
--cases=*maxcases*
: By default, all cases are copied from *input* to *output*. Specifying this option to limit the number of cases written to *output* to *maxcases*.

`-e` *charset*
`--encoding=`*charset*
: Overrides the encoding in which character strings in *input* are interpreted. This option is necessary because old SPSS system files, and SPSS/PC+ system files, do not self-identify their encoding.

`-k` *variable...*
`--keep=`*variable...*
: By default, `pspp-convert` includes all the variables from the input file. Use this option to list specific variables to include; any variables not listed will be dropped. The variables in the output file will also be reordered into the given order. The variable list may use `TO` in the same way as in PSPP syntax, *e.g.* if the dictionary contains consecutive variables `a`, `b`, `c`, and `d`, then `--keep='a to d'` will include all of them (and no others).

`-d` *variable...*
`--drop=`*variable...*
: Drops the specified variables from the output.

  When `--keep` and `--drop` are used together, `--keep` is processed first.

`-h`
`--help` Prints a usage message on stdout and exits.

`-v`
`--version`
: Prints version information on stdout and exits.

The following options affect CSV output:

`--recode` By default, `pspp-convert` writes user-missing values to CSV output files as their regular values. With this option, `pspp-convert` recodes them to system-missing values (which are written as a single space).

`--no-var-names`
: By default, `pspp-convert` writes the variable names as the first line of output. With this option, `pspp-convert` omits this line.

`--labels` By default, `pspp-convert` writes variables' values to CSV output files. With this option, `pspp-convert` writes value labels.

`--print-formats`
: By default, `pspp-convert` writes numeric variables as plain numbers. This option makes `pspp-convert` honor variables' print formats.

`--decimal=`*decimal*
: This option sets the character used as a decimal point in output. The default is '`.`'.

`--delimiter=`*delimiter*
: This option sets the character used to separate fields in output. The default is '`,`', unless the decimal point is '`,`', in which case '`;`' is used.

`--qualifier=`*qualifier*
: The option sets the character used to quote fields that contain the delimiter. The default is '`"`'.

The following options specify how to obtain the password for encrypted files:

`-p` *password*
`--password=`*password*

Specifies the password to use to decrypt an encrypted SPSS system file or syntax file. If this option is not specified, `pspp-convert` will prompt interactively for the password as necessary.

Be aware that command-line options, including passwords, may be visible to other users on multiuser systems.

When used with `-a` (or `--password-alphabet`) and `-l` (or `--password-length`), this option specifies the starting point for the search. This can be used to restart a search that was interrupted.

`-a` *alphabet*
`--password-alphabet=`*alphabet*

Specifies the alphabet of symbols over which to search for an encrypted file's password. *alphabet* may include individual characters and ranges delimited by '`-`'. For example, `-a a-z` searches lowercase letters, `-a A-Z0-9` searches uppercase letters and digits, and `-a ' -~'` searches all printable ASCII characters.

`-l` *max-length*
`--password-length=`*max-length*

Specifies the maximum length of the passwords to try.

`--password-list=`*file*

Specifies a file to read containing a list of passwords to try, one per line. If *file* is `-`, reads from stdin.

19 Invoking pspp-output

pspp-output is a command-line utility accompanying PSPP. It supports multiple operations on SPSS viewer or .spv files, here called SPV files. SPSS 16 and later writes SPV files to represent the contents of its output editor.

SPSS 15 and earlier versions instead use .spo files. pspp-output does not support this format.

pspp-options may be invoked in the following ways:

pspp-output detect *file*

pspp-output [*options*] dir *file*

pspp-output [*options*] convert *source destination*

pspp-output [*options*] get-table-look *source destination*

pspp-output [*options*] convert-table-look *source destination*

pspp-output --help

pspp-output --version

Each of these forms is documented separately below. pspp-output also has several undocumented command forms that developers may find useful for debugging.

19.1 The detect Command

pspp-output detect *file*

When *file* is an SPV file, pspp-output exits successfully without outputting anything. When *file* is not an SPV file or some other error occurs, pspp-output prints an error message and exits with a failure indication.

19.2 The dir Command

pspp-output [*options*] dir *file*

Prints on stdout a table of contents for SPV file *file*. By default, this table lists every object in the file, except for hidden objects. See Section 19.6 [Input Selection Options], page 281, for information on the options available to select a subset of objects.

The following additional option for dir is intended mainly for use by PSPP developers:

--member-names
: Also show the names of the Zip members associated with each object.

19.3 The convert Command

pspp-output [*options*] convert *source destination*

Reads SPV file *source* and converts it to another format, writing the output to *destination*.

By default, the intended format for *destination* is inferred based on its extension, in the same way that the pspp program does for its output files. See Chapter 3 [Invoking PSPP], page 3, for details.

See Section 19.6 [Input Selection Options], page 281, for information on the options available to select a subset of objects to include in the output. The following additional options are accepted:

-O format=*format*
: Overrides the format inferred from the output file's extension. Use --help to list the available formats. See Chapter 3 [Invoking PSPP], page 3, for details of the available output formats.

-O *option*=*value*
: Sets an option for the output file format. See Chapter 3 [Invoking PSPP], page 3, for details of the available output options.

-F
--force
: By default, if the source is corrupt or otherwise cannot be processed, the destination is not written. With -F or --force, the destination is written as best it can, even with errors.

--table-look=*file*
: Reads a table style from *file* and applies it to all of the output tables. The file should be a TableLook .stt or .tlo file.

--use-page-setup
: By default, the convert command uses the default page setup (for example, page size and margins) for *destination*, or the one specified with -O options, if any. Specify this option to ignore these sources of page setup in favor of the one embedded in the SPV, if any.

19.4 The get-table-look Command

pspp-output [*options*] get-table-look *source destination*

Reads SPV file *source*, applies any selection options (see Section 19.6 [Input Selection Options], page 281), picks the first table from the selected object, extracts the TableLook from that table, and writes it to *destination* (typically with an .stt extension) in the TableLook XML format.

Use '-' for *source* to instead write the default look to *destination*.

The user may use the TableLook file to change the style of tables in other files, by passing it to the --table-look option on the convert command.

19.5 The convert-table-look Command

pspp-output [*options*] convert-table-look *source destination*

Reads .stt or .tlo file *source*, and writes it back to *destination* (typically with an .stt extension) in the TableLook XML format. This is useful for converting a TableLook .tlo file from SPSS 15 or earlier into the newer .stt format.

19.6 Input Selection Options

The `dir` and `convert` commands, by default, operate on all of the objects in the source SPV file, except for objects that are not visible in the output viewer window. The user may specify these options to select a subset of the input objects. When multiple options are used, only objects that satisfy all of them are selected:

`--select=[^]`*`class...`*

Include only objects of the given *class*; with leading '^', include only objects not in the class. Use commas to separate multiple classes. The supported classes are:

> `charts headings logs models tables texts trees warnings outlineheaders pagetitle notes unknown other`

Use `--select=help` to print this list of classes.

`--commands=[^]`*`command...`*
`--subtypes=[^]`*`subtype...`*
`--labels=[^]`*`label...`*

Include only objects with the specified *command*, *subtype*, or *label*. With a leading '^', include only the objects that do not match. Multiple values may be specified separated by commas. An asterisk at the end of a value acts as a wildcard.

The `--command` option matches command identifiers, case insensitively. All of the objects produced by a single command use the same, unique command identifier. Command identifiers are always in English regardless of the language used for output. They often differ from the command name in PSPP syntax. Use the `pspp-output` program's `dir` command to print command identifiers in particular output.

The `--subtypes` option matches particular tables within a command, case insensitively. Subtypes are not necessarily unique: two commands that produce similar output tables may use the same subtype. Subtypes are always in English and `dir` will print them.

The `--labels` option matches the labels in table output (that is, the table titles). Labels are affected by the output language, variable names and labels, split file settings, and other factors.

`--nth-commands=`*`n...`*

Include only objects from the *n*th command that matches `--command` (or the *n*th command overall if `--command` is not specified), where *n* is 1 for the first command, 2 for the second, and so on.

`--instances=`*`instance...`*

Include the specified *instance* of an object that matches the other criteria within a single command. The *instance* may be a number (1 for the first instance, 2 for the second, and so on) or `last` for the last instance.

`--show-hidden`

Include hidden output objects in the output. By default, they are excluded.

`--or` Separates two sets of selection options. Objects selected by either set of options are included in the output.

The following additional input selection options are intended mainly for use by PSPP developers:

`--errors` Include only objects that cause an error when read. With the `convert` command, this is most useful in conjunction with the `--force` option.

`--members=`*`member...`*
Include only the objects that include a listed Zip file *member*. More than one name may be included, comma-separated. The members in an SPV file may be listed with the `dir` command by adding the `--show-members` option or with the `zipinfo` program included with many operating systems. Error messages that `pspp-output` prints when it reads SPV files also often include member names.

`--member-names`
Displays the name of the Zip member or members associated with each object just above the object itself.

20 Invoking pspp-dump-sav

pspp-dump-sav is a command-line utility accompanying PSPP. It is not installed by default, so it may be missing from your PSPP installation. It reads one or more SPSS system files and prints their contents. The output format is useful for debugging system file readers and writers and for discovering how to interpret unknown or poorly understood records. End users may find the output useful for providing the PSPP developers information about system files that PSPP does not accurately read.

Synopsis:

```
pspp-dump-sav [-d[maxcases] | --data[=maxcases]] file...

pspp-dump-sav --help | -h

pspp-dump-sav --version | -v
```

The following options are accepted:

-d[*maxcases*]
--data[=*maxcases*]
: By default, pspp-dump-sav does not print any of the data in a system file, only the file headers. Specify this option to print the data as well. If *maxcases* is specified, then it limits the number of cases printed.

-h
--help
: Prints a usage message on stdout and exits.

-v
--version
: Prints version information on stdout and exits.

Some errors that prevent files from being interpreted successfully cause pspp-dump-sav to exit without reading any additional files given on the command line.

21 Not Implemented

This chapter lists parts of the PSPP language that are not yet implemented.

`2SLS` Two stage least squares regression

`ACF` Autocorrelation function

`ALSCAL` Multidimensional scaling

`ANACOR` Correspondence analysis

`ANOVA` Factorial analysis of variance

`CASEPLOT` Plot time series

`CASESTOVARS`
Restructure complex data

`CATPCA` Categorical principle components analysis

`CATREG` Categorical regression

`CCF` Time series cross correlation

`CLEAR TRANSFORMATIONS`
Clears transformations from active dataset

`CLUSTER` Hierarchical clustering

`CONJOINT` Analyse full concept data

`CORRESPONDENCE`
Show correspondence

`COXREG` Cox proportional hazards regression

`CREATE` Create time series data

`CSDESCRIPTIVES`
Complex samples descriptives

`CSGLM` Complex samples GLM

`CSLOGISTIC`
Complex samples logistic regression

`CSPLAN` Complex samples design

`CSSELECT` Select complex samples

`CSTABULATE`
Tabulate complex samples

`CURVEFIT` Fit curve to line plot

`DATE` Create time series data

`DETECTANOMALY`
Find unusual cases

`DISCRIMINANT`
: Linear discriminant analysis

`EDIT`
: obsolete

`END FILE TYPE`
: Ends complex data input

`FILE TYPE`
: Complex data input

`FIT`
: Goodness of Fit

`GENLOG`
: Categorical model fitting

`GET TRANSLATE`
: Read other file formats

`GGRAPH`
: Custom defined graphs

`HILOGLINEAR`
: Hierarchical loglinear models

`HOMALS`
: Homogeneity analysis

`IGRAPH`
: Interactive graphs

`INFO`
: Local Documentation

`KEYED DATA LIST`
: Read nonsequential data

`KM`
: Kaplan-Meier

`LOGLINEAR`
: General model fitting

`MANOVA`
: Multivariate analysis of variance

`MAPS`
: Geographical display

`MIXED`
: Mixed linear models

`MODEL CLOSE`
: Close server connection

`MODEL HANDLE`
: Define server connection

`MODEL LIST`
: Show existing models

`MODEL NAME`
: Specify model label

`MULTIPLE CORRESPONDENCE`
: Multiple correspondence analysis

`MULT RESPONSE`
: Multiple response analysis

`MVA` Missing value analysis

`NAIVEBAYES`
Small sample bayesian prediction

`NLR` Non Linear Regression

`NOMREG` Multinomial logistic regression

`NONPAR CORR`
Nonparametric correlation

`NUMBERED`

`OLAP CUBES`
On-line analytical processing

`OMS` Output management

`ORTHOPLAN`
Orthogonal effects design

`OVERALS` Nonlinear canonical correlation

`PACF` Partial autocorrelation

`PARTIAL CORR`
Partial correlation

`PLANCARDS`
Conjoint analysis planning

`PLUM` Estimate ordinal regression models

`POINT` Marker in keyed file

`PPLOT` Plot time series variables

`PREDICT` Specify forecast period

`PREFSCAL` Multidimensional unfolding

`PRINCALS` PCA by alternating least squares

`PROBIT` Probit analysis

`PROCEDURE OUTPUT`
Specify output file

`PROXIMITIES`
Pairwise similarity

`PROXSCAL` Multidimensional scaling of proximity data

`RATIO STATISTICS`
Descriptives of ratios

`READ MODEL`
Read new model

`RECORD TYPE`
: Defines a type of record within FILE TYPE

`REFORMAT` Read obsolete files

`REPEATING DATA`
: Specify multiple cases per input record

`REPORT` Pretty print working file

`RMV` Replace missing values

`SCRIPT` Run script file

`SEASON` Estimate seasonal factors

`SELECTPRED`
: Select predictor variables

`SPCHART` Plot control charts

`SPECTRA` Plot spectral density

`STEMLEAF` Plot stem-and-leaf display

`SUMMARIZE`
: Univariate statistics

`SURVIVAL` Survival analysis

`TDISPLAY` Display active models

`TREE` Create classification tree

`TSAPPLY` Apply time series model

`TSET` Set time sequence variables

`TSHOW` Show time sequence variables

`TSMODEL` Estimate time series model

`TSPLOT` Plot time sequence variables

`TWOSTEP CLUSTER`
: Cluster observations

`UNIANOVA` Univariate analysis

`UNNUMBERED`
: obsolete

`VALIDATEDATA`
: Identify suspicious cases

`VARCOMP` Estimate variance

`VARSTOCASES`
: Restructure complex data

`VERIFY` Report time series

`WLS` Weighted least squares regression

`XGRAPH` High resolution charts

22 Bugs

Occasionally you may encounter a bug in PSPP.

If you believe you have found a bug, please make sure that it really is a bug. Sometimes, what may appear to be a bug, turns out to be a misunderstanding of how to use the program. If you are unsure, ask for advice on the pspp-users mailing list. Information about the mailing list is at `http://lists.gnu.org/mailman/listinfo/pspp-users`.

It is also valuable to try the newest version of PSPP, since the problem may have already been fixed. You can always find the newest version of PSPP by visiting the PSPP website (`https://www.gnu.org/s/pspp`). You might have obtained PSPP from a downstream packager, such as a GNU/Linux distribution; if your downstream package is not up-to-date, please ask the distributor to update to the newest version.

If the problem persists in the up-to-date version, check to see if it has already been reported. Reported issues are listed at `http://savannah.gnu.org/bugs/?group=pspp`. If it has already been reported, you might consider adding a comment with additional information or even just to mention that you are also experiencing the problem, since the PSPP developers are often inclined to work on issues that are important to a large number of users.

For known issues in individual language features, see the relevant section in see Chapter 6 [Language], page 25.

If the problem exists in a recent version and it has not already been reported, then please report it.

22.1 How to report bugs

The best way to send a bug report is using the web page at `http://savannah.gnu.org/bugs/?group=pspp`. Alternatively, bug reports may be sent by email to `bug-gnu-pspp@gnu.org`.

A high-quality bug report allows the developers to understand, reproduce, and ultimately fix the problem. We recommend including the following:

- The version of PSPP in which you encountered the problem. It also often helps to know some information about how PSPP was built.

  With PSPP command syntax, `SHOW SYSTEM.` will output everything we ordinarily need. In the PSPPIRE GUI, Help → System Info produces the same output.
- The operating system and type of computer on which it is running.
- A sample of the syntax which causes the problem or, if it is a user interface problem, the sequence of steps required to reproduce it. Screenshots can be helpful for reporting bugs in the graphical user interface, especially since GUI bugs can arise on some systems but not others, but they do not usually help fixing other kinds of bugs.
- A description of what you think is wrong: What happened that you didn't expect, and what did you expect to happen? Include any error messages that PSPP output.

Here is one example of a bug report that includes all of the elements above:

```
I'm running PSPP on a system where SHOW SYSTEM.  outputs the
following:




                                System Information
      +-------------+-------------------------------------------------------------+
      |Version      |GNU pspp 2.0.1                                               |
      |Host System  |arm-unknown-linux-gnueabihf                                  |
      |Build System |arm-unknown-linux-gnueabihf                                  |
      |Locale       |/usr/share/locale                                            |
      |Directory    |                                                             |
      |Journal File |/build/pspp-2MkWF9/pspp-2.0.1/debian/.debhelper/generated/   |
      |             |_source/home/.local/state/pspp/pspp.jnl                      |
      |Compiler     |15.2.0                                                       |
      |Version      |                                                             |
      +-------------+-------------------------------------------------------------+


The bug I'm seeing is that executing the following syntax:

 DATA LIST FREE /x *.
 BEGIN DATA.
 1 2 3
 END DATA.
 LIST.

results in:

 4
 5
 6

but I think the output should be:

 1
 2
 3
```

The following bug report, on the other hand, does not provide enough information for PSPP developers to understand the problem. This means that the developers cannot identify or fix the problem without additional rounds of questions, which is more work for both the reporter and the developer:

```
I downloaded the latest version of PSPP and entered a sequence of numbers,
but when I analyse them it gives the wrong output.
```

PSPP developers value all users' feedback, but cannot promise an immediate response. The bug reporting is not a consultancy or support service, although you can make private arrangements for such services. Since PSPP is free software, consultants have access to the information they need to provide such support.

For general enquiries or help, please use the pspp-users mailing list (`http://lists.gnu.org/mailman/listinfo/pspp-users`) instead of the bug mailing list or bug tracker.

The PSPP bug tracker and bug reporting mailing list are public. To privately report a security vulnerability in GNU PSPP, please send your report to the closed mailing list `pspp-security@gnu.org`. The PSPP developers will help you assess your report and fix problems prior to public disclosure.

23 Function Index

!

!BLANKS 140
!CONCAT 141
!EVAL 141
!HEAD 141
!INDEX 142
!LENGTH 142
!NULL 142
!QUOTE 142
!SUBSTR 143
!TAIL 141
!UNQUOTE 142
!UPCASE 143

(

(*variable*) 55

A

ABS 46, 238
ACOS 47
ALL 239
ANY 48, 239
ARCOS 47
ARSIN 47, 238
ARTAN 47, 238
ASIN 47
ATAN 47

B

BLOCK 240

C

CDF.BERNOULLI 60
CDF.BETA 56
CDF.BINOM 60
CDF.BVNOR 56
CDF.CAUCHY 57
CDF.CHISQ 57
CDF.EXP 57
CDF.F 57
CDF.GAMMA 57
CDF.GEOM 60
CDF.HYPER 60
CDF.LAPLACE 58
CDF.LNORMAL 58
CDF.LOGISTIC 58
CDF.NEGBIN 60
CDF.NORMAL 58
CDF.PARETO 59
CDF.POISSON 60
CDF.RAYLEIGH 59
CDF.T 59
CDF.T1G 59
CDF.T2G 59
CDF.UNIFORM 59
CDF.WEIBULL 59
CDFNORM 58
CFVAR 49
CHOL 243
CMAX 242
CMIN 242
CONCAT 49
COS 47, 238
CSSQ 242
CSUM 242
CTIME.DAYS 51
CTIME.HOURS 52
CTIME.MINUTES 52
CTIME.SECONDS 52

D

DATE.DMY 52
DATE.MDY 52
DATE.MOYR 52
DATE.QYR 52
DATE.WKYR 52
DATE.YRDAY 53
DATEDIFF 54
DATESUM 54
DESIGN 244
DET 244
DIAG 243

E

EOF 246
EVAL 244
EXP 46, 238

G

GINV 244
GRADE 243
GSCH 244

I

IDENT ... 240
IDF.BETA ... 56
IDF.CAUCHY ... 57
IDF.CHISQ ... 57
IDF.EXP ... 57
IDF.F ... 57
IDF.GAMMA ... 57
IDF.LAPLACE ... 58
IDF.LNORMAL ... 58
IDF.LOGISTIC ... 58
IDF.NORMAL ... 58
IDF.PARETO ... 59
IDF.RAYLEIGH ... 59
IDF.T ... 59
IDF.T1G ... 59
IDF.T2G ... 59
IDF.UNIFORM ... 59
IDF.WEIBULL ... 59
INDEX ... 49
INV ... 244

K

KRONEKER ... 244

L

LAG ... 55
LENGTH ... 49
LG10 ... 46, 238
LN ... 46, 238
LNGAMMA ... 46
LOWER ... 50
LPAD ... 50
LTRIM ... 50

M

MAGIC ... 240
MAKE ... 240
MAX ... 49
MDIAG ... 241
MEAN ... 49
MEDIAN ... 49
MIN ... 49
MISSING ... 47
MMAX ... 242
MMIN ... 242
MOD ... 46, 239
MOD10 ... 46
MSSQ ... 242
MSUM ... 242

N

NCDF.BETA ... 56
NCDF.CHISQ ... 57
NCOL ... 243
NMISS ... 47
NORMAL ... 58
NPDF.BETA ... 56
NROW ... 243
NUMBER ... 50
NVALID ... 48

P

PDF.BERNOULLI ... 60
PDF.BETA ... 56
PDF.BINOM ... 60
PDF.BVNOR ... 56
PDF.CAUCHY ... 57
PDF.EXP ... 57
PDF.F ... 57
PDF.GAMMA ... 57
PDF.GEOM ... 60
PDF.HYPER ... 60
PDF.LANDAU ... 57
PDF.LAPLACE ... 58
PDF.LNORMAL ... 58
PDF.LOG ... 60
PDF.LOGISTIC ... 58
PDF.NEGBIN ... 60
PDF.NORMAL ... 58
PDF.NTAIL ... 58
PDF.PARETO ... 59
PDF.POISSON ... 60
PDF.RAYLEIGH ... 59
PDF.RTAIL ... 59
PDF.T ... 59
PDF.T1G ... 59
PDF.T2G ... 59
PDF.UNIFORM ... 59
PDF.WEIBULL ... 59
PDF.XPOWER ... 57
PROBIT ... 58

R

RANGE ... 48
RANK ... 245
REPLACE ... 50
RESHAPE ... 241
RINDEX ... 49
RMAX ... 242
RMIN ... 242
RND ... 46, 239
RNKORDER ... 243
RPAD ... 50
RSSQ ... 242
RSUM ... 242
RTRIM ... 50

RV.BERNOULLI ... 60
RV.BETA ... 56
RV.BINOM ... 60
RV.CAUCHY ... 57
RV.CHISQ ... 57
RV.EXP ... 57
RV.F ... 57
RV.GAMMA ... 57
RV.GEOM ... 60
RV.HYPER ... 60
RV.LANDAU ... 57
RV.LAPLACE ... 58
RV.LEVY ... 58
RV.LNORMAL ... 58
RV.LOG ... 60
RV.LOGISTIC ... 58
RV.LVSKEW ... 58
RV.NEGBIN ... 60
RV.NORMAL ... 58
RV.NTAIL ... 58
RV.PARETO ... 59
RV.POISSON ... 60
RV.RAYLEIGH ... 59
RV.RTAIL ... 59
RV.T ... 59
RV.UNIFORM ... 59
RV.WEIBULL ... 60
RV.XPOWER ... 57

S

SD ... 49
SIG.CHISQ ... 57
SIG.F ... 57
SIN ... 47, 238
SOLVE ... 245
SQRT ... 46, 239
SSCP ... 242
STRING ... 50
STRUNC ... 50
SUBSTR ... 50, 51
SUM ... 49
SVAL ... 245
SWEEP ... 245
SYSMIS ... 48

T

T ... 241
TAN ... 47
TIME.DAYS ... 51
TIME.HMS ... 51
TRACE ... 242
TRANSPOS ... 241
TRUNC ... 47, 239

U

UNIFORM ... 59, 241
UPCASE ... 51

V

VALUE ... 48
VARIANCE ... 49

X

XDATE.DATE ... 53
XDATE.HOUR ... 53
XDATE.JDAY ... 53
XDATE.MDAY ... 53
XDATE.MINUTE ... 53
XDATE.MONTH ... 53
XDATE.QUARTER ... 53
XDATE.SECOND ... 53
XDATE.TDAY ... 53
XDATE.TIME ... 54
XDATE.WEEK ... 54
XDATE.WKDAY ... 54
XDATE.YEAR ... 54

Y

YRMODA ... 55

24 Command Index

*

* ... 260

A

ADD DOCUMENT ... 260
ADD FILES ... 94
ADD VALUE LABELS ... 101
AGGREGATE ... 107
APPLY DICTIONARY ... 78
AUTORECODE ... 110

B

BEGIN DATA ... 62
BINOMIAL ... 202
BREAK ... 135

C

CACHE ... 260
CD ... 260
CHISQUARE ... 203
Cochran ... 204
COMMENT ... 260
COMPUTE ... 113
CORRELATIONS ... 159
COUNT ... 115
CROSSTABS ... 160
CTABLES ... 166

D

DATA LIST ... 64
DATA LIST FIXED ... 64
DATA LIST FREE ... 67
DATA LIST LIST ... 68
DATAFILE ATTRIBUTE ... 62
DATASET ... 63
DATASET ACTIVATE ... 63
DATASET CLOSE ... 63
DATASET COPY ... 63
DATASET DECLARE ... 63
DATASET DISPLAY ... 64
DATASET NAME ... 63
DEFINE ... 135
DELETE VARIABLES ... 100
DESCRIPTIVES ... 149
DISPLAY ... 97
DISPLAY DOCUMENTS ... 261
DISPLAY FILE LABEL ... 261
DO IF ... 146
DO REPEAT ... 147
DOCUMENT ... 261
DROP DOCUMENTS ... 261

E

ECHO ... 261
END CASE ... 68
END DATA ... 62
END FILE ... 68
END MATRIX ... 232
ERASE ... 261
EXAMINE ... 155
EXECUTE ... 262
EXPORT ... 79

F

FACTOR ... 194
FILE HANDLE ... 68
FILE LABEL ... 262
FILTER ... 127
FINISH ... 262
FLIP ... 118
FORMATS ... 101
FREQUENCIES ... 152
FRIEDMAN ... 205

G

GET ... 14, 79
GET DATA ... 80
GLM ... 197
GRAPH ... 158

H

HOST ... 262

I

IF ... 120
IMPORT ... 86
INCLUDE ... 263
INPUT PROGRAM ... 71
INSERT ... 263

K

K-S ... 205
K-W ... 206
KENDALL ... 205
KOLMOGOROV-SMIRNOV ... 205
KRUSKAL-WALLIS ... 206

L

LEAVE ... 106
LIST ... 13, 74
LOGISTIC REGRESSION ... 197
LOOP ... 148

M

M-W ... 206
MANN-WHITNEY ... 206
MATCH FILES ... 95
Matrix file ... 223
MATRIX ... 232
MATRIX DATA ... 224
MCNEMAR ... 206
MCONVERT ... 231
MEANS ... 199
MEDIAN ... 206
MISSING VALUES ... 102
MRSETS ... 105

N

N OF CASES ... 127
NEW FILE ... 74
NPAR TESTS ... 201
NUMERIC ... 98

O

ONEWAY ... 214
OUTPUT ... 264

P

PERMISSIONS ... 265
PRESERVE ... 265
PRINT ... 74
PRINT EJECT ... 75
PRINT FORMATS ... 100
PRINT SPACE ... 76

Q

QUICK CLUSTER ... 215

R

RANK ... 216
RECODE ... 121
REGRESSION ... 23, 217
RELIABILITY ... 219
RENAME VARIABLES ... 98
REREAD ... 76
RESTORE ... 265
ROC ... 221
RUNS ... 207

S

SAMPLE ... 128
SAVE ... 15, 86
SAVE DATA COLLECTION ... 88
SAVE TRANSLATE ... 88
SELECT IF ... 128
SET ... 265
SHOW ... 273
SIGN ... 207
SORT CASES ... 123
SORT VARIABLES ... 99
SPLIT FILE ... 129
STRING ... 98
SUBTITLE ... 274
SYSFILE INFO ... 90

T

T-TEST ... 21, 207
TEMPORARY ... 132
TITLE ... 274

U

UPDATE ... 96

V

VALUE LABELS ... 101
VARIABLE ALIGNMENT ... 103
VARIABLE ATTRIBUTE ... 102
VARIABLE LABELS ... 100
VARIABLE LEVEL ... 104
VARIABLE ROLE ... 104
VARIABLE WIDTH ... 103
VECTOR ... 104

W

WEIGHT ... 133
WILCOXON ... 207
WRITE ... 77
WRITE FORMATS ... 101

X

XEXPORT ... 91
XSAVE ... 91

25 Concept Index

"

'"' 25

$

$CASENUM 31
$DATE 31
$DATE11 32
$JDATE 32
$LENGTH 32
$SYSMIS 32
$TIME 32
$WIDTH 32

&

'&' 45

'

'\'' 25

(

(..... 46
'( )' 44

)

) 46

*

'*' 44
'**' 45

+

'+' 44

,

PSPP, command structure 26
PSPP, invoking 3
PSPP, language 25

–

'-' 44, 45

.

'.' 29, 43

/

'/' 44

<

< 45
<= 45
<> 45

=

'=' 45

>

'>' 45
>= 45

_

'_' 29

‘

"is defined as" 43

|

'|' 45

~

'~' 45
~= 45

A

absolute value 46
addition 44
analysis of variance 197, 214
AND 45
ANOVA 197, 214
arccosine 47
arcsine 47
arctangent 47
Area under curve 221
arguments, invalid 52
arguments, minimum valid 48
arguments, of date construction functions 52
arguments, of date extraction functions 53
arithmetic mean 199
arithmetic operators 44
attributes of variables 29

B

Backus-Naur Form . . . 43
bar chart . . . 154, 158, 162
Batch syntax . . . 27
binary formats . . . 37
binomial test . . . 202
bivariate logistic regression . . . 197
BNF . . . 43
Boolean . . . 44, 45
boxplot . . . 156
bugs . . . 288

C

case conversion . . . 51
case-sensitivity . . . 25
cases . . . 62
changing directory . . . 260
changing file permissions . . . 265
chi-square . . . 162
chi-square test . . . 203
chi-square test of independence . . . 163
clustering . . . 215
Cochran Q test . . . 204
coefficient of concordance . . . 205
coefficient of variation . . . 48
comma separated values . . . 15
command file . . . 42
command syntax, description of . . . 43
commands, ordering . . . 28
commands, structure . . . 26
commands, unimplemented . . . 284
concatenation . . . 49
conditionals . . . 135
consistency . . . 18
constructing dates . . . 52
constructing times . . . 51
control flow . . . 135
convention, `TO` . . . 32
copyright . . . 2
correlation . . . 159
cosine . . . 47
covariance . . . 160
Cronbach's Alpha . . . 219
cross-case function . . . 55
currency formats . . . 35
custom attributes . . . 31
custom tables . . . 166

D

data . . . 62
data file . . . 42
data files . . . 82
data reduction . . . 194
Data, embedding in syntax files . . . 62
data, embedding in syntax files . . . 64
data, fixed-format, reading . . . 64
data, reading from a file . . . 64
databases . . . 15, 81
dataset . . . 29
date examination . . . 53
date formats . . . 38
date, Julian . . . 55
dates . . . 51
dates, concepts . . . 51
dates, constructing . . . 52
dates, day of the month . . . 53
dates, day of the week . . . 54
dates, day of the year . . . 53
dates, day-month-year . . . 52
dates, in days . . . 53
dates, in hours . . . 53
dates, in minutes . . . 53
dates, in months . . . 53
dates, in quarters . . . 53
dates, in seconds . . . 53
dates, in weekdays . . . 54
dates, in weeks . . . 54
dates, in years . . . 54
dates, mathematical properties of . . . 54
dates, month-year . . . 52
dates, quarter-year . . . 52
dates, time of day . . . 54
dates, valid . . . 51
dates, week-year . . . 52
dates, year-day . . . 53
day of the month . . . 53
day of the week . . . 54
day of the year . . . 53
day-month-year . . . 52
days . . . 51, 53
decimal places . . . 264
description of command syntax . . . 43
deviation, standard . . . 49
dictionary . . . 29
directory . . . 260
division . . . 44
DocBook . . . 1

E

embedding data in syntax files . . . 64
Embedding data in syntax files . . . 62
embedding fixed-format data . . . 64
encoding, characters . . . 272
equality, testing . . . 45
`EQ` . . . 45
erroneous data . . . 15
errors, in data . . . 15
examination, of times . . . 51
Exploratory data analysis . . . 155, 158
exponentiation . . . 45
`expression` . . . 43
expressions, mathematical . . . 44
extraction, of dates . . . 53
extraction, of time . . . 51

F

factor analysis . . . 194
factorial anova . . . 197
false . . . 45
file definition commands . . . 27
file handles . . . 42
file mode . . . 265
file, command . . . 42
file, data . . . 42
file, output . . . 42
file, portable . . . 42
file, syntax file . . . 42
file, system . . . 42
fixed effects . . . 197
fixed-format data, reading . . . 64
flow of control . . . 135
formats . . . 32
Friedman test . . . 205
function, cross-case . . . 55
functions . . . 46
functions, miscellaneous . . . 55
functions, missing-value . . . 47
functions, statistical . . . 48
functions, string . . . 49
functions, time & date . . . 51

G

geometric mean . . . 200
`GE` . . . 45
Gnumeric . . . 81
Graphic user interface . . . 11
greater than . . . 45
greater than or equal to . . . 45
grouping operators . . . 44
`GT` . . . 45

H

harmonic mean . . . 200
headers . . . 271
hexadecimal formats . . . 37
histogram . . . 153, 156, 158
hours . . . 52, 53
hours-minutes-seconds . . . 51
HTML . . . 1, 9
Hypothesis testing . . . 21

I

identifiers . . . 25
identifiers, reserved . . . 25
inequality, testing . . . 45
input . . . 62
input program commands . . . 27
`integer` . . . 43
integers . . . 25
Interactive syntax . . . 27
intersection, logical . . . 45
introduction . . . 1
inverse cosine . . . 47
inverse sine . . . 47
inverse tangent . . . 47
inversion, logical . . . 45
Inverting data . . . 17
invocation . . . 3
Invocation . . . 276, 279, 283

J

Julian date . . . 55

K

K-means clustering . . . 215
Kendall's W test . . . 205
keywords . . . 43
Kolmogorov-Smirnov test . . . 205
Kruskal-Wallis test . . . 206

L

labels, value . . . 30
labels, variable . . . 30
PSPP language . . . 1
language, PSPP . . . 1, 25
language, command structure . . . 26
language, lexical analysis . . . 25
language, tokens . . . 25
length . . . 271
less than . . . 45
less than or equal to . . . 45
lexical analysis . . . 25
`LE` . . . 45
licence . . . 2
license . . . 2
Likert scale . . . 17
linear regression . . . 23, 217
locale . . . 272
logarithms . . . 46
logical intersection . . . 45
logical inversion . . . 45
logical operators . . . 45
logical union . . . 45
logistic regression . . . 197
loops . . . 135
`LT` . . . 45

M

macro . . . 135
Mann-Whitney U test . . . 206
mathematical expressions . . . 44
mathematics . . . 46
mathematics, advanced . . . 46
mathematics, applied to times & dates . . . 54
mathematics, miscellaneous . . . 46
maximum . . . 49
McNemar test . . . 206
mean . . . 49
means . . . 199
measurement level . . . 30
median . . . 49
Median test . . . 206
membership, of set . . . 48
memory, amount used to store cases . . . 269
minimum . . . 49
minimum valid number of arguments . . . 48
minutes . . . 52, 53
missing values . . . 29, 30, 47
mode . . . 265
modulus . . . 46
modulus, by 10 . . . 46
month-year . . . 52
months . . . 53
multiplication . . . 44

N

names, of functions . . . 46
negation . . . 45
`NE` . . . 45
nonparametric tests . . . 201
nonterminals . . . 43
normality, testing . . . 19, 155, 158
`NOT` . . . 45
npplot . . . 156
null hypothesis . . . 21
`number` . . . 43
numbers . . . 25
numbers, converting from strings . . . 50
numbers, converting to strings . . . 50
numeric formats . . . 33

O

obligations, your . . . 2
observations . . . 62
OpenDocument . . . 81
operations, order of . . . 61
operator precedence . . . 61
operators . . . 26, 43, 46
operators, arithmetic . . . 44
operators, grouping . . . 44
operators, logical . . . 45
order of commands . . . 28
order of operations . . . 61
`OR` . . . 45
output . . . 62
output file . . . 42

P

p-value . . . 21
pager . . . 271
parentheses . . . 44, 46
PDF . . . 1, 6
percentiles . . . 153, 157
period . . . 29
piechart . . . 153
PNG . . . 6
portable file . . . 42
postgres . . . 81
Postscript . . . 6
PostScript . . . 1
precedence, operator . . . 61
precision, of output . . . 264
principal axis factoring . . . 194
principal components analysis . . . 194
print format . . . 30
procedures . . . 28
productions . . . 43
`pspp-convert` . . . 276
`pspp-dump-sav` . . . 283
`pspp-output` . . . 279
PSPPIRE . . . 11

punctuators . . . 26, 43

Q

Q, Cochran Q . . . 204
quarter-year . . . 52
quarters . . . 53

R

reading data . . . 14
reading data from a file . . . 64
reading fixed-format data . . . 64
reals . . . 25
Receiver Operating Characteristic . . . 221
recoding data . . . 16
regression . . . 217
reliability . . . 18
replacing substrings . . . 50
reserved identifiers . . . 25
restricted expressions . . . 234
restricted transformations . . . 27
rights, your . . . 2
rounding . . . 46
runs test . . . 207

S

saving . . . 15
scatterplot . . . 158
scratch variables . . . 41
screening . . . 15
searching strings . . . 49
seconds . . . 52, 53
set membership . . . 48
Shapiro-Wilk . . . 156
sign test . . . 207
sine . . . 47
spreadlevel plot . . . 156
spreadsheet files . . . 81
spreadsheets . . . 15
square roots . . . 46
standard deviation . . . 49
start symbol . . . 43
statistics . . . 48
`string` . . . 43
string formats . . . 41
string functions . . . 49
strings . . . 25
strings, case of . . . 50, 51
strings, concatenation of . . . 49
strings, converting from numbers . . . 50
strings, converting to numbers . . . 50
strings, finding length of . . . 49
strings, padding . . . 50
strings, replacing substrings . . . 50
strings, taking substrings of . . . 50
strings, trimming . . . 50
strings, truncating . . . 50
substrings . . . 50
subtraction . . . 44
sum . . . 49
SVG . . . 6
symbol, start . . . 43
syntax file . . . 42
SYSMIS . . . 16
system file . . . 42
system files . . . 14
system variables . . . 31
system-missing . . . 45

T

T-test . . . 21
tables, custom . . . 166
tangent . . . 47
terminals . . . 43
terminals and nonterminals, differences . . . 43
testing for equality . . . 45
testing for inequality . . . 45
tex . . . 9
text files . . . 82
TEX . . . 9
time . . . 54
time examination . . . 51
time formats . . . 38
time, concepts . . . 51
time, in days . . . 51, 53
time, in hours . . . 52, 53
time, in hours-minutes-seconds . . . 51
time, in minutes . . . 52, 53
time, in seconds . . . 52, 53
time, instants of . . . 51
time, intervals . . . 51
time, lengths of . . . 51
time, mathematical properties of . . . 54
times . . . 51
times, constructing . . . 51
times, in days . . . 53
tnumbers . . . 271
`TO` convention . . . 32
tokens . . . 25
transformation . . . 15
transformations . . . 27, 107
trigonometry . . . 47
troubleshooting . . . 288
true . . . 45
truncation . . . 47
type of variables . . . 30

U

U, Mann-Whitney U . . . 206
unimplemented commands . . . 284
union, logical . . . 45
univariate analysis of variance . . . 197
utility commands . . . 27

V

value label . . . 55
value labels . . . 30
values, Boolean . . . 44
values, missing . . . 29, 30, 47
values, system-missing . . . 45
`var-list` . . . 43
`var-name` . . . 43
variable . . . 29
variable labels . . . 30
variable names, ending with period . . . 29
variable role . . . 31
variables . . . 13
Variables . . . 97
variables, attributes of . . . 29
variables, system . . . 31
variables, type . . . 30
variables, width . . . 30
variance . . . 49
variation, coefficient of . . . 48

W

week . . . 54
week-year . . . 52
weekday . . . 54
white space, trimming . . . 50
width . . . 271
width of variables . . . 30
wilcoxon matched pairs signed ranks test . . . 207
workspace . . . 269
write format . . . 30

Y

year-day . . . 53
years . . . 54
your rights and obligations . . . 2

Appendix A GNU Free Documentation License

Version 1.3, 3 November 2008

Copyright © 2000, 2001, 2002, 2007, 2008 Free Software Foundation, Inc.
http://fsf.org/

Everyone is permitted to copy and distribute verbatim copies
of this license document, but changing it is not allowed.

0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document *free* in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or non-commercially. Secondarily, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The "Document", below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as "you". You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released

under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

The "publisher" means any person or entity that distributes copies of the Document to the public.

A section "Entitled XYZ" means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as "Acknowledgements", "Dedications", "Endorsements", or "History".) To "Preserve the Title" of such a section when you modify the Document means that it remains a section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

3. COPYING IN QUANTITY

   If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

   If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

   If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

   It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

4. MODIFICATIONS

   You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

   A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any,

be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.

B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.

C. State on the Title page the name of the publisher of the Modified Version, as the publisher.

D. Preserve all the copyright notices of the Document.

E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.

F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.

G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.

H. Include an unaltered copy of this License.

I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.

J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.

K. For any section Entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.

L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.

M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version.

N. Do not retitle any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section.

O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their

titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties—for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

5. COMBINING DOCUMENTS

   You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

   The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

   In the combination, you must combine any sections Entitled "History" in the various original documents, forming one section Entitled "History"; likewise combine any sections Entitled "Acknowledgements", and any sections Entitled "Dedications". You must delete all sections Entitled "Endorsements."

6. COLLECTIONS OF DOCUMENTS

   You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

   You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

7. AGGREGATION WITH INDEPENDENT WORKS

   A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an "aggregate" if the copyright resulting from the compilation is not used to limit the legal rights of the compilation's users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

   If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document's Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

8. TRANSLATION

   Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

   If a section in the Document is Entitled "Acknowledgements", "Dedications", or "History", the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

9. TERMINATION

   You may not copy, modify, sublicense, or distribute the Document except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, or distribute it is void, and will automatically terminate your rights under this License.

   However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

   Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

   Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, receipt of a copy of some or all of the same material does not give you any rights to use it.

10. FUTURE REVISIONS OF THIS LICENSE

    The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See `http://www.gnu.org/copyleft/`.

    Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation. If the Document specifies that a proxy can decide which future versions of this License can be used, that proxy's public statement of acceptance of a version permanently authorizes you to choose that version for the Document.

11. RELICENSING

    "Massive Multiauthor Collaboration Site" (or "MMC Site") means any World Wide Web server that publishes copyrightable works and also provides prominent facilities for anybody to edit those works. A public wiki that anybody can edit is an example of such a server. A "Massive Multiauthor Collaboration" (or "MMC") contained in the site means any set of copyrightable works thus published on the MMC site.

    "CC-BY-SA" means the Creative Commons Attribution-Share Alike 3.0 license published by Creative Commons Corporation, a not-for-profit corporation with a principal place of business in San Francisco, California, as well as future copyleft versions of that license published by that same organization.

    "Incorporate" means to publish or republish a Document, in whole or in part, as part of another Document.

    An MMC is "eligible for relicensing" if it is licensed under this License, and if all works that were first published under this License somewhere other than this MMC, and subsequently incorporated in whole or in part into the MMC, (1) had no cover texts or invariant sections, and (2) were thus incorporated prior to November 1, 2008.

    The operator of an MMC Site may republish an MMC contained in the site under CC-BY-SA on the same site at any time before August 1, 2009, provided the MMC is eligible for relicensing.

ADDENDUM: How to use this License for your documents

To use this License in a document you have written, include a copy of the License in the document and put the following copyright and license notices just after the title page:

```
Copyright (C)  year  your name.
Permission is granted to copy, distribute and/or modify this document
under the terms of the GNU Free Documentation License, Version 1.3
or any later version published by the Free Software Foundation;
with no Invariant Sections, no Front-Cover Texts, and no Back-Cover
Texts.  A copy of the license is included in the section entitled ``GNU
Free Documentation License''.
```

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the "with. . .Texts." line with this:

```
with the Invariant Sections being list their titles, with
the Front-Cover Texts being list, and with the Back-Cover Texts
being list.
```

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.