

CONTENTS

PREFACE

xiii

CHAPTER 1 CHOOSING A STATISTICAL TEST *1*

- 1.1 SOME RESEARCH TERMS *2*
- 1.2 CHOOSING A STATISTICAL TEST: SOME GUIDELINES *5*
- 1.3 SIGNIFICANCE OF DIFFERENCES *7*
 - 1.3.1 The design of the experiment: Independent versus related samples *7*
 - 1.3.2 Flow-chart for selecting a suitable test for differences between averages *8*
 - 1.3.3 Two conditions: The t-tests *9*
 - 1.3.4 Two conditions: Nonparametric tests *10*
- 1.4 ANALYSIS OF VARIANCE DESIGNS *11*
 - 1.4.1 Between subjects and within subjects factors *11*
 - 1.4.2 Factorial designs: Between subjects and within subjects designs *13*
 - 1.4.3 Mixed or split-plot factorial experiments *14*
 - 1.4.4 Flow-chart for ANOVA *14*
 - 1.4.5 Analysing the results of one-factor experiments *15*
 - 1.4.6 Analysing the results of factorial experiments *17*
- 1.5 MEASURING STRENGTH OF ASSOCIATION BETWEEN VARIABLES *17*
 - 1.5.1 Flow-chart for selecting a suitable test of association *17*
 - 1.5.2 Measuring association in nominal data: Contingency tables *18*
 - 1.5.3 Multiway contingency tables *19*
- 1.6 PREDICTING SCORES OR CATEGORY MEMBERSHIP *19*
 - 1.6.1 Flow-chart for selecting the appropriate procedure for predicting a score or a category *20*
 - 1.6.2 Simple regression *20*
 - 1.6.3 Multiple regression *21*
 - 1.6.4 Predicting category membership: Discriminant analysis and logistic regression *21*
- 1.7 ONE-SAMPLE TESTS *21*
 - 1.7.1 Flow-chart for selecting the appropriate one-sample test *22*
 - 1.7.2 Goodness-of-fit: Data in the form of measurements *23*
 - 1.7.3 Goodness-of-fit: Nominal data *23*
 - 1.7.4 Inferences about the mean of a single population *23*
 - 1.7.5 Nominal data: Testing a coin for fairness *24*

- 1.8 FINDING LATENT VARIABLES: FACTOR ANALYSIS 24
- 1.9 A FINAL COMMENT 25

CHAPTER 2 WINDOWS OPERATIONS FOR SPSS 26

- 2.1 WORKING WITH WINDOWS 27
 - 2.1.1 The Windows NT operating system 27
 - 2.1.2 The screen pointer: Handling the mouse 28
 - 2.1.3 Keeping more than one application open 30
- 2.2 PROPERTIES OF WINDOWS 30
- 2.3 FINDING PROGRAMS AND FILES 33
- 2.4 FILE AND FOLDER OPERATIONS 36
- 2.5 OPENING AND CLOSING SPSS 37
 - 2.5.1 Accessing the Data Editor 38
 - 2.5.2 Closing SPSS and Windows 41
 - 2.5.3 Resuming work on a saved data set 41
- Exercise 1 SOME BASIC WINDOWS OPERATIONS 42

CHAPTER 3 DATA HANDLING IN SPSS 44

- 3.1 INTRODUCTION 45
- 3.2 ENTERING DATA 45
 - 3.2.1 Data from a between subjects experiment 45
 - 3.2.2 Rules for naming variables 48
 - 3.2.3 Obtaining the Variable View version of the Data Editor 49
 - 3.2.4 Filling in the Variable View of the Data Editor 49
 - 3.2.5 Filling in the Data View of the Data Editor 57
 - 3.2.6 Data from a within subjects experiment 60
- 3.3 EDITING DATA 62
- 3.4 SAVING AND RETRIEVING SPSS FILES 65
 - 3.4.1 Saving a file 65
 - 3.4.2 Reading in SPSS files 67
 - 3.4.3 Importing and exporting data 68
- 3.5 LISTING DATA 70
 - 3.5.1 Listing cases 70
 - 3.5.2 Displaying data file information 74
- 3.6 PRINTING IN SPSS 75

3.7	SOME SPECIAL OPERATIONS	77
3.7.1	Case selection	77
3.7.2	The weighting of cases by their frequencies of occurrence	79
3.7.3	Splitting files	81
3.8	COPYING SPSS DATA OR OUTPUT INTO OTHER APPLICATIONS (e.g. WORD PROCESSORS)	83
3.8.1	Copying data	83
3.8.2	Copying output	83
Exercise 2	QUESTIONNAIRE DATA	84

CHAPTER 4 EXPLORATORY DATA ANALYSIS 87

4.1	INTRODUCTION	88
4.1.1	Exploratory data analysis (EDA)	88
4.1.2	The influence of outliers and asymmetry of distributions	89
4.1.3	Formal tests, statistical models and their assumptions	90
4.2	FINDING MENUS	90
4.3	DESCRIBING DATA	93
4.3.1	Describing nominal and ordinal data	93
4.3.2	Describing interval data	98
4.4	MANIPULATION OF THE DATA SET	109
4.4.1	Reducing and transforming data	109
4.4.2	The COMPUTE command	110
4.4.3	The RECODE command	113
4.4.4	The Categorize Variables command	116
Exercise 3	QUESTIONNAIRE DATA (continued)	117

CHAPTER 5 MORE GRAPHS AND CHARTS 120

5.1	INTRODUCTION	121
5.1.1	Requesting graphs and charts	121
5.1.2	Seeing the graph or chart on screen	121
5.2	EDITING GRAPHS OR CHARTS	122
5.2.1	The Chart Editor	122
5.3	ERROR BAR CHARTS	127
5.4	PIE CHARTS	131
5.5	LINE GRAPHS	133
5.6	SCATTERPLOTS	135
Exercise 4	EXPLORATORY DATA ANALYSIS (EDA)	137
Exercise 5	EDA (continued)	140

- Exercise 6 MORE CHARTS AND GRAPHS *141*
Exercise 7 RECODING DATA; SELECTING CASES; LINE GRAPH *144*

CHAPTER 6 COMPARING AVERAGES: TWO-SAMPLE AND ONE-SAMPLE TESTS *147*

- 6.1 INTRODUCTION *148*
 6.1.1 Two-sample and one-sample tests *148*
 6.1.2 Hypotheses and hypothesis testing *148*
 6.1.3 SPSS commands for the two-sample design *149*
 6.1.4 SPSS commands for the one-sample design *150*
6.2 PARAMETRIC METHODS: THE T-TESTS *150*
 6.2.1 Assumptions underlying the use of the t-test *150*
 6.2.2 Paired and independent samples *151*
 6.2.3 The paired samples t-test *152*
 6.2.4 The independent samples t-test *156*
6.3 NONPARAMETRIC EQUIVALENTS OF THE T-TESTS *161*
 6.3.1 Related samples: Wilcoxon, Sign and McNemar tests *161*
 6.3.2 Independent samples: Mann-Whitney test *163*
6.4 ONE-SAMPLE TESTS *165*
 6.4.1 Goodness-of-fit: Data in the form of measurements *165*
 6.4.2 Goodness-of-fit: Nominal data *168*
 6.4.3 Inferences about the mean of a single population *174*
Exercise 8 COMPARING THE AVERAGES OF TWO SAMPLES OF TWO
 INDEPENDENT SAMPLES OF DATA *178*
Exercise 9 COMPARING THE AVERAGES OF TWO RELATED SAMPLES OF
 DATA *181*
Exercise 10 ONE-SAMPLE TESTS *184*

CHAPTER 7 THE ONE-FACTOR BETWEEN SUBJECTS EXPERIMENT *187*

- 7.1 INTRODUCTION *188*
7.2 THE ONE-WAY ANOVA *189*
 7.2.1 The mnemonics experiment revisited *189*
 7.2.2 Procedure for the one-way ANOVA *191*
 7.2.3 Output for the one-way ANOVA *193*
7.3 NONPARAMETRIC TESTS *196*
 7.3.1 The Kruskal-Wallis test *196*
 7.3.2 Dichotomous data: Chi-square test *198*
Exercise 11 ONE-FACTOR BETWEEN SUBJECTS ANOVA *199*

CHAPTER 8 FACTORIAL EXPERIMENTS (BETWEEN SUBJECTS) 202

- 8.1 INTRODUCTION 203
- 8.2 FACTORIAL ANOVA WITH SPSS 206
 - 8.2.1 Preparing the data for the factorial ANOVA 207
 - 8.2.2 Exploring the data: Obtaining boxplots 208
 - 8.2.3 Choosing a factorial ANOVA 210
 - 8.2.4 Output for a factorial ANOVA 213
- 8.3 EXPERIMENTS WITH MORE THAN TWO TREATMENT FACTORS 221
- Exercise 12 FACTORIAL BETWEEN SUBJECTS ANOVA (TWO-WAY ANOVA) 224

CHAPTER 9 WITHIN SUBJECTS EXPERIMENTS 227

- 9.1 INTRODUCTION 228
- 9.2 ADVANTAGES AND DISADVANTAGES OF WITHIN SUBJECTS EXPERIMENTS 229
- 9.3 WITHIN SUBJECTS ANOVA WITH SPSS 230
- 9.4 A ONE-FACTOR WITHIN SUBJECTS ANOVA 231
 - 9.4.1 Some experimental results 231
 - 9.4.2 Entering the data 232
 - 9.4.3 Exploring the data: Boxplots for within subjects factors 232
 - 9.4.4 Running the within subjects ANOVA 234
 - 9.4.5 Output for a one-factor within subjects ANOVA 237
 - 9.4.6 Unplanned multiple comparisons: Bonferroni method 240
- 9.5 NONPARAMETRIC TESTS FOR A ONE-FACTOR WITHIN SUBJECTS EXPERIMENT 240
 - 9.5.1 The Friedman test for ordinal data 241
 - 9.5.2 Cochran's Q test for nominal data 242
- 9.6 THE TWO-FACTOR WITHIN SUBJECTS ANOVA 244
 - 9.6.1 Results of a two-factor within subjects experiment 244
 - 9.6.2 Preparing the data set 245
 - 9.6.3 Running the two-factor within subjects analysis 245
 - 9.6.4 Output for a two-factor within subjects ANOVA 248
 - 9.6.5 Unplanned comparisons following a factorial within subjects experiment 251
- Exercise 13 ONE-FACTOR WITHIN SUBJECTS (REPEATED MEASURES) ANOVA 252
- Exercise 14 TWO-FACTOR WITHIN SUBJECTS ANOVA 254

CHAPTER 10 EXPERIMENTS OF MIXED DESIGN 256

- 10.1 INTRODUCTION 257
- 10.2 THE TWO-FACTOR MIXED FACTORIAL ANOVA 258
 - 10.2.1 Results of a mixed $A \times (B)$ experiment 258
 - 10.2.2 Preparing the SPSS data set 258
 - 10.2.3 Exploring the results: Boxplots and tables of means and standard deviations 259
 - 10.2.4 Procedure for a mixed $A \times (B)$ ANOVA 263
 - 10.2.5 Output for the two-factor mixed ANOVA 265
- 10.3 THE THREE-FACTOR MIXED ANOVA 269
 - 10.3.1 The mixed $A \times (B \times C)$ experiment 269
 - 10.3.2 The mixed $A \times B \times (C)$ experiment 270
- 10.4 FURTHER ANALYSIS: SIMPLE EFFECTS AND MULTIPLE COMPARISONS 272
- Exercise 15 MIXED ANOVA (BETWEEN AND WITHIN SUBJECTS FACTORS) 273
- Exercise 16 MIXED ANOVA: THREE-FACTOR EXPERIMENT 275

CHAPTER 11 MEASURING STATISTICAL ASSOCIATION 278

- 11.1 INTRODUCTION 279
- 11.2 CORRELATIONAL ANALYSIS WITH SPSS 281
 - 11.2.1 Procedure for the Pearson correlation 284
 - 11.2.2 Output for the Pearson correlation 285
 - 11.2.3 Point-biserial correlation 286
- 11.3 OTHER MEASURES OF ASSOCIATION 286
 - 11.3.1 Measures of association strength for ordinal data 286
 - 11.3.2 Measures of association strength for categorical data 290
- Exercise 17 THE PEARSON CORRELATION 298
- Exercise 18 OTHER MEASURES OF ASSOCIATION 300
- Exercise 19 THE ANALYSIS OF NOMINAL DATA 303

CHAPTER 12 REGRESSION 306

- 12.1 INTRODUCTION 307
 - 12.1.1 Simple, two-variable regression 307
 - 12.1.2 Multiple regression 307
 - 12.1.3 Residuals 308
 - 12.1.4 The multiple correlation coefficient 308

12.2	SIMPLE REGRESSION	308
12.2.1	Procedure for simple regression	309
12.2.2	Output for simple regression	312
12.3	MULTIPLE REGRESSION	317
12.3.1	Procedure for simultaneous multiple regression	319
12.3.2	Procedure for stepwise multiple regression	322
12.3.3	The need for a substantive model of causation	327
12.4	SCATTERPLOTS AND REGRESSION LINES	327
Exercise 20	SIMPLE, TWO-VARIABLE REGRESSION	331
Exercise 21	MULTIPLE REGRESSION	333

CHAPTER 13 MULTIWAY FREQUENCY ANALYSIS 335

13.1	INTRODUCTION	336
13.1.1	Comparison of loglinear analysis with ANOVA	336
13.1.2	Why 'loglinear' analysis?	337
13.1.3	Constructing a loglinear model	338
13.1.4	Small expected frequencies	338
13.2	AN EXAMPLE OF A LOGLINEAR ANALYSIS	339
13.2.1	A three-way contingency table	339
13.2.2	Running a loglinear analysis	341
13.2.3	Output for a loglinear analysis	344
13.2.4	Comparison with the total independence model	349
Exercise 22	LOGLINEAR ANALYSIS	351

CHAPTER 14 DISCRIMINANT ANALYSIS AND LOGISTIC REGRESSION 354

14.1	INTRODUCTION	355
14.1.1	Discriminant analysis	355
14.1.2	Types of discriminant analysis	356
14.1.3	Stepwise discriminant analysis	356
14.1.4	Restrictive assumptions of discriminant analysis	357
14.2	DISCRIMINANT ANALYSIS WITH SPSS	357
14.2.1	Preparing the data set	358
14.2.2	Exploring the data	358
14.2.3	Running discriminant analysis	359
14.2.4	Output for discriminant analysis	361
14.2.5	Predicting group membership	367

14.3	LOGISTIC REGRESSION	368
14.3.1	Interpretation of the regression coefficients	370
14.3.2	An example with two regressors	370
14.3.3	Preparing the data set	370
14.3.4	Running logistic regression	371
14.3.5	Output for logistic regression	372
14.3.6	Different approaches to logistic regression	375
Exercise 23	PREDICTING CATEGORY MEMBERSHIP: DISCRIMINANT ANALYSIS AND LOGISTIC REGRESSION	377

CHAPTER 15 FACTOR ANALYSIS 381

15.1	INTRODUCTION	382
15.1.1	The nature of factors	382
15.1.2	Stages in a factor analysis	383
15.1.3	The extraction of factors	384
15.1.4	The rationale of rotation	384
15.1.5	Confirmatory factor analysis and structural equation modelling	384
15.2	A FACTOR ANALYSIS OF DATA ON SIX VARIABLES	385
15.2.1	Entering the data for a factor analysis	386
15.2.2	The factor analysis command	387
15.2.3	Output for factor analysis	389
15.3	USING SPSS COMMAND LANGUAGE	395
15.3.1	The power of SPSS syntax: An example	395
15.3.2	Using a correlation matrix as input for factor analysis	398
15.3.3	Progressing with SPSS syntax	401
Exercise 24	FACTOR ANALYSIS	402

REVISION EXERCISES 404

REFERENCES 410

INDEX 412