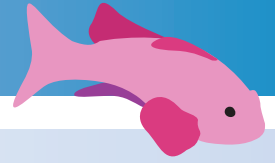
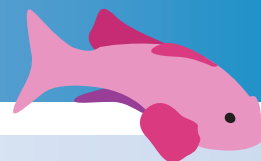


# Brief contents



<i>Preface</i>	<i>xvi</i>
<i>Guided tour</i>	<i>xx</i>
<i>Acknowledgements</i>	<i>xxii</i>
1 Variables and research design	1
2 Introduction to SPSS	25
3 Descriptive statistics	42
4 Probability, sampling and distributions	97
5 Hypothesis testing and statistical significance	134
6 Correlational analysis: Pearson's $r$	174
7 Analyses of differences between two conditions: the t-test	217
8 Issues of significance	246
9 Measures of association	265
10 Analysis of differences between three or more conditions	298
11 Analysis of variance with more than one IV	328
12 Regression analysis	377
13 Analysis of three or more groups partialling out effects of a covariate	414
14 Introduction to factor analysis	446
15 Introduction to multivariate analysis of variance (MANOVA)	481
16 Non-parametric statistics	516
Answers to activities and SPSS exercises	551
Appendix 1: Table of z-scores and the proportion of the standard normal distribution falling above and below each score	592
Appendix 2: Table $r$ to $zr$	595
<i>Index</i>	<i>597</i>

# Contents



<i>Preface</i>	<i>xvi</i>
<i>Guided tour</i>	<i>xx</i>
<i>Acknowledgements</i>	<i>xxii</i>
<b>1 Variables and research design</b>	<b>1</b>
Chapter overview	1
1.1 Why teach statistics without mathematical formulae?	1
1.2 Variables	3
1.3 Levels of measurement	7
1.4 Research designs	8
1.5 Between-participants and within-participants designs	16
Summary	20
Multiple choice questions	21
References	24
Answers to multiple choice questions	24
<b>2 Introduction to SPSS</b>	<b>25</b>
Chapter overview	25
2.1 Basics	25
2.2 Starting SPSS	25
2.3 Working with data	30
2.4 Data entry	31
2.5 Saving your data	34
2.6 Inputting data for between-participants and within-participants designs	36
2.7 Within-participants designs	39
Summary	40
SPSS exercises	40
<b>3 Descriptive statistics</b>	<b>42</b>
Chapter overview	42
3.1 Samples and populations	42
3.2 Measures of central tendency	45

3.3	Sampling error	50
	SPSS: obtaining measures of central tendency	53
3.4	Graphically describing data	56
	SPSS: generating graphical descriptives	66
3.5	Scattergrams	68
	SPSS: generating scattergrams	70
3.6	Sampling error and relationships between variables	71
3.7	The normal distribution	73
3.8	Variation or spread of distributions	76
	SPSS: obtaining measures of variation	80
3.9	Other characteristics of distributions	81
3.10	Non-normal distributions	82
	SPSS: displaying the normal curve on histograms	88
3.11	Writing up your descriptive statistics	90
	Summary	90
	SPSS exercises	91
	Multiple choice questions	92
	References	95
	Answers to multiple choice questions	96

## 4 Probability, sampling and distributions 97

	Chapter overview	97
4.1	Probability	97
4.2	The standard normal distribution	101
4.3	Applying probability to research	108
4.4	Sampling distributions	108
4.5	Confidence intervals and the standard error	111
	SPSS: obtaining confidence intervals	120
4.6	Error bar charts	121
4.7	Overlapping confidence intervals	122
	SPSS: generating error bar charts	124
4.8	Confidence intervals around other statistics	127
	Summary	127
	SPSS exercises	128
	Multiple choice questions	130
	References	133
	Answers to multiple choice questions	133

## 5 Hypothesis testing and statistical significance 134

	Chapter overview	134
5.1	Another way of applying probabilities to research: hypothesis testing	134
5.2	Null hypothesis	139
5.3	Logic of null hypothesis testing	140
5.4	The significance level	142
5.5	Statistical significance	144
5.6	The correct interpretation of the p-value	146
5.7	Statistical tests	147

5.8	Type I error	148
5.9	Type II error	150
5.10	Why set $\alpha$ at 0.05?	151
5.11	One-tailed and two-tailed hypotheses	151
5.12	Assumptions underlying the use of statistical tests	156
	SPSS: Statistics Coach	163
	Summary	167
	SPSS exercises	167
	Multiple choice questions	169
	References	172
	Answers to multiple choice questions	173

## 6 Correlational analysis: Pearson's $r$ 174

	Chapter overview	174
6.1	Bivariate correlations	175
	SPSS: bivariate correlations – Pearson's $r$	188
	SPSS: obtaining a scattergram matrix	197
6.2	First- and second-order correlations	200
	SPSS: partial correlations – Pearson's $r$	201
6.3	Patterns of correlations	208
	Summary	209
	SPSS exercise	210
	Multiple choice question	211
	References	215
	Answers to multiple choice questions	216

## 7 Analyses of differences between two conditions: the t-test 217

	Chapter overview	217
7.1	Analysis of two conditions	218
	SPSS: for an independent t-test	228
	SPSS: two samples repeated-measures design – paired t-test	234
	Summary	239
	SPSS exercise	240
	Multiple choice questions	241
	References	245
	Answers to multiple choice questions	245

## 8 Issues of significance 246

	Chapter overview	246
8.1	Criterion significance levels	246
8.2	Effect size	251
8.3	Power	251
8.4	Factors influencing power	252

8.5	Calculating power	256
8.6	Confidence intervals	258
	Summary	259
	Multiple choice questions	260
	References	263
	Answers to multiple choice questions	264

## 9 Measures of association 265

	Chapter overview	265
9.1	Frequency (categorical) data	265
9.2	One-variable $\chi^2$ or goodness-of-fit test	267
	SPSS: one-variable $\chi^2$	269
	SPSS: one-variable $\chi^2$ – using frequencies different from those expected under the null hypothesis	273
9.3	$\chi^2$ test for independence: $2 \times 2$	276
	SPSS: $2 \times 2 \chi^2$	279
9.4	$\chi^2$ test of independence: $r \times c$	285
	Summary	290
	SPSS exercises	290
	Multiple choice questions	292
	References	297
	Answers to multiple choice questions	297

## 10 Analysis of differences between three or more conditions 298

	Chapter overview	298
10.1	Visualising the design	299
10.2	Meaning of analysis of variance	300
	SPSS: performing a one-way ANOVA	305
10.3	Descriptive statistics	307
10.4	Planned comparisons	308
10.5	Controlling for multiple testing	309
10.6	Post-hoc tests	309
10.7	Repeated-measures ANOVA	312
	SPSS: instructions for repeated-measures ANOVA	313
	Summary	319
	SPSS exercises	320
	Multiple choice questions	321
	References	327
	Answers to multiple choice questions	327

## 11 Analysis of variance with more than one IV 328

	Chapter overview	328
11.1	Introduction	328
11.2	Sources of variance	329
11.3	Designs suitable for factorial ANOVA	331

11.4	ANOVA terminology	332
11.5	Two between-participants independent variables	333
	SPSS: analysis of two between-participants factors	346
11.6	Two within-participants variables	351
	SPSS: ANOVA with two within-participants factors	359
11.7	One between- and one within-participants variable	362
	SPSS: ANOVA with one between-participants factor and one within-participants factor	368
	Summary	370
	SPSS exercises	370
	Multiple choice questions	372
	References	376
	Answers to multiple choice questions	376

## 12 Regression analysis 377

	Chapter overview	377
12.1	The purpose of linear regression	377
	SPSS: drawing the line of best fit	380
	SPSS: linear regression analysis	391
12.2	Multiple regression	398
	Summary	407
	SPSS exercises	407
	Multiple choice questions	409
	References	413
	Answers to multiple choice questions	413

## 13 Analysis of three or more groups partialling out effects of a covariate 414

	Chapter overview	414
	SPSS: obtaining a chart of regression lines	416
13.1	Pre-existing groups	422
13.2	Pretest–posttest designs	428
	SPSS: obtaining output for an ANCOVA	432
	Summary	440
	SPSS exercise	440
	Multiple choice questions	441
	References	445
	Answers to multiple choice questions	445

## 14 Introduction to factor analysis 446

	Chapter overview	446
14.1	What is the purpose of factor analysis?	446
14.2	The two main types of factor analysis	448
14.3	Use of factor analysis in psychometrics	448
14.4	Visualising factors	449
14.5	Conceptualising factor analysis	450

14.6	Naming the factors	452
14.7	Loadings of variables on factors	453
14.8	The correlational matrix	455
14.9	The unrotated and rotated matrices	456
14.10	Plotting the variables in factor space	457
14.11	Rotating the matrix	459
14.12	Steps taken in performing a factor analysis	462
14.13	Use of factors or components in further analyses	466
14.14	The meaning of negative loadings	467
	SPSS: factor analysis – principal components analysis	468
	Summary	476
	Multiple choice questions	476
	References	480
	Answers to multiple choice questions	480

## 15 Introduction to multivariate analysis of variance (MANOVA) 481

	Chapter overview	481
15.1	Multivariate statistics	481
15.2	Why use multivariate analyses of variance?	482
15.3	Multivariate analysis of variance	482
15.4	Logic of MANOVA	483
15.5	Assumptions of MANOVA	485
15.6	Which F-value?	489
15.7	Post-hoc analyses of individual DVs	490
15.8	Correlated DVs	492
15.9	How to write up these analyses	493
	SPSS: conducting MANOVA with one between-participants IV and two DVs	494
15.10	Within-participants designs	496
	SPSS: one within-participants IV and two DVs	503
	Summary	506
	SPSS exercises	506
	Multiple choice questions	508
	References	515
	Recommended texts	515
	Answers to multiple choice questions	515

## 16 Non-parametric statistics 516

	Chapter overview	516
16.1	Alternative to Pearson's $r$ : Spearman's rho	517
	SPSS: correlational analysis – Spearman's rho	517
	SPSS exercise	521
16.2	Alternatives to the t-test: Mann–Whitney and Wilcoxon	521
	SPSS: two-sample test for independent groups – Mann–Whitney	523
	SPSS exercise	527
	SPSS: two-sample test for repeated measures – Wilcoxon	530
	SPSS exercise	535

16.3	Alternatives to ANOVA	535
	SPSS: independent samples test for more than two conditions – Kruskal–Wallis	536
	SPSS exercise	540
	SPSS: repeated-measures test for more than two conditions – Friedman's test	542
	SPSS exercise	544
	Summary	545
	Multiple choice questions	545
	References	550
	Answers to multiple choice questions	550
	Answers to activities and SPSS exercises	551
	Appendix 1: Table of z-scores and the proportion of the standard normal distribution falling above and below each score	592
	Appendix 2: Table $r$ to $zr$	595
	<i>Index</i>	597

### Companion Website

For open-access **student resources** specifically written to complement this textbook and support your learning, please visit [www.pearsoned.co.uk/dancey](http://www.pearsoned.co.uk/dancey)



### Lecturer Resources

For password-protected online resources tailored to support the use of this textbook in teaching, please visit [www.pearsoned.co.uk/dancey](http://www.pearsoned.co.uk/dancey)