Detailed Contents

Preface *xvii*
Making the Most of This Book *xxiv*

1. Asking and Answering Research Questions 1

A Simple Opinion Poll 1
Further Intuitions 6
Quiz 1.1 7
Careful Thinking About Uncertainty 8
The Replicability Crisis and Open Science 9
Meta-Analysis 10
A Step-by-Step Plan for Estimation 12
Quiz 1.2 13
Reporting Your Work 14
Take-Home Messages 15
End-of-Chapter Exercises 16
Answers to Quizzes 16
Answers to In-Chapter Exercises 16

2. Research Fundamentals: Don't Fool Yourself 17

Inference From Sample to Population 18
Making Comparisons 21
Quiz 2.1 24
Measurement 25
Four Types of Measure: NOIR 27
Quiz 2.2 31
Three Problematic Forms of Selection 32
Open Science: Do We Have the Full Story? 35
Where Do Research Questions Come From? 37
Quiz 2.3 38
Reporting Your Work 38
Take-Home Messages 39
End-of-Chapter Exercises 40
Answers to Quizzes 41
Answers to In-Chapter Exercises 41

3. Picturing and Describing Data 43

Pictures of a Data Set 43
Using the ESCI Software 47
The Normal Distribution 50

Quiz 3.1 51
Descriptive Statistics: Measures of Location 51
Descriptive Statistics: Measures of Spread 55
Quiz 3.2 58
Descriptive Statistics: Individual Data Points 58
Choosing Descriptive Statistics 63
Good and Bad Pictures 64
Quiz 3.3 66
Reporting Your Work 66
Take-Home Messages 67
End-of-Chapter Exercises 67
Answers to Quizzes 69
Answers to In-Chapter Exercises 70

4. The Normal Distribution and Sampling 72

Continuous Distributions 72
The Normal Distribution 73
Quiz 4.1 76
Population and Samples 78
Sampling: The Mean Heap and Dance of the Means 80
Quiz 4.2 84
The Standard Error 84
Some Statistical Magic: The Central Limit Theorem 87
Quiz 4.3 92
Take-Home Messages 92
End-of-Chapter Exercises 93
Answers to Quizzes 94
Answers to In-Chapter Exercises 94

5. Confidence Intervals and Effect Sizes 97

Discussing CIs Informally 97
Estimation Error and MoE 98
Calculating a CI: Sound the Trumpets! 101
Quiz 5.1 102
The *t* Distribution 105
Randomness 110
Effect Sizes 111
Quiz 5.2 112
Interpreting Effect Sizes and Confidence Intervals 113
CI Length, MoE, and Level of Confidence, *C* 118
Quiz 5.3 120
Reporting Your Work 121
Take-Home Messages 121
End-of-Chapter Exercises 122
Answers to Quizzes 125
Answers to In-Chapter Exercises 125

6. *p* Values, Null Hypothesis Significance Testing, and Confidence Intervals 128

The Basics of NHST and *p* Values 128
Quiz 6.1 132
p Values and the Normal Distribution 133
p Values and the *t* Distribution 135
Translating Between 95% CIs and *p* Values 137
Quiz 6.2 142
Four NHST and *p* Value Red Flags 142
NHST Decision Making 147
Quiz 6.3 153
Reporting Your Work 154
Take-Home Messages 155
End-of-Chapter Exercises 156
Answers to Quizzes 157
Answers to In-Chapter Exercises 158

7. The Independent Groups Design 160

The Independent Groups Design 160
Quiz 7.1 168
A Standardized Effect Size Measure: Cohen's *d* 169
Quiz 7.2 175
Thinking About Values of Cohen's *d* 177
Quiz 7.3 180
NHST and *p* Values 180
Overlap of CIs on Independent Means 182
Beware the Enormous Variability of *p*: The Dance of the *p* Values 185
Interpreting the Independent Groups Design 185
Quiz 7.4 187
Reporting Your Work 187
Take-Home Messages 188
End-of-Chapter Exercises 189
Answers to Quizzes 192
Answers to In-Chapter Exercises 192

8. The Paired Design 195

The Paired Design 195
Quiz 8.1 203
Cohen's *d* for the Paired Design 204
Quiz 8.2 209
NHST and *p* Values for the Paired Design 209
Quiz 8.3 211
Interpreting the Paired Design 211
Two Designs: Comparing and Choosing 213

Quiz 8.4 214
Reporting Your Work 215
Take-Home Messages 216
End-of-Chapter Exercises 217
Answers to Quizzes 219
Answers to In-Chapter Exercises 219

9. Meta-Analysis 222

The Forest Plot 223
Does a Brain Picture Increase Credibility? 223
Two Models for Meta-Analysis: Fixed Effect and Random Effects 227
Quiz 9.1 230
Moderator Analysis 230
What Meta-Analysis Can Give Us 235
The Problem of Publication Bias 236
Quiz 9.2 239
Cohen's *d* for Meta-Analysis 239
Steps in a Large Meta-Analysis 243
Meta-Analysis Can Change the World 245
Meta-Analytic Thinking 249
Quiz 9.3 250
Reporting Your Work 251
Take-Home Messages 252
End-of-Chapter Exercises 253
Answers to Quizzes 255
Answers to In-Chapter Exercises 255

10. Open Science and Planning Research 257

The Replicability Crisis: Why Many Published Results May Be False 257
Open Science 259
Pilot Testing 261
Preregistration 262
Open Materials and Data 264
Quiz 10.1 265
Precision for Planning 265
Quiz 10.2 278
Planning Using Statistical Power 279
Comparing Power and Precision for Planning 284
Quiz 10.3 286
Reporting Your Work 286
Take-Home Messages 288
End-of-Chapter Exercises 289
Answers to Quizzes 290
Answers to In-Chapter Exercises 291

11. Correlation 293

The Scatterplot, a Revealing Picture of Correlation 295
Calculating *r* 299
Quiz 11.1 304
Scatterplots That Reveal 304
Inference: Confidence Intervals and *p* Values 308
The Confidence Interval on *r* 309
Quiz 11.2 313
Interpreting Correlations and Scatterplots 315
The CI on the Difference Between Two Independent Correlations 320
Correlation *r* for Meta-Analysis 320
Quiz 11.3 322
Reporting Your Work 324
Take-Home Messages 325
End-of-Chapter Exercises 326
Answers to Quizzes 328
Answers to In-Chapter Exercises 328

12. Regression 331

The regression line for *Y* on *X* 332
Quiz 12.1 339
The Proportion of Variance Accounted for: r^2 344
Regression Reversed: The Regression of *X* on *Y* 346
Quiz 12.2 347
Assumptions Underlying Regression Predictions 348
Inference, and Measuring the Uncertainty of Prediction 349
Assumptions Underlying Regression CIs and Prediction Intervals 355
Three Intervals: Which Should I Use? 356
Regression to the Mean: A Possibly Strange Natural Phenomenon 357
Quiz 12.3 361
Reporting Your Work 362
Take-Home Messages 363
End-of-Chapter Exercises 364
Answers to Quizzes 366
Answers to In-Chapter Exercises 367

13. Frequencies, Proportions, and Risk 369

Research On Possible Psychic Powers 369
Proportions 370
The Confidence Interval on a Proportion 372
Quiz 13.1 375
The Difference Between Two Independent Proportions 377
The Relation Between Two Variables: Frequency Tables 379

Quiz 13.2 382
Chi-Square, an Alternative Approach to Examining the Relation in Frequency Tables 382
Risk, and the Difference Between Risks 387
Quiz 13.3 390
Reporting Your Work 390
Take-Home Messages 391
End-of-Chapter Exercises 392
Answers to Quizzes 394
Answers to In-Chapter Exercises 395

14. Extended Designs: One Independent Variable 397

The One-Way Independent Groups Design 397
Violence, Sex, and Advertising Effectiveness 398
Assumptions for the One-Way Independent Groups Design 404
Quiz 14.1 405
An Example With Full Data: Student Motivation 405
From Comparisons to Contrasts 406
Can Eating Less Delay Alzheimer's? 409
Planned and Exploratory Analysis 413
Quiz 14.2 416
The One-Way Repeated Measure Design 417
Analysis of Variance 421
Quiz 14.3 423
Reporting Your Work 424
Take-Home Messages 425
End-of-Chapter Exercises 426
Answers to Quizzes 429
Answers to In-Chapter Exercises 429

15. Extended Designs: Two Independent Variables 431

The Two-Way Independent Groups Design 431
An Example: Sleep Deprivation and False Memory 432
Quiz 15.1 439
Assumptions for the Two-Way Independent Groups Design 440
Patterns of Means for a 2 × 2 Factorial Design 440
Choosing Contrasts 446
Beyond the Two-Way Independent Groups Design 448
2 × 2 Designs With a Repeated Measure 449
Quiz 15.2 454
Extending Beyond 2 × 2 Designs 457
Analyzing One-Way and Factorial Designs: A Summary 462
Planning More Complex Designs 463
Quiz 15.3 463
Reporting Your Work 464
Take-Home Messages 465

End-of-Chapter Exercises 466
Answers to Quizzes 468
Answers to In-Chapter Exercises 468

16. Future Directions 471

A Step-By-Step Research Plan 471
How Important Is Open Science? 472
Advances in Open Science 473
Quiz 16.1 476
Dealing With Non-Normal Data 477
Archival Data 482
Quiz 16.2 484
Dealing With Numerous Dependent Variables 485
Big Data 487
Quiz 16.3 489
Reporting Your Work 489
Take-Home Messages for Chapter 16 491
Take-Home Messages for the Whole Book 492
End-of-Chapter Exercises 492
Answers to Quizzes 493
Answers to In-Chapter Exercises 493

Appendix: The ESCI Software 495
Downloading ESCI 495
Loading and Running ESCI 495
Strategy for Getting Started With a New ESCI Page 497
The ESCI Files and Their Pages 497
ESCI for Analyzing Your Own Data 499
Answers to End-of-Chapter Exercises 503
Glossary 531
References 544
Author Index 551
Subject Index 555