# BRIEF CONTENTS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>INTRODUCTION TO BIOSTATISTICS</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>DESCRIPTIVE STATISTICS</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>SOME BASIC PROBABILITY CONCEPTS</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>PROBABILITY DISTRIBUTIONS</td>
<td>92</td>
</tr>
<tr>
<td>5</td>
<td>SOME IMPORTANT SAMPLING DISTRIBUTIONS</td>
<td>134</td>
</tr>
<tr>
<td>6</td>
<td>ESTIMATION</td>
<td>161</td>
</tr>
<tr>
<td>7</td>
<td>HYPOTHESIS TESTING</td>
<td>214</td>
</tr>
<tr>
<td>8</td>
<td>ANALYSIS OF VARIANCE</td>
<td>304</td>
</tr>
<tr>
<td>9</td>
<td>SIMPLE LINEAR REGRESSION AND CORRELATION</td>
<td>413</td>
</tr>
<tr>
<td>10</td>
<td>MULTIPLE REGRESSION AND CORRELATION</td>
<td>489</td>
</tr>
<tr>
<td>11</td>
<td>REGRESSION ANALYSIS: SOME ADDITIONAL TECHNIQUES</td>
<td>539</td>
</tr>
<tr>
<td>12</td>
<td>THE CHI-SQUARE DISTRIBUTION AND THE ANALYSIS OF FREQUENCIES</td>
<td>600</td>
</tr>
<tr>
<td>13</td>
<td>NONPARAMETRIC AND DISTRIBUTION-FREE STATISTICS</td>
<td>670</td>
</tr>
<tr>
<td>14</td>
<td>SURVIVAL ANALYSIS</td>
<td>750</td>
</tr>
<tr>
<td>15</td>
<td>VITAL STATISTICS (ONLINE)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>APPENDIX: STATISTICAL TABLES</td>
<td>A-1</td>
</tr>
<tr>
<td></td>
<td>ANSWERS TO ODD-NUMBERED EXERCISES</td>
<td>A-107</td>
</tr>
<tr>
<td></td>
<td>INDEX</td>
<td>I-1</td>
</tr>
</tbody>
</table>
## CONTENTS

### 1 INTRODUCTION TO BIOSTATISTICS 1

1.1 Introduction 2  
1.2 Some Basic Concepts 2  
1.3 Measurement and Measurement Scales 5  
1.4 Sampling and Statistical Inference 7  
1.5 The Scientific Method and the Design of Experiments 13  
1.6 Computers and Biostatistical Analysis 15  
1.7 Summary 16  
Review Questions and Exercises 17  
References 18

### 2 DESCRIPTIVE STATISTICS 19

2.1 Introduction 20  
2.2 The Ordered Array 20  
2.3 Grouped Data: The Frequency Distribution 22  
2.4 Descriptive Statistics: Measures of Central Tendency 38  
2.5 Descriptive Statistics: Measures of Dispersion 43  
2.6 Summary 55  
Review Questions and Exercises 57  
References 63

### 3 SOME BASIC PROBABILITY CONCEPTS 65

3.1 Introduction 65  
3.2 Two Views of Probability: Objective and Subjective 66  
3.3 Elementary Properties of Probability 68  
3.4 Calculating the Probability of an Event 69  
3.5 Bayes' Theorem, Screening Tests, Sensitivity, Specificity, and Predictive Value Positive and Negative 78  
3.6 Summary 84  
Review Questions and Exercises 85  
References 90

### 4 PROBABILITY DISTRIBUTIONS 92

4.1 Introduction 93  
4.2 Probability Distributions of Discrete Variables 93  
4.3 The Binomial Distribution 99  
4.4 The Poisson Distribution 108  
4.5 Continuous Probability Distributions 113  
4.6 The Normal Distribution 116  
4.7 Normal Distribution Applications 122  
4.8 Summary 128  
Review Questions and Exercises 130  
References 133

### 5 SOME IMPORTANT SAMPLING DISTRIBUTIONS 134

5.1 Introduction 134  
5.2 Sampling Distributions 135  
5.3 Distribution of the Sample Mean 136  
5.4 Distribution of the Difference Between Two Sample Means 145  
5.5 Distribution of the Sample Proportion 150  
5.6 Distribution of the Difference Between Two Sample Proportions 154  
5.7 Summary 157  
Review Questions and Exercises 158  
References 160

### 6 ESTIMATION 161

6.1 Introduction 162  
6.2 Confidence Interval for a Population Mean 165
6.3 The t Distribution 171
6.4 Confidence Interval for the Difference Between Two Population Means 177
6.5 Confidence Interval for a Population Proportion 185
6.6 Confidence Interval for the Difference Between Two Population Proportions 187
6.7 Determination of Sample Size for Estimating Means 189
6.8 Determination of Sample Size for Estimating Proportions 191
6.9 Confidence Interval for the Variance of a Normally Distributed Population 193
6.10 Confidence Interval for the Ratio of the Variances of Two Normally Distributed Populations 198
6.11 Summary 203
Review Questions and Exercises 205
References 210

7 HYPOTHESIS TESTING 214
7.1 Introduction 215
7.2 Hypothesis Testing: A Single Population Mean 222
7.3 Hypothesis Testing: The Difference Between Two Population Means 236
7.4 Paired Comparisons 249
7.5 Hypothesis Testing: A Single Population Proportion 257
7.6 Hypothesis Testing: The Difference Between Two Population Proportions 261
7.7 Hypothesis Testing: A Single Population Variance 264
7.8 Hypothesis Testing: The Ratio of Two Population Variances 267
7.9 The Type II Error and the Power of a Test 272
7.10 Determining Sample Size to Control Type II Errors 277
7.11 Summary 280
Review Questions and Exercises 282
References 300

8 ANALYSIS OF VARIANCE 304
8.1 Introduction 305
8.2 The Completely Randomized Design 308
8.3 The Randomized Complete Block Design 334
8.4 The Repeated Measures Design 346
8.5 The Factorial Experiment 358
8.6 Summary 373
Review Questions and Exercises 376
References 408

9 SIMPLE LINEAR REGRESSION AND CORRELATION 413
9.1 Introduction 414
9.2 The Regression Model 414
9.3 The Sample Regression Equation 417
9.4 Evaluating the Regression Equation 427
9.5 Using the Regression Equation 441
9.6 The Correlation Model 445
9.7 The Correlation Coefficient 446
9.8 Some Precautions 459
9.9 Summary 460
Review Questions and Exercises 464
References 486

10 MULTIPLE REGRESSION AND CORRELATION 489
10.1 Introduction 490
10.2 The Multiple Linear Regression Model 490
10.3 Obtaining the Multiple Regression Equation 492
10.4 Evaluating the Multiple Regression Equation 501
10.5 Using the Multiple Regression Equation 507
10.6 The Multiple Correlation Model 510
10.7 Summary 523
Review Questions and Exercises 525
References 537
## 11 Regression Analysis: Some Additional Techniques 539

11.1 Introduction 540  
11.2 Qualitative Independent Variables 543  
11.3 Variable Selection Procedures 560  
11.4 Logistic Regression 569  
11.5 Summary 582  
   Review Questions and Exercises 583  
   References 597

## 12 The Chi-Square Distribution and the Analysis of Frequencies 600

12.1 Introduction 601  
12.2 The Mathematical Properties of the Chi-Square Distribution 601  
12.3 Tests of Goodness-of-Fit 604  
12.4 Tests of Independence 619  
12.5 Tests of Homogeneity 630  
12.6 The Fisher Exact Test 636  
12.7 Relative Risk, Odds Ratio, and the Mantel–Haenszel Statistic 641  
12.8 Summary 655  
   Review Questions and Exercises 657  
   References 666

## 13 Nonparametric and Distribution-Free Statistics 670

13.1 Introduction 671  
13.2 Measurement Scales 672  
13.3 The Sign Test 673  
13.4 The Wilcoxon Signed-Rank Test for Location 681  
13.5 The Median Test 686  
13.6 The Mann–Whitney Test 690  
13.7 The Kolmogorov–Smirnov Goodness-of-Fit Test 698  
13.8 The Kruskal–Wallis One-Way Analysis of Variance by Ranks 704  
13.9 The Friedman Two-Way Analysis of Variance by Ranks 712  
13.10 The Spearman Rank Correlation Coefficient 718  
13.11 Nonparametric Regression Analysis 727  
13.12 Summary 730  
   Review Questions and Exercises 732  
   References 747

## 14 Survival Analysis 750

14.1 Introduction 750  
14.2 Time-to-Event Data and Censoring 751  
14.3 The Kaplan–Meier Procedure 756  
14.4 Comparing Survival Curves 763  
14.5 Cox Regression: The Proportional Hazards Model 768  
14.6 Summary 773  
   Review Questions and Exercises 774  
   References 777

## 15 Vital Statistics (Online) 787

- www.wiley.com/college/daniel
- 15.1 Introduction
- 15.2 Death Rates and Ratios
- 15.3 Measures of Fertility
- 15.4 Measures of Morbidity
- 15.5 Summary
   Review Questions and Exercises
   References

## Appendix: Statistical Tables A-1

## Answers to Odd-Numbered Exercises A-107

## Index I-1