

FIFTH EDITION

STATISTICS

for Management and Economics



KELLER

WARRACK

Brief Contents

- 1 What Is Statistics? 1
- 2 Graphical Descriptive Techniques 17
- 3 Art and Science of Graphical Presentations 73
- 4 Numerical Descriptive Measures 89
- 5 Data Collection and Sampling 147
- 6 Probability and Discrete Probability Distributions 165
- 7 Continuous Probability Distributions 235
- 8 Sampling Distributions 261
- 9 Introduction to Estimation 285
- 10 Introduction to Hypothesis Testing 311
- 11 Inference About the Description of a Single Population 347
- 12 Inference About the Comparison of Two Populations 393
- REVIEW CHAPTER
- 13 Statistical Inference: A Review of Chapters 11 and 12 461
- 14 Analysis of Variance 480
- 15 Additional Test for Qualitative Data 543
- 16 Nonparametric Statistics 575
- 17 Simple Linear Regression and Correlation 625
- 18 Multiple Regression 679
- 19 Model Building 731
- 20 Time-Series Analysis and Forecasting 777
- 21 Statistical Process Control 833
- REVIEW CHAPTER
- 22 Statistical Inference: Conclusion 867
- Appendix A Data File Sample Statistics A-1
- Appendix B Tables B-1
- Appendix C Answers to Selected Even-Numbered Exercises C-1
- Index I-1
- Guide to Statistical Techniques Inside Front Cover (left)
- Guide to Statistics in the Workplace Inside Front Cover (right)
- Index of Computer Instructions Inside Back Cover (left)

Contents

1 WHAT IS STATISTICS? 1

- 1.1 Introduction to Statistics 2
- 1.2 Key Statistical Concepts 6
- 1.3 Statistical Applications in Business 7
- 1.4 Statistics and the Computer 14
- 1.5 World Wide Web and Learning Center 15

2 GRAPHICAL DESCRIPTIVE TECHNIQUES 17

- 2.1 Introduction 18
- 2.2 Types of Data 18
- 2.3 Graphical Techniques for Quantitative Data 23
- 2.4 Pie Charts, Bar Charts, and Line Charts 44
- 2.5 Scatter Diagrams 55
- 2.6 Summary 61
 - CASE 2.1 Pacific Salmon Catches 66
 - CASE 2.2 Bombardier, Inc. 66
 - CASE 2.3 The North American Free Trade Agreement (NAFTA) 67
 - APPENDIX 2.A Brief Introduction to Microsoft Excel 69
 - APPENDIX 2.B Brief Introduction to Minitab 70

3 ART AND SCIENCE OF GRAPHICAL PRESENTATIONS 73

- 3.1 Introduction 74
- 3.2 Graphical Excellence 74
- 3.3 Graphical Deception 82
- 3.4 Summary 87
 - CASE 3.1 Canadian Federal Budget 87

4 NUMERICAL DESCRIPTIVE MEASURES 89

- 4.1 Introduction 90
- 4.2 Measures of Central Location 90

4.3 Measures of Variability 102
4.4 Interpreting Standard Deviation 113
4.5 Measures of Relative Standing and Box Plots 117
4.6 Approximating Descriptive Measures for Grouped Data 124
4.7 Measures of Association 126
4.8 General Guidelines on the Exploration of Data 140
4.9 Summary 140
APPENDIX 4.A Summation Notation 144

5 DATA COLLECTION AND SAMPLING 147

5.1 Introduction 148
5.2 Sources of Data 148
5.3 Sampling 152
5.4 Sampling Plans 154
5.5 Errors Involved in Sampling 160
5.6 Use of Sampling in Auditing (Optional) 161
5.7 Summary 162

6 PROBABILITY AND DISCRETE PROBABILITY DISTRIBUTIONS 165

6.1 Introduction 166
6.2 Assigning Probabilities to Events 166
6.3 Probability Rules and Trees 178
6.4 Random Variables and Probability Distributions 186
6.5 Expected Value and Variance 192
6.6 Bivariate Distributions 200
6.7 Investment Portfolio Diversification (Optional) 205
6.8 Binomial Distribution 209
6.9 Poisson Distribution 219
6.10 Summary 225
CASE 6.1 Let's Make a Deal 231
CASE 6.2 Gains from Market Timing 231
CASE 6.3 Calculating Probabilities Associated with the Stock Market 232
CASE 6.4 To Bunt or Not to Bunt? 233

7 CONTINUOUS PROBABILITY DISTRIBUTIONS 235

- 7.1 Introduction 236
- 7.2 Continuous Probability Distributions 236
- 7.3 Normal Distribution 240
- 7.4 Exponential Distribution 254
- 7.5 Summary 259

8 SAMPLING DISTRIBUTIONS 261

- 8.1 Introduction 262
- 8.2 Sampling Distribution of the Mean 262
- 8.3 Creating the Sampling Distribution by Computer Simulation (Optional) 273
- 8.4 Sampling Distribution of a Proportion 276
- 8.5 Sampling Distribution of the Difference Between Two Means 280
- 8.6 From Here to Inference 282
- 8.7 Summary 284

9 INTRODUCTION TO ESTIMATION 285

- 9.1 Introduction 286
- 9.2 Concepts of Estimation 286
- 9.3 Estimating the Population Mean When the Population Standard Deviation Is Known 289
- 9.4 Selecting the Sample Size 302
- 9.5 Simulation Experiments (Optional) 305
- 9.6 Summary 308

10 INTRODUCTION TO HYPOTHESIS TESTING 311

- 10.1 Introduction 312
- 10.2 Concepts of Hypothesis Testing 313
- 10.3 Testing the Population Mean When the Population Standard Deviation Is Known 315
- 10.4 Calculating the Probability of a Type II Error 334
- 10.5 The Road Ahead 342
- 10.6 Summary 344

11 INFERENCE ABOUT THE DESCRIPTION OF A SINGLE POPULATION 347

- 11.1 Introduction 348
- 11.2 Inference About a Population Mean When the Population Standard Deviation Is Unknown 349
- 11.3 Inference About a Population Variance (Optional) 363
- 11.4 Inference About a Population Proportion 373
- 11.5 The Myth of the Law of Averages (Optional) 386
- 11.6 Summary 388
- CASE 11.1 Pepsi's Exclusivity Agreement with a University 391
- CASE 11.2 Pepsi's Exclusivity Agreement with a University: Coke's Side of the Equation 392
- CASE 11.3 Number of Uninsured Motorists 392

12 INFERENCE ABOUT THE COMPARISON OF TWO POPULATIONS 393

- 12.1 Introduction 394
- 12.2 Inference About the Difference Between Two Means: Independent Samples 395
- 12.3 Observational and Experimental Data 413
- 12.4 Inference About the Difference Between Two Means: Matched Pairs Experiment 414
- 12.5 Inference About the Ratio of Two Variances (Optional) 425
- 12.6 Inference About the Difference Between Two Population Proportions 434
- 12.7 Market Segmentation (Optional) 447
- 12.8 Summary 449
- CASE 12.1 Specialty Advertising Recall 454
- CASE 12.2 Bonanza International 455
- CASE 12.3 Accounting Course Exemptions 456
- APPENDIX 12.A Excel Instructions 458
- APPENDIX 12.B Minitab Instructions 459

13 REVIEW CHAPTER STATISTICAL INFERENCE: A REVIEW OF CHAPTERS 11 AND 12 461

- 13.1 Introduction 462
- 13.2 Guide to Identifying the Correct Technique: Chapters 11 and 12 462

CASE 13.1 Stock Market Returns After the Death of Key Executives 475

CASE 13.2 Quebec Separation: *Out ou Non?* 476

CASE 13.3 Host Selling and Announcer Commercials 476

14 ANALYSIS OF VARIANCE 479

14.1 Introduction 480

14.2 Single-Factor (One-Way) Analysis of Variance: Independent Samples 481

14.3 Analysis of Variance Models 497

14.4 Single-Factor Analysis of Variance: Randomized Blocks 499

14.5 Two-Factor Analysis of Variance: Independent Samples 507

14.6 Operations Management Application: Finding and Reducing Variation 521

14.7 Multiple Comparisons (Optional) 526

14.8 Bartlett's Test (Optional) 533

14.9 Summary 536

CASE 14.1 Effects of Financial Planning 540

CASE 14.2 Diversification Strategy for Multinational Firms 541

15 ADDITIONAL TEST FOR QUALITATIVE DATA 543

15.1 Introduction 544

15.2 Chi-Squared Goodness-of-Fit Test 544

15.3 Chi-Squared Test of a Contingency Table 551

15.4 Summary of Tests on Qualitative Data 560

15.5 Chi-Squared Test for Normality (Optional) 562

15.6 Summary 566

CASE 15.1 Predicting the Outcomes of Basketball, Baseball, Football, and Hockey Games from Intermediate Results 569

CASE 15.2 Can Exposure to a Code of Professional Ethics Help Make Managers More Ethical? 570

CASE 15.3 Stock Return Distributions 571

APPENDIX 15.A Minitab Instructions 573

16 NONPARAMETRIC STATISTICS 575

16.1 Introduction 576

16.2 Wilcoxon Rank Sum Test for Independent Samples 577

16.3 Sign Test and Wilcoxon Signed Rank Sum Test for Matched Pairs 589

- 16.4 Kruskal-Wallis Test 602
- 16.5 Friedman Test 608
- 16.6 Testing for Normality 613
- 16.7 Summary 618
- CASE 16.1 Capitalization Ratios in the United States and Japan 622
- CASE 16.2 Bank of Commerce Customer Survey 623

17 SIMPLE LINEAR REGRESSION AND CORRELATION 625

- 17.1 Introduction 626
- 17.2 Model 627
- 17.3 Estimating the Coefficients 629
- 17.4 Error Variable: Required Conditions 636
- 17.5 Assessing the Model 638
- 17.6 Finance Application: Market Model 649
- 17.7 Using the Regression Equation 652
- 17.8 Coefficients of Correlation 657
- 17.9 Regression Diagnostics—I 664
- 17.10 Summary 673
- CASE 17.1 Duxbury Press 676
- CASE 17.2 Predicting University Grades from High School Grades 676
- CASE 17.3 Insurance Compensation for Lost Revenues 677

18 MULTIPLE REGRESSION 679

- 18.1 Introduction 680
- 18.2 Model and Required Conditions 680
- 18.3 Estimating the Coefficients and Assessing the Model 681
- 18.4 Regression Diagnostics—II 699
- 18.5 Regression Diagnostics—III (Time Series) 714
- 18.6 Summary 725
- CASE 18.1 Duxbury Press Revisited 729
- CASE 18.2 Quebec Referendum Vote: Was There Electoral Fraud? 729
- CASE 18.3 Quebec Referendum Vote: The Rebuttal 730

19 MODEL BUILDING 731

- 19.1 Introduction 732
- 19.2 Polynomial Models 732
- 19.3 Qualitative Independent Variables 745
- 19.4 Regression and the Analysis of Variance (Optional) 755
- 19.5 Stepwise Regression 758
- 19.6 Model Building 765
- 19.7 Human Resources Management Application: Pay Equity 766
- 19.8 Summary 772
- CASE 19.1 Challenger Disaster 774
- CASE 19.2 Track and Field Performance Forecasts 775

20 TIME-SERIES ANALYSIS AND FORECASTING 777

- 20.1 Introduction 778
- 20.2 Components of a Time Series 779
- 20.3 Smoothing Techniques 781
- 20.4 Trend Analysis 794
- 20.5 Measuring the Cyclical Effect 800
- 20.6 Measuring the Seasonal Effect 805
- 20.7 Introduction to Forecasting 811
- 20.8 Time-Series Forecasting with Exponential Smoothing 814
- 20.9 Time-Series Forecasting with Regression 819
- 20.10 Summary 829

21 STATISTICAL PROCESS CONTROL 833

- 21.1 Introduction 834
- 21.2 Process Variation 834
- 21.3 Control Charts for Variables: \bar{x} and S Charts 840
- 21.4 Control Charts for Variables: \bar{x} and R Charts (Optional) 853
- 21.5 Control Chart for Attributes: p Chart 860
- 21.6 Summary 865

22 REVIEW CHAPTER STATISTICAL INFERENCE: CONCLUSION 867

- 22.1 Introduction 868
- 22.2 Identifying the Correct Techniques: Summary of Statistical Inference 868
 - CASE 22.1 Do Banks Discriminate Against Women Business Owners?—I 875
 - CASE 22.2 Do Banks Discriminate Against Women Business Owners?—II 879
- 22.3 The Last Word 885
 - CASE 22.3 Ambulance and Fire Department Response Interval Study 897
 - CASE 22.4 Underpricing in Initial Public Offerings 898
 - CASE 22.5 PC Magazine Survey 898
 - CASE 22.6 WLU Graduate Survey 899
 - CASE 22.7 Evaluation of a New Antidepressant Drug 900
 - CASE 22.8 Nutrition Education Programs 901
 - CASE 22.9 Do Banks Discriminate Against Women Business Owners?—III 901

Appendix A Data File Sample Statistics A-1

Appendix B Tables B-1

Appendix C Answers to Selected Even-Numbered Exercises C-1

Index I-1

Guide to Statistical Techniques Inside Front Cover (left)

Guide to Statistics in the Workplace Inside Front Cover (right)

Index of Computer Instructions Inside Back Cover (left)