

Basic Business Statistics

13th
Edition

Concepts and Applications



Berenson

Levine

Szabat

A ROADMAP FOR SELECTING A STATISTICAL METHOD

Data Analysis Task	For Numerical Variables	For Categorical Variables
Describing a group or several groups	<p>Ordered array, stem-and-leaf display, frequency distribution, relative frequency distribution, percentage distribution, cumulative percentage distribution, histogram, polygon, cumulative percentage polygon, bullet maps, sparklines, gauges, treemaps (Sections 2.2, 2.4, 17.1)</p> <p>Mean, median, mode, geometric mean, quartiles, range, interquartile range, standard deviation, variance, coefficient of variation, skewness, kurtosis, boxplot, normal probability plot (Sections 3.1, 3.2, 3.3, 6.3)</p> <p>Index numbers (online Section 16.8)</p> <p>Gauges, bullet graphs, and treemaps (Section 17.1)</p>	<p>Summary table, bar chart, pie chart, Pareto chart (Sections 2.1 and 2.3)</p>
Inference about one group	<p>Confidence interval estimate of the mean (Sections 8.1 and 8.2)</p> <p>t test for the mean (Section 9.2)</p> <p>Chi-square test for a variance or standard deviation (online Section 12.7)</p>	<p>Confidence interval estimate of the proportion (Section 8.3)</p> <p>Z test for the proportion (Section 9.4)</p>
Comparing two groups	<p>Tests for the difference in the means of two independent populations (Section 10.1)</p> <p>Wilcoxon rank sum test (Section 12.4)</p> <p>Paired t test (Section 10.2)</p> <p>F test for the difference between two variances (Section 10.4)</p> <p>Wilcoxon signed ranks test (online Section 12.8)</p>	<p>Z test for the difference between two proportions (Section 10.3)</p> <p>Chi-square test for the difference between two proportions (Section 12.1)</p> <p>McNemar test for two related samples (online Section 12.6)</p>
Comparing more than two groups	<p>One-way analysis of variance for comparing several means (Section 11.1)</p> <p>Kruskal-Wallis test (Section 12.5)</p> <p>Randomized block design (Section 11.2)</p> <p>Two-way analysis of variance (Section 11.3)</p> <p>Friedman rank test (online Section 12.9)</p>	<p>Chi-square test for differences among more than two proportions (Section 12.2)</p>
Analyzing the relationship between two variables	<p>Scatter plot, time series plot (Section 2.5)</p> <p>Covariance, coefficient of correlation (Section 3.5)</p> <p>Simple linear regression (Chapter 13)</p> <p>t test of correlation (Section 13.7)</p> <p>Time-series forecasting (Chapter 16)</p> <p>Sparklines (Section 17.1)</p>	<p>Contingency table, side-by-side bar chart, PivotTables (Sections 2.1, 2.3, 2.6)</p> <p>Chi-square test of independence (Section 12.3)</p>
Analyzing the relationship between two or more variables	<p>Multiple regression (Chapters 14 and 15)</p> <p>Regression trees (Section 17.3)</p> <p>Neural nets (Section 17.4)</p> <p>Cluster analysis (Section 17.5)</p> <p>Multidimensional scaling (Section 17.6)</p>	<p>Multidimensional contingency tables (Section 2.7)</p> <p>Drilldown and slicers (Section 17.1)</p> <p>Logistic regression (Section 14.7)</p> <p>Classification trees (Section 17.3)</p> <p>Neural nets (Section 17.4)</p>

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Basic Business Statistics Concepts and Applications

THIRTEENTH EDITION

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*To our spouses and children,
Rhoda, Marilyn, Kathy, Lori, and Sharyn*

*and to our parents, in loving memory,
Nat, Ethel, Lee, Reuben, Mary, and William*

About the Authors



The authors of this book: Kathryn Szabat, David Levine, and Mark Berenson at a Decision Sciences Institute meeting.

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Brief Contents

Preface xix

Getting Started: Important Things to Learn First 1

- 1 Defining and Collecting Data 13
- 2 Organizing and Visualizing Variables 36
- 3 Numerical Descriptive Measures 101
- 4 Basic Probability 151
- 5 Discrete Probability Distributions 185
- 6 The Normal Distribution and Other Continuous Distributions 219
- 7 Sampling Distributions 250
- 8 Confidence Interval Estimation 272
- 9 Fundamentals of Hypothesis Testing: One-Sample Tests 308
- 10 Two-Sample Tests 347
- 11 Analysis of Variance 394
- 12 Chi-Square and Nonparametric Tests 447
- 13 Simple Linear Regression 491
- 14 Introduction to Multiple Regression 543
- 15 Multiple Regression Model Building 596
- 16 Time-Series Forecasting 629
- 17 Business Analytics 674
- 18 A Roadmap for Analyzing Data 707
- 19 Statistical Applications in Quality Management (*online*)
- 20 Decision Making (*online*)

Appendices A–G 715

Self-Test Solutions and Answers to Selected Even-Numbered Problems 767

Index 803

Contents

Preface **xix**

Getting Started: Important Things to Learn First **1**

USING STATISTICS: “You Cannot Escape from Data” 1

- GS.1 Statistics: A Way of Thinking 2
- GS.2 Data: What Is It? 3
- GS.3 Business Analytics: The Changing Face of Statistics 4
 - “Big Data” 4
 - Statistics: An Important Part of Your Business Education 5
- GS.4 Software and Statistics 6
 - Excel and Minitab Guides 6

REFERENCES 7

KEY TERMS 7

EXCEL GUIDE 8

- EG1. Getting Started with Microsoft Excel 8
- EG2. Entering Data 8
- EG3. Opening and Saving Workbooks 9
- EG4. Creating and Copying Worksheets 10
- EG5. Printing Worksheets 10

MINITAB GUIDE 11

- MG1. Getting Started with Minitab 11
- MG2. Entering Data 11
- MG3. Opening and Saving Worksheets and Projects 11
- MG4. Creating and Copying Worksheets 12
- MG5. Printing Parts of a Project 12

1 Defining and Collecting Data **13**

USING STATISTICS: Beginning of the End ... Or the End of the Beginning? 13

- 1.1 Defining Data 14
 - Establishing the Variable Type 14
- 1.2 Measurement Scales for Variables 15
 - Nominal and Ordinal Scales 15
 - Interval and Ratio Scales 16
- 1.3 Collecting Data 18
 - Data Sources 18
 - Populations and Samples 19
 - Data Formatting 19
 - Data Cleaning 20
 - Recoding Variables 20
- 1.4 Types of Sampling Methods 21
 - Simple Random Sample 22
 - Systematic Sample 23

Stratified Sample 23

Cluster Sample 23

- 1.5 Types of Survey Errors 24
 - Coverage Error 25
 - Nonresponse Error 25
 - Sampling Error 25
 - Measurement Error 25
 - Ethical Issues About Surveys 26

THINK ABOUT THIS: New Media Surveys/Old Sampling Problems 26

USING STATISTICS: Beginning of the End ... Revisited 27

SUMMARY 28

REFERENCES 28

KEY TERMS 28

CHECKING YOUR UNDERSTANDING 29

CHAPTER REVIEW PROBLEMS 29

CASES FOR CHAPTER 1 30

- Managing Ashland MultiComm Services 30
- CardioGood Fitness 30
- Clear Mountain State Student Surveys 31
- Learning with the Digital Cases 31

CHAPTER 1 EXCEL GUIDE 33

- EG1.1 Defining Data 33
- EG1.2 Measurement Scales for Variables 33
- EG1.3 Collecting Data 33
- EG1.4 Types of Sampling Methods 33

CHAPTER 1 MINITAB GUIDE 34

- MG1.1 Defining Data 34
- MG1.2 Measurement Scales for Variables 34
- MG1.3 Collecting Data 35
- MG1.4 Types of Sampling Methods 35

2 Organizing and Visualizing Variables **36**

USING STATISTICS: The Choice Is Yours 36

How to Proceed with This Chapter 37

- 2.1 Organizing Categorical Variables 38
 - The Summary Table 38
 - The Contingency Table 39
- 2.2 Organizing Numerical Variables 42
 - The Ordered Array 42
 - The Frequency Distribution 43
 - Classes and Excel Bins 45
 - The Relative Frequency Distribution and the Percentage Distribution 45
 - The Cumulative Distribution 47
 - Stacked and Unstacked Data 49

- 2.3 Visualizing Categorical Variables 51
 - The Bar Chart 51
 - The Pie Chart 52
 - The Pareto Chart 53
 - The Side-by-Side Bar Chart 55
- 2.4 Visualizing Numerical Variables 57
 - The Stem-and-Leaf Display 57
 - The Histogram 59
 - The Percentage Polygon 60
 - The Cumulative Percentage Polygon (Ogive) 61
- 2.5 Visualizing Two Numerical Variables 65
 - The Scatter Plot 65
 - The Time-Series Plot 66
- 2.6 Organizing Many Categorical Variables 68
- 2.7 Challenges in Organizing and Visualizing Variables 70
 - Obscuring Data 70
 - Creating False Impressions 71
 - Chartjunk 72
 - Guidelines for Constructing Visualizations 74

USING STATISTICS: The Choice Is Yours, Revisited 75

- SUMMARY 75
- REFERENCES 76
- KEY EQUATIONS 76
- KEY TERMS 77
- CHECKING YOUR UNDERSTANDING 77
- CHAPTER REVIEW PROBLEMS 77

CASES FOR CHAPTER 2 82

- Managing Ashland MultiComm Services 82
- Digital Case 83
- CardioGood Fitness 83
- The Choice Is Yours Follow-Up 83
- Clear Mountain State Student Surveys 84

CHAPTER 2 EXCEL GUIDE 85

- EG2.1 Organizing Categorical Variables 85
- EG2.2 Organizing Numerical Variables 87
- EG2.3 Visualizing Categorical Variables 89
- EG2.4 Visualizing Numerical Variables 91
- EG2.5 Visualizing Two Numerical Variables 94
- EG2.6 Organizing Many Categorical Variables 94

CHAPTER 2 MINITAB GUIDE 95

- MG2.1 Organizing Categorical Variables 95
- MG2.2 Organizing Numerical Variables 96
- MG2.3 Visualizing Categorical Variables 96
- MG2.4 Visualizing Numerical Variables 98
- MG2.5 Visualizing Two Numerical Variables 100
- MG2.6 Organizing Many Categorical Variables 100

3 Numerical Descriptive Measures

USING STATISTICS: More Descriptive Choices 101

- 3.1 Central Tendency 102
 - The Mean 102
 - The Median 104
 - The Mode 105
 - The Geometric Mean 106

- 3.2 Variation and Shape 107
 - The Range 107
 - The Variance and the Standard Deviation 108
 - The Coefficient of Variation 112
 - Z Scores 113
 - Shape: Skewness and Kurtosis 114

VISUAL EXPLORATIONS: Exploring Descriptive Statistics 117

- 3.3 Exploring Numerical Data 120
 - Quartiles 120
 - The Interquartile Range 122
 - The Five-Number Summary 123
 - The Boxplot 124
- 3.4 Numerical Descriptive Measures for a Population 127
 - The Population Mean 127
 - The Population Variance and Standard Deviation 128
 - The Empirical Rule 129
 - The Chebyshev Rule 130
- 3.5 The Covariance and the Coefficient of Correlation 131
 - The Covariance 132
 - The Coefficient of Correlation 133

USING STATISTICS: More Descriptive Choices, Revisited 138

- SUMMARY 138
- REFERENCES 139
- KEY EQUATIONS 139
- KEY TERMS 140
- CHECKING YOUR UNDERSTANDING 140
- CHAPTER REVIEW PROBLEMS 141

CASES FOR CHAPTER 3 144

- Managing Ashland MultiComm Services 144
- Digital Case 144
- CardioGood Fitness 144
- More Descriptive Choices Follow-up 144
- Clear Mountain State Student Surveys 144

CHAPTER 3 EXCEL GUIDE 145

- EG3.1 Central Tendency 145
- EG3.2 Variation and Shape 145
- EG3.3 Exploring Numerical Data 146
- EG3.4 Numerical Descriptive Measures for a Population 147
- EG3.5 The Covariance and the Coefficient of Correlation 147

CHAPTER 3 MINITAB GUIDE 148

- MG3.1 Central Tendency 148
- MG3.2 Variation and Shape 148
- MG3.3 Exploring Numerical Data 149
- MG3.4 Numerical Descriptive Measures for a Population 149
- MG3.5 The Covariance and the Coefficient of Correlation 149

4 Basic Probability

USING STATISTICS: Possibilities at M&R Electronics World 151

- 4.1 Basic Probability Concepts 152
 - Events and Sample Spaces 153
 - Contingency Tables and Venn Diagrams 155
 - Simple Probability 155
 - Joint Probability 156

	Marginal Probability	157
	General Addition Rule	158
4.2	Conditional Probability	161
	Computing Conditional Probabilities	161
	Decision Trees	163
	Independence	165
	Multiplication Rules	166
	Marginal Probability Using the General Multiplication Rule	167
4.3	Bayes' Theorem	169
	THINK ABOUT THIS: Divine Providence and Spam	172
4.4	Counting Rules	174
4.5	Ethical Issues and Probability	177
	USING STATISTICS: Possibilities at M&R Electronics World, Revisited	178
	SUMMARY	178
	REFERENCES	178
	KEY EQUATIONS	179
	KEY TERMS	179
	CHECKING YOUR UNDERSTANDING	180
	CHAPTER REVIEW PROBLEMS	180
	CASES FOR CHAPTER 4	182
	Digital Case	182
	CardioGood Fitness	182
	The Choice <i>Is</i> Yours Follow-Up	182
	Clear Mountain State Student Surveys	182
	CHAPTER 4 EXCEL GUIDE	183
	EG4.1 Basic Probability Concepts	183
	EG4.2 Conditional Probability	183
	EG4.3 Bayes' Theorem	183
	EG4.4 Counting Rules	183
	CHAPTER 4 MINITAB GUIDE	184
	MG4.1 Basic Probability Concepts	184
	MG4.2 Conditional Probability	184
	MG4.3 Bayes' Theorem	184
	MG4.4 Counting Rules	184

5 Discrete Probability Distributions 185

	USING STATISTICS: Events of Interest at Ricknel Home Centers	185
5.1	The Probability Distribution for a Discrete Variable	186
	Expected Value of a Discrete Variable	186
	Variance and Standard Deviation of a Discrete Variable	187
5.2	Covariance of a Probability Distribution and Its Application in Finance	189
	Covariance	190
	Expected Value, Variance, and Standard Deviation of the Sum of Two Variables	191
	Portfolio Expected Return and Portfolio Risk	191
5.3	Binomial Distribution	195

5.4	Poisson Distribution	202
5.5	Hypergeometric Distribution	206
5.6	Using the Poisson Distribution to Approximate the Binomial Distribution (<i>online</i>)	209
	USING STATISTICS: Events of Interest at Ricknel Homecenters, Revisited	209
	SUMMARY	209
	REFERENCES	209
	KEY EQUATIONS	210
	KEY TERMS	210
	CHECKING YOUR UNDERSTANDING	211
	CHAPTER REVIEW PROBLEMS	211

CASES FOR CHAPTER 5 213

Managing Ashland MultiComm Services	213
Digital Case	214

CHAPTER 5 EXCEL GUIDE 215

EG5.1 The Probability Distribution for a Discrete Variable	215
EG5.2 Covariance of a Probability Distribution and its Application in Finance	215
EG5.3 Binomial Distribution	215
EG5.4 Poisson Distribution	216
EG5.5 Hypergeometric Distribution	216

CHAPTER 5 MINITAB GUIDE 217

MG5.1 The Probability Distribution for a Discrete Variable	217
MG5.2 Covariance and its Application in Finance	217
MG5.3 Binomial Distribution	217
MG5.4 Poisson Distribution	217
MG5.5 Hypergeometric Distribution	218

6 The Normal Distribution and Other Continuous Distributions 219

USING STATISTICS: Normal Downloading at MyTVLab 219

6.1	Continuous Probability Distributions	220
6.2	The Normal Distribution	220
	Computing Normal Probabilities	222
	Finding X Values	227
	VISUAL EXPLORATIONS: Exploring the Normal Distribution	231
	THINK ABOUT THIS: What Is Normal?	231
6.3	Evaluating Normality	233
	Comparing Data Characteristics to Theoretical Properties	233
	Constructing the Normal Probability Plot	235
6.4	The Uniform Distribution	237
6.5	The Exponential Distribution	240
6.6	The Normal Approximation to the Binomial Distribution (<i>online</i>)	242

USING STATISTICS: Normal Downloading at MyTVLab, Revisited 242

- SUMMARY 243
- REFERENCES 243
- KEY EQUATIONS 243
- KEY TERMS 244
- CHECKING YOUR UNDERSTANDING 244
- CHAPTER REVIEW PROBLEMS 244

CASES FOR CHAPTER 6 245

- Managing Ashland MultiComm Services 245
- Digital Case 246
- CardioGood Fitness 246
- More Descriptive Choices Follow-up 246
- Clear Mountain State Student Surveys 246

CHAPTER 6 EXCEL GUIDE 247

- EG6.1 Continuous Probability Distributions 247
- EG6.2 The Normal Distribution 247
- EG6.3 Evaluating Normality 247
- EG6.4 The Uniform Distribution 248
- EG6.5 The Exponential Distribution 248

CHAPTER 6 MINITAB GUIDE 248

- MG6.1 Continuous Probability Distributions 248
- MG6.2 The Normal Distribution 248
- MG6.3 Evaluating Normality 248
- MG6.4 The Uniform Distribution 249
- MG6.5 The Exponential Distribution 249

7 Sampling Distributions 250

USING STATISTICS: Sampling Oxford Cereals 250

- 7.1 Sampling Distributions 251
- 7.2 Sampling Distribution of the Mean 251
 - The Unbiased Property of the Sample Mean 251
 - Standard Error of the Mean 253
 - Sampling from Normally Distributed Populations 254
 - Sampling from Non-normally Distributed Populations—The Central Limit Theorem 257

VISUAL EXPLORATIONS: Exploring Sampling Distributions 261

- 7.3 Sampling Distribution of the Proportion 262
- 7.4 Sampling from Finite Populations (*online*) 265

USING STATISTICS: Sampling Oxford Cereals, Revisited 266

- SUMMARY 266
- REFERENCES 266
- KEY EQUATIONS 266
- KEY TERMS 267
- CHECKING YOUR UNDERSTANDING 267
- CHAPTER REVIEW PROBLEMS 267

CASES FOR CHAPTER 7 269

- Managing Ashland MultiComm Services 269
- Digital Case 269

CHAPTER 7 EXCEL GUIDE 270

- EG7.1 Sampling Distributions 270
- EG7.2 Sampling Distribution of the Mean 270
- EG7.3 Sampling Distribution of the Proportion 270

CHAPTER 7 MINITAB GUIDE 271

- MG7.1 Sampling Distributions 271

- MG7.2 Sampling Distribution of the Mean 271
- MG7.3 Sampling Distribution of the Proportion 271

8 Confidence Interval Estimation 272

USING STATISTICS: Getting Estimates at Ricknel Home Centers 272

- 8.1 Confidence Interval Estimate for the Mean (σ Known) 273
 - Can You Ever Know the Population Standard Deviation? 278
- 8.2 Confidence Interval Estimate for the Mean (σ Unknown) 279
 - Student's t Distribution 279
 - Properties of the t Distribution 280
 - The Concept of Degrees of Freedom 281
 - The Confidence Interval Statement 282
- 8.3 Confidence Interval Estimate for the Proportion 287
- 8.4 Determining Sample Size 290
 - Sample Size Determination for the Mean 290
 - Sample Size Determination for the Proportion 292
- 8.5 Confidence Interval Estimation and Ethical Issues 295
- 8.6 Application of Confidence Interval Estimation in Auditing (*online*) 296
- 8.7 Estimation and Sample Size Estimation for Finite Populations (*online*) 296
- 8.8 Bootstrapping (*online*) 296

USING STATISTICS: Getting Estimates at Ricknel Home Centers, Revisited 296

- SUMMARY 297
- REFERENCES 297
- KEY EQUATIONS 297
- KEY TERMS 298
- CHECKING YOUR UNDERSTANDING 298
- CHAPTER REVIEW PROBLEMS 298

CASES FOR CHAPTER 8 301

- Managing Ashland MultiComm Services 301
- Digital Case 302
- Sure Value Convenience Stores 303
- CardioGood Fitness 303
- More Descriptive Choices Follow-Up 303
- Clear Mountain State Student Surveys 303

CHAPTER 8 EXCEL GUIDE 304

- EG8.1 Confidence Interval Estimate for the Mean (σ Known) 304
- EG8.2 Confidence Interval Estimate for the Mean (σ Unknown) 304
- EG8.3 Confidence Interval Estimate for the Proportion 305
- EG8.4 Determining Sample Size 305

CHAPTER 8 MINITAB GUIDE 306

- MG8.1 Confidence Interval Estimate for the Mean (σ Known) 306
- MG8.2 Confidence Interval Estimate for the Mean (σ Unknown) 306
- MG8.3 Confidence Interval Estimate for the Proportion 306
- MG8.4 Determining Sample Size 307

9 Fundamentals of Hypothesis Testing: One-Sample Tests 308

USING STATISTICS: Significant Testing at Oxford Cereals 308

- 9.1 Fundamentals of Hypothesis-Testing Methodology 309
 - The Null and Alternative Hypotheses 309
 - The Critical Value of the Test Statistic 310
 - Regions of Rejection and Nonrejection 311
 - Risks in Decision Making Using Hypothesis Testing 311
 - Z Test for the Mean (σ Known) 314
 - Hypothesis Testing Using the Critical Value Approach 314
 - Hypothesis Testing Using the p -Value Approach 317
 - A Connection Between Confidence Interval Estimation and Hypothesis Testing 319
 - Can You Ever Know the Population Standard Deviation? 320
- 9.2 t Test of Hypothesis for the Mean (σ Unknown) 321
 - The Critical Value Approach 322
 - The p -Value Approach 324
 - Checking the Normality Assumption 324
- 9.3 One-Tail Tests 328
 - The Critical Value Approach 328
 - The p -Value Approach 329
- 9.4 Z Test of Hypothesis for the Proportion 332
 - The Critical Value Approach 333
 - The p -Value Approach 334
- 9.5 Potential Hypothesis-Testing Pitfalls and Ethical Issues 336
 - Statistical Significance Versus Practical Significance 336
 - Statistical *Insignificance* Versus Importance 337
 - Reporting of Findings 337
 - Ethical Issues 337
- 9.6 Power of a Test (*online*) 337

USING STATISTICS: Significant Testing at Oxford Cereals, Revisited 338

- SUMMARY 338
- REFERENCES 338
- KEY EQUATIONS 339
- KEY TERMS 339
- CHECKING YOUR UNDERSTANDING 339
- CHAPTER REVIEW PROBLEMS 339

CASES FOR CHAPTER 9 341

- Managing Ashland MultiComm Services 341
- Digital Case 342
- Sure Value Convenience Stores 342

CHAPTER 9 EXCEL GUIDE 343

- EG9.1 Fundamentals of Hypothesis-Testing Methodology 343
- EG9.2 t Test of Hypothesis for the Mean (σ Unknown) 343
- EG9.3 One-Tail Tests 344
- EG9.4 Z Test of Hypothesis for the Proportion 344

CHAPTER 9 MINITAB GUIDE 345

- MG9.1 Fundamentals of Hypothesis-Testing Methodology 345
- MG9.2 t Test of Hypothesis for the Mean (σ Unknown) 345

- MG9.3 One-Tail Tests 345
- MG9.4 Z Test of Hypothesis for the Proportion 346

10 Two-Sample Tests 347

USING STATISTICS: For North Fork, Are There Different Means to the Ends? 347

- 10.1 Comparing the Means of Two Independent Populations 348
 - Pooled-Variance t Test for the Difference Between Two Means 348
 - Confidence Interval Estimate for the Difference Between Two Means 353
 - t Test for the Difference Between Two Means, Assuming Unequal Variances 354
 - Do People Really Do This? 356
- 10.2 Comparing the Means of Two Related Populations 359
 - Paired t Test 360
 - Confidence Interval Estimate for the Mean Difference 365
- 10.3 Comparing the Proportions of Two Independent Populations 367
 - Z Test for the Difference Between Two Proportions 367
 - Confidence Interval Estimate for the Difference Between Two Proportions 371
- 10.4 F Test for the Ratio of Two Variances 373
- 10.5 Effect Size (*online*)

USING STATISTICS: For North Fork, Are There Different Means to the Ends? Revisited 378

- SUMMARY 379
- REFERENCES 380
- KEY EQUATIONS 380
- KEY TERMS 381
- CHECKING YOUR UNDERSTANDING 381
- CHAPTER REVIEW PROBLEMS 381

CASES FOR CHAPTER 10 383

- Managing Ashland MultiComm Services 383
- Digital Case 384
- Sure Value Convenience Stores 384
- CardioGood Fitness 384
- More Descriptive Choices Follow-Up 385
- Clear Mountain State Student Surveys 385

CHAPTER 10 EXCEL GUIDE 386

- EG10.1 Comparing the Means of Two Independent Populations 386
- EG10.2 Comparing the Means of Two Related Populations 388
- EG10.3 Comparing the Proportions of Two Independent Populations 389
- EG10.4 F Test for the Ratio of Two Variances 389

CHAPTER 10 MINITAB GUIDE 391

- MG10.1 Comparing the Means of Two Independent Populations 391
- MG10.2 Comparing the Means of Two Related Populations 391
- MG10.3 Comparing the Proportions of Two Independent Populations 392
- MG10.4 F Test for the Ratio of Two Variances 392

11 Analysis of Variance 394

USING STATISTICS: The Means to Find Differences at Arlington's 394

- 11.1 The Completely Randomized Design: One-Way ANOVA 395
 - Analyzing Variation in One-Way ANOVA 396
 - F Test for Differences Among More Than Two Means 398
 - Multiple Comparisons: The Tukey-Kramer Procedure 402
 - The Analysis of Means (ANOM) (*online*) 404
 - ANOVA Assumptions 405
 - Levene Test for Homogeneity of Variance 405
- 11.2 The Randomized Block Design 410
 - Testing for Factor and Block Effects 410
 - Multiple Comparisons: The Tukey Procedure 415
- 11.3 The Factorial Design: Two-Way ANOVA 418
 - Factor and Interaction Effects 419
 - Testing for Factor and Interaction Effects 421
 - Multiple Comparisons: The Tukey Procedure 424
 - Visualizing Interaction Effects: The Cell Means Plot 426
 - Interpreting Interaction Effects 426
- 11.4 Fixed Effects, Random Effects, and Mixed Effects Models (*online*) 431

USING STATISTICS: The Means to Find Differences at Arlington's Revisited 431

- SUMMARY 431
- REFERENCES 432
- KEY EQUATIONS 432
- KEY TERMS 433
- CHECKING YOUR UNDERSTANDING 434
- CHAPTER REVIEW PROBLEMS 434

CASES FOR CHAPTER 11 437

- Managing Ashland MultiComm Services 437
- Digital Case 437
- Sure Value Convenience Stores 438
- CardioGood Fitness 438
- More Descriptive Choices Follow-Up 438
- Clear Mountain State Student Surveys 438

CHAPTER 11 EXCEL GUIDE 440

- EG11.1 The Completely Randomized Design: One-Way ANOVA 440
- EG11.2 The Randomized Block Design 442
- EG11.3 The Factorial Design: Two-Way ANOVA 443

CHAPTER 11 MINITAB GUIDE 444

- MG11.1 The Completely Randomized Design: One-Way ANOVA 444
- MG11.2 The Randomized Block Design 445
- MG11.3 The Factorial Design: Two-Way ANOVA 445

12 Chi-Square and Nonparametric Tests 447

USING STATISTICS: Avoiding Guesswork About Resort Guests 447

- 12.1 Chi-Square Test for the Difference Between Two Proportions 448

- 12.2 Chi-Square Test for Differences Among More Than Two Proportions 455

- The Marascuilo Procedure 458
- The Analysis of Proportions (ANOP) (*online*) 460

- 12.3 Chi-Square Test of Independence 461
- 12.4 Wilcoxon Rank Sum Test: A Nonparametric Method for Two Independent Populations 467
- 12.5 Kruskal-Wallis Rank Test: A Nonparametric Method for the One-Way ANOVA 473
 - Assumptions 476
- 12.6 McNemar Test for the Difference Between Two Proportions (Related Samples) (*online*) 477
- 12.7 Chi-Square Test for the Variance or Standard Deviation (*online*) 478
- 12.8 Wilcoxon Signed Ranks Test: A Nonparametric Test for Two Related Populations (*online*) 478
- 12.9 Friedman Rank Test: A Nonparametric Test for the Randomized Block Design (*online*) 478

USING STATISTICS: Avoiding Guesswork About Resort Guests, Revisited 478

- SUMMARY 479
- REFERENCES 479
- KEY EQUATIONS 480
- KEY TERMS 480
- CHECKING YOUR UNDERSTANDING 480
- CHAPTER REVIEW PROBLEMS 480

CASES FOR CHAPTER 12 482

- Managing Ashland MultiComm Services 482
- Digital Case 483
- Sure Value Convenience Stores 483
- CardioGood Fitness 484
- More Descriptive Choices Follow-Up 484
- Clear Mountain State Student Surveys 484

CHAPTER 12 EXCEL GUIDE 486

- EG12.1 Chi-Square Test for the Difference Between Two Proportions 486
- EG12.2 Chi-Square Test for Differences Among More Than Two Proportions 486
- EG12.3 Chi-Square Test of Independence 487
- EG12.4 Wilcoxon Rank Sum Test: a Nonparametric Method for Two Independent Populations 487
- EG12.5 Kruskal-Wallis Rank Test: a Nonparametric Method for the One-Way ANOVA 488

CHAPTER 12 MINITAB GUIDE 489

- MG12.1 Chi-Square Test for the Difference Between Two Proportions 489
- MG12.2 Chi-Square Test for Differences Among More Than Two Proportions 489
- MG12.3 Chi-Square Test of Independence 489
- MG12.4 Wilcoxon Rank Sum Test: a Nonparametric Method for Two Independent Populations 489
- MG12.5 Kruskal-Wallis Rank Test: a Nonparametric Method for the One-Way ANOVA 490

13 Simple Linear Regression 491

USING STATISTICS: Knowing Customers at Sunflowers Apparel 491

- 13.1 Types of Regression Models 492
 - Simple Linear Regression Models 493
- 13.2 Determining the Simple Linear Regression Equation 494
 - The Least-Squares Method 494
 - Predictions in Regression Analysis: Interpolation Versus Extrapolation 497
 - Computing the Y Intercept, b_0 , and the Slope, b_1 497

VISUAL EXPLORATIONS: Exploring Simple Linear Regression Coefficients 500

- 13.3 Measures of Variation 502
 - Computing the Sum of Squares 502
 - The Coefficient of Determination 503
 - Standard Error of the Estimate 505
- 13.4 Assumptions of Regression 507
- 13.5 Residual Analysis 507
 - Evaluating the Assumptions 507
- 13.6 Measuring Autocorrelation: The Durbin-Watson Statistic 511
 - Residual Plots to Detect Autocorrelation 511
 - The Durbin-Watson Statistic 512
- 13.7 Inferences About the Slope and Correlation Coefficient 515
 - t Test for the Slope 516
 - F Test for the Slope 517
 - Confidence Interval Estimate for the Slope 519
 - t Test for the Correlation Coefficient 519
- 13.8 Estimation of Mean Values and Prediction of Individual Values 523
 - The Confidence Interval Estimate for the Mean Response 523
 - The Prediction Interval for an Individual Response 524
- 13.9 Potential Pitfalls in Regression 527
 - Six Steps for Avoiding the Potential Pitfalls 529

USING STATISTICS: Knowing Customers at Sunflowers Apparel, Revisited 529

SUMMARY 529
REFERENCES 530
KEY EQUATIONS 531
KEY TERMS 532
CHECKING YOUR UNDERSTANDING 532
CHAPTER REVIEW PROBLEMS 532

CASES FOR CHAPTER 13 536

- Managing Ashland MultiComm Services 536
- Digital Case 536
- Brynne Packaging 536

CHAPTER 13 EXCEL GUIDE 538

- EG13.1 Types of Regression Models 538
- EG13.2 Determining the Simple Linear Regression Equation 538
- EG13.3 Measures of Variation 539
- EG13.4 Assumptions of Regression 539
- EG13.5 Residual Analysis 539
- EG13.6 Measuring Autocorrelation: the Durbin-Watson Statistic 540

- EG13.7 Inferences About the Slope and Correlation Coefficient 540
- EG13.8 Estimation of Mean Values and Prediction of Individual Values 540

CHAPTER 13 MINITAB GUIDE 541

- MG13.1 Types of Regression Models 541
- MG13.2 Determining the Simple Linear Regression Equation 541
- MG13.3 Measures of Variation 541
- MG13.4 Assumptions 541
- MG13.5 Residual Analysis 541
- MG13.6 Measuring Autocorrelation: the Durbin-Watson Statistic 542
- MG13.7 Inferences About the Slope and Correlation Coefficient 542
- MG13.8 Estimation of Mean Values and Prediction of Individual Values 542

14 Introduction to Multiple Regression 543

USING STATISTICS: The Multiple Effects of OmniPower Bars 543

- 14.1 Developing a Multiple Regression Model 544
 - Interpreting the Regression Coefficients 545
 - Predicting the Dependent Variable Y 547
- 14.2 r^2 , Adjusted r^2 , and the Overall F Test 550
 - Coefficient of Multiple Determination 550
 - Adjusted r^2 550
 - Test for the Significance of the Overall Multiple Regression Model 551
- 14.3 Residual Analysis for the Multiple Regression Model 553
- 14.4 Inferences Concerning the Population Regression Coefficients 555
 - Tests of Hypothesis 555
 - Confidence Interval Estimation 556
- 14.5 Testing Portions of the Multiple Regression Model 558
 - Coefficients of Partial Determination 562
- 14.6 Using Dummy Variables and Interaction Terms in Regression Models 563
 - Dummy Variables 564
 - Interactions 566
- 14.7 Logistic Regression 573
- 14.8 Influence Analysis 578
 - The Hat Matrix Elements, h_i 579
 - The Studentized Deleted Residuals, t_i 579
 - Cook's Distance Statistic, D_i 579
 - Comparison of Statistics 580

USING STATISTICS: The Multiple Effects of Omnipower Bars, Revisited 581

SUMMARY 581
REFERENCES 583
KEY EQUATIONS 583
KEY TERMS 584
CHECKING YOUR UNDERSTANDING 584
CHAPTER REVIEW PROBLEMS 584

CASES FOR CHAPTER 14 587

- Managing Ashland MultiComm Services 587
- Digital Case 588

CHAPTER 14 EXCEL GUIDE 589

- EG14.1 Developing a Multiple Regression Model 589
- EG14.2 r^2 , Adjusted r^2 , and the Overall F Test 590
- EG14.3 Residual Analysis for the Multiple Regression Model 590
- EG14.4 Inferences Concerning the Population Regression Coefficients 591
- EG14.5 Testing Portions of the Multiple Regression Model 591
- EG14.6 Using Dummy Variables and Interaction Terms in Regression Models 591
- EG14.7 Logistic Regression 591
- EG14.8 Influence Analysis 592

CHAPTER 14 MINITAB GUIDE 592

- MG14.1 Developing a Multiple Regression Model 592
- MG14.2 r^2 , Adjusted r^2 , and the Overall F Test 593
- MG14.3 Residual Analysis for the Multiple Regression Model 593
- MG14.4 Inferences Concerning the Population Regression Coefficients 593
- MG14.5 Testing Portions of the Multiple Regression Model 594
- MG14.6 Using Dummy Variables and Interaction Terms in Regression Models 594
- MG14.7 Logistic Regression 594
- MG14.8 Influence Analysis 595

15 Multiple Regression Model Building 596

USING STATISTICS: Valuing Parsimony at WSTA-TV 596

- 15.1 The Quadratic Regression Model 597
 - Finding the Regression Coefficients and Predicting Y 597
 - Testing for the Significance of the Quadratic Model 599
 - Testing the Quadratic Effect 600
 - The Coefficient of Multiple Determination 602
- 15.2 Using Transformations in Regression Models 604
 - The Square-Root Transformation 605
 - The Log Transformation 605
- 15.3 Collinearity 608
- 15.4 Model Building 609
 - The Stepwise Regression Approach to Model Building 611
 - The Best-Subsets Approach to Model Building 612
 - Model Validation 616
 - Steps for Successful Model Building 616
- 15.5 Pitfalls in Multiple Regression and Ethical Issues 618
 - Pitfalls in Multiple Regression 618
 - Ethical Issues 618

USING STATISTICS: Valuing Parsimony at WSTA-TV, Revisited 619

- SUMMARY 619
- KEY EQUATIONS 619
- REFERENCES 621
- KEY TERMS 621
- CHECKING YOUR UNDERSTANDING 621
- CHAPTER REVIEW PROBLEMS 621

CASES FOR CHAPTER 15 623

- The Mountain States Potato Company 623
- Sure Value Convenience Stores 623
- Digital Case 623

- The Craybill Instrumentation Company Case 624
- More Descriptive Choices Follow-Up 624

CHAPTER 15 EXCEL GUIDE 625

- EG15.1 The Quadratic Regression Model 625
- EG15.2 Using Transformations in Regression Models 625
- EG15.3 Collinearity 625
- EG15.4 Model Building 626

CHAPTER 15 MINITAB GUIDE 626

- MG15.1 The Quadratic Regression Model 626
- MG15.2 Using Transformations in Regression Models 627
- MG15.3 Collinearity 627
- MG15.4 Model Building 627

16 Time-Series Forecasting 629

USING STATISTICS: Principled Forecasting 629

- 16.1 The Importance of Business Forecasting 630
- 16.2 Component Factors of Time-Series Models 630
- 16.3 Smoothing an Annual Time Series 631
 - Moving Averages 632
 - Exponential Smoothing 634
- 16.4 Least-Squares Trend Fitting and Forecasting 637
 - The Linear Trend Model 637
 - The Quadratic Trend Model 639
 - The Exponential Trend Model 641
 - Model Selection Using First, Second, and Percentage Differences 643
- 16.5 Autoregressive Modeling for Trend Fitting and Forecasting 647
 - Selecting an Appropriate Autoregressive Model 648
 - Determining the Appropriateness of a Selected Model 649
- 16.6 Choosing an Appropriate Forecasting Model 655
 - Performing a Residual Analysis 655
 - Measuring the Magnitude of the Residuals Through Squared or Absolute Differences 655
 - Using the Principle of Parsimony 656
 - A Comparison of Four Forecasting Methods 656
- 16.7 Time-Series Forecasting of Seasonal Data 658
 - Least-Squares Forecasting with Monthly or Quarterly Data 659
- 16.8 Index Numbers (*online*) 664

THINK ABOUT THIS: Let the Model User Beware 664**USING STATISTICS: Principled Forecasting, Revisited 664**

- SUMMARY 665
- REFERENCES 665
- KEY EQUATIONS 666
- KEY TERMS 666
- CHECKING YOUR UNDERSTANDING 667
- CHAPTER REVIEW PROBLEMS 667

CASES FOR CHAPTER 16 668

- Managing Ashland MultiComm Services 668
- Digital Case 668

CHAPTER 16 EXCEL GUIDE 669

- EG16.1 The Importance of Business Forecasting 669
- EG16.2 Component Factors of Time-Series Models 669
- EG16.3 Smoothing an Annual Time Series 669

- EG16.4 Least-Squares Trend Fitting and Forecasting 670
- EG16.5 Autoregressive Modeling for Trend Fitting and Forecasting 670
- EG16.6 Choosing an Appropriate Forecasting Model 671
- EG16.7 Time-Series Forecasting of Seasonal Data 671

CHAPTER 16 MINITAB GUIDE 672

- MG16.1 The Importance of Business Forecasting 672
- MG16.2 Component Factors of Time-Series Models 672
- MG16.3 Smoothing an Annual Time Series 672
- MG16.4 Least-Squares Trend Fitting and Forecasting 673
- MG16.5 Autoregressive Modeling for Trend Fitting and Forecasting 673
- MG16.6 Choosing an Appropriate Forecasting Model 673
- MG16.7 Time-Series Forecasting of Seasonal Data 673

17 Business Analytics 674

USING STATISTICS: Finding the Right Lines at WaldoLands 674

- 17.1 Descriptive Analytics 675
 - Dashboards 676
 - Data Discovery 678
- 17.2 Predictive Analytics 682
- 17.3 Classification and Regression Trees 683
 - Regression Tree Example 685
- 17.4 Neural Networks 688
 - Multilayer Perceptrons 688
- 17.5 Cluster Analysis 691
- 17.6 Multidimensional Scaling 693

USING STATISTICS: Finding the Right Lines at Waldolands, Revisited 696

REFERENCES 697

KEY EQUATIONS 697

KEY TERMS 697

CHECKING YOUR UNDERSTANDING 698

CHAPTER REVIEW PROBLEMS 698

CASE FOR CHAPTER 17

The Mountain States Potato Company 699

CHAPTER 17 SOFTWARE GUIDE 700

- SG17.1 Descriptive Analytics 700
- SG17.2 Predictive Analytics 704
- SG17.3 Classification and Regression Trees 704
- SG17.4 Neural Networks 705
- SG17.5 Cluster Analysis 706
- SG17.6 Multidimensional Scaling 706

18 A Roadmap for Analyzing Data 707

USING STATISTICS: Mounting Future Analyses 707

- 18.1 Analyzing Numerical Variables 709
 - Describing the Characteristics of a Numerical Variable 710
 - Reaching Conclusions About the Population Mean and/or Standard Deviation 710

Determining Whether the Mean and/or Standard Deviation Differs Depending on the Group 710

Determining Which Factors Affect the Value of a Variable 711

Predicting the Value of a Variable Based on the Values of Other Variables 711

Determining Whether the Values of a Variable Are Stable Over Time 711

18.2 Analyzing Categorical Variables 711

Describing the Proportion of Items of Interest in Each Category 712

Reaching Conclusions About the Proportion of Items of Interest 712

Determining Whether the Proportion of Items of Interest Differs Depending on the Group 712

Predicting the Proportion of Items of Interest Based on the Values of Other Variables 712

Determining Whether the Proportion of Items of Interest Is Stable Over Time 712

USING STATISTICS: Mounting Future Analyses, Revisited 713 Digital Case 713

CHAPTER REVIEW PROBLEMS 713

19 Statistical Applications in Quality Management (online)

USING STATISTICS: Finding Quality at the Beachcomber

- 19.1 The Theory of Control Charts
- 19.2 Control Chart for the Proportion: The p Chart
- 19.3 The Red Bead Experiment: Understanding Process Variability
- 19.4 Control Chart for an Area of Opportunity: The c Chart
- 19.5 Control Charts for the Range and the Mean
 - The R Chart
 - The \bar{X} Chart
- 19.6 Process Capability
 - Customer Satisfaction and Specification Limits
 - Capability Indices
 - CPL , CPU , and C_{pk}
- 19.7 Total Quality Management
- 19.8 Six Sigma
 - The DMAIC Model
 - Roles in a Six Sigma Organization
 - Lean Six Sigma

USING STATISTICS: Finding Quality at the Beachcomber, Revisited

SUMMARY

REFERENCES

KEY EQUATIONS

KEY TERMS

CHECKING YOUR UNDERSTANDING

CHAPTER REVIEW PROBLEMS

CASES FOR CHAPTER 19

- The Harnswell Sewing Machine Company Case
- Managing Ashland Multicomm Services

CHAPTER 19 EXCEL GUIDE

- EG19.1 The Theory of Control Charts
- EG19.2 Control Chart for the Proportion: The p Chart
- EG19.3 The Red Bead Experiment: Understanding Process Variability
- EG19.4 Control Chart for an Area of Opportunity: The c Chart
- EG19.5 Control Charts for the Range and the Mean
- EG19.6 Process Capability

20 Decision Making (online)

USING STATISTICS: Reliable Decision Making

- 20.1 Payoff Tables and Decision Trees
- 20.2 Criteria for Decision Making
 - Maximax Payoff
 - Maximin Payoff
 - Expected Monetary Value
 - Expected Opportunity Loss
 - Return-to-Risk Ratio
- 20.3 Decision Making with Sample Information
- 20.4 Utility

THINK ABOUT THIS: Risky Business

USING STATISTICS: Reliable Decision-Making, Revisited

- SUMMARY
- REFERENCES
- KEY EQUATIONS
- KEY TERMS
- CHAPTER REVIEW PROBLEMS

CHAPTER 20 EXCEL GUIDE

- EG20.1 Payoff Tables and Decision Trees
- EG20.2 Criteria for Decision Making

Appendices 715

- A. Basic Math Concepts and Symbols 716
 - A.1 Rules for Arithmetic Operations 716
 - A.2 Rules for Algebra: Exponents and Square Roots 716
 - A.3 Rules for Logarithms 717
 - A.4 Summation Notation 718
 - A.5 Statistical Symbols 721
 - A.6 Greek Alphabet 721
- B. Required Excel Skills 722
 - B.1 Worksheet Entries and References 722
 - B.2 Absolute and Relative Cell References 723
 - B.3 Entering Formulas into Worksheets 723
 - B.4 Pasting with Paste Special 724
 - B.5 Basic Worksheet Cell Formatting 724
 - B.6 Chart Formatting 726

- B.7 Selecting Cell Ranges for Charts 727
- B.8 Deleting the “Extra” Bar from a Histogram 727
- B.9 Creating Histograms for Discrete Probability Distributions 728
- C. Online Resources 729
 - C.1 About the Online Resources for This Book 729
 - C.2 Accessing the MyStatLab Course Online 729
 - C.3 Details of Downloadable Files 729
 - C.4 PHStat 737
- D. Configuring Microsoft Excel 738
 - D.1 Getting Microsoft Excel Ready for Use (ALL) 738
 - D.2 Getting PHStat Ready for Use (ALL) 739
 - D.3 Configuring Excel Security for Add-In Usage (WIN) 739
 - D.4 Opening PHStat (ALL) 740
 - D.5 Using a Visual Explorations Add-in Workbook (ALL) 741
 - D.6 Checking for the Presence of the Analysis ToolPak or Solver Add-Ins (ALL) 741
- E. Tables 742
 - E.1 Table of Random Numbers 742
 - E.2 The Cumulative Standardized Normal Distribution 744
 - E.3 Critical Values of t 746
 - E.4 Critical Values of χ^2 748
 - E.5 Critical Values of F 749
 - E.6 Lower and Upper Critical Values, T_1 , of the Wilcoxon Rank Sum Test 753
 - E.7 Critical Values of the Studentized Range, Q 754
 - E.8 Critical Values, d_1 and d_U , of the Durbin–Watson Statistic, D (Critical Values Are One-Sided) 756
 - E.9 Control Chart Factors 757
 - E.10 The Standardized Normal Distribution 758
- F. Useful Excel Knowledge 759
 - F.1 Useful Keyboard Shortcuts 759
 - F.2 Verifying Formulas and Worksheets 760
 - F.3 New Function Names 760
 - F.4 Understanding the Nonstatistical Functions 762
- G. Software FAQs 764
 - G.1 PHStat FAQs 764
 - G.2 Microsoft Excel FAQs 765
 - G.3 FAQs for New Users of Microsoft Excel 2013 766
 - G.4 Minitab FAQs 766

Self-Test Solutions and Answers to Selected Even-Numbered Problems 767

Index 803

Preface

Over a generation ago, advances in “data processing” led to new business opportunities as first centralized and then desktop computing proliferated. The Information Age was born. Computer science became much more than just an adjunct to a mathematics curriculum, and whole new fields of studies, such as computer information systems, emerged.

More recently, further advances in information technologies have combined with data analysis techniques to create new opportunities in what is more data *science* than data *processing* or *computer science*. The world of business statistics has grown larger, bumping into other disciplines. And, in a reprise of something that occurred a generation ago, new fields of study, this time with names such as informatics, data analytics, and decision science, have emerged.

This time of change makes what is taught in business statistics and how it is taught all the more critical. These new fields of study all share statistics as a foundation for further learning. We are accustomed to thinking about change, as seeking ways to continuously improve the teaching of business statistics have always guided our efforts. We actively participate in Decision Sciences Institute (DSI), American Statistical Association (ASA), and Making Statistics More Effective in Schools and Business (MSMESB) conferences. We use the ASA’s Guidelines for Assessment and Instruction (GAISE) reports and combine them with our experiences teaching business statistics to a diverse student body at several large universities.

What to teach and how to teach it are particularly significant questions to ask during a time of change. As an author team, we bring a unique collection of experiences that we believe helps us find the proper perspective in balancing the old and the new. Our two lead authors, Mark L. Berenson and David M. Levine, were the first educators to create a business statistics textbook that discussed using statistical software and incorporated “computer output” as illustrations—just the first of many teaching and curricular innovations in their many years of teaching business statistics. Our newest co-author, Kathryn A. Szabat, has provided statistical advice to various business and nonbusiness communities. Her background in statistics and operations research and her experiences interacting with professionals in practice have guided her, as departmental chair, in developing a new, interdisciplinary academic department, Business Systems and Analytics, in response to the technology- and data-driven changes in business today.

All three of us benefit from our many years teaching undergraduate business subjects and the diversity of interests and efforts of our past co-author, Timothy Krehbiel. We are pleased to offer the innovations and new content that are itemized starting on the next page. As in prior editions, we are guided by these key learning principles:

- Help students see the relevance of statistics to their own careers by providing examples drawn from the functional areas in which they may be specializing.
- Emphasize interpretation of statistical results over mathematical computation.
- Give students ample practice in understanding how to apply statistics to business.
- Familiarize students with how to use statistical software to assist business decision making.
- Provide clear instructions to students for using statistical applications.

Read more about these principles on page xxviii.

What’s New and Innovative in This Edition?

This thirteenth edition of *Basic Business Statistics* contains both new and innovative features and content, while refining and extending the use of the DCOVA (**D**efine, **C**ollect, **O**rganize, **V**isualize, and **A**nalyze) framework, first introduced in the twelfth edition as an integrated approach for applying statistics to help solve business problems.

Innovations

Getting Started: Important Things to Learn First—In a time of change, you can never know exactly what knowledge and background students bring into an introductory business statistics classroom. Add that to the need to curb the fear factor about learning statistics that so many students begin with, and there’s a lot to cover even before you teach your first statistical concept.

We created “Getting Started: Important Things to Learn First” to meet this challenge. This unit sets the context for explaining what statistics is (not what students may think!) while ensuring that all students share an understanding of the forces that make learning business statistics critically important today. Especially designed for instructors teaching with course management tools, including those teaching hybrid or online courses, “Getting Started” has been developed to be posted online or otherwise distributed before the first class section begins and is available for download as explained in Appendix C.

Student Tips—In-margin notes reinforce hard-to-master concepts and provide quick study tips for mastering important details.

Discussion of Business Analytics—“Getting Started: Important Things to Learn First” quickly defines *business analytics* and *big data* and notes how these things are changing the face of statistics.

This material serves as an introduction to the new “Business Analytics” chapter (Chapter 17). This new chapter begins with a scenario that uses the management of a theme park to introduce applications of business analytics. The chapter begins by discussing descriptive visualization methods used for general oversight and applies them to issues raised in the scenario. Using other examples, the chapter then discusses the predictive analytics methods classification and regression trees, neural nets, cluster analysis, and multidimensional scaling that are in common use today.

Because standard Microsoft Excel and Minitab offer little or no support for the methods discussed, the chapter uses results created using JMP, the interactive data analysis software from the SAS Institute, and Tableau Public, the Web-based data visualization tool from Tableau Software, where appropriate. For those interested, a special *Software Guide* located at the end of the chapter explains how to use these two programs (and Microsoft Excel) to construct the results shown in the chapter.

PHStat version 4—For Microsoft Excel users, this new version of the Pearson Education statistics add-in contains several new and enhanced procedures, simpler set up, and is compatible with both Microsoft Windows and (Mac) OS X Excel versions.

Chapter Short Takes Online PDF documents (available for download as explained in Appendix C) that supply additional insights or explanations to important statistical concepts or details about the results presented in this book.

Revised and Enhanced Content

New Continuing End-of-Chapter Cases—This thirteenth edition features several new end-of-chapter cases. New and recurring throughout the book is a case that concerns analysis of sales and marketing data for home fitness equipment (CardioGood Fitness), a case that concerns pricing decisions made by a retailer (Sure Value Convenience Stores), and the More Descriptive Choices Follow-Up case, which extends the use of the retirement funds sample first introduced in Chapter 2. Also recurring is the Clear Mountain State Student Surveys case, which uses data collected from surveys of undergraduate and graduate students to practice and reinforce statistical methods learned in various chapters. This case replaces end-of-chapter questions related to the student survey database in the previous edition. Joining the Mountain States Potato Company regression case of the previous edition are new cases in simple linear regression (Brynne Packaging) and multiple regression (The Craybill Instrumentation Company).

Many New Applied Examples and Problems—Many of the applied examples throughout this book use new problems or revised data. Approximately 44% of the problems are new to this edition. The ends-of-section and ends-of-chapter problem sets contain many new problems that use data from *The Wall Street Journal*, *USA Today*, and other sources.

Revised Using Statistics Scenarios—There are new or revised Using Statistics scenarios in five chapters.

Checklist for Preparing to Use Microsoft Excel or Minitab with This Book—Found in Section GS.4 of “Getting Started: Important Things to Learn First,” this checklist explains for students which skills they will need and where they will find information about those skills in the book.

Revised Appendices Keyed to the Preparing to Use Microsoft Excel Checklist—The revised Appendix B discusses the Excel skills that readers need to make best use of the *In-Depth Excel* instructions in this book. Appendix F presents useful Excel knowledge, including a discussion of the new worksheet function names that were introduced in Excel 2010. Appendix G presents FAQs about using Excel and Minitab with this book.

Configuring Microsoft Excel Appendix—This revised Appendix D discusses the procedures and practices that will help readers that use Microsoft Excel to avoid common technical problems that might otherwise arise as they learn business statistics with this book.

Distinctive Features

We have continued many of the traditions of past editions and have highlighted some of these features below.

Using Statistics Business Scenarios—Each chapter begins with a Using Statistics example that shows how statistics is used in the functional areas of business—accounting, finance, information systems, management, and marketing. Each scenario is used throughout the chapter to provide an applied context for the concepts. The chapter concludes with a Using Statistics, Revisited section that reinforces the statistical methods and applications discussed in each chapter.

Emphasis on Data Analysis and Interpretation of Excel and Minitab Results—We believe that the use of computer software is an integral part of learning statistics. Our focus emphasizes analyzing data by interpreting results while reducing emphasis on doing computations. For example, in the coverage of tables and charts in Chapter 2, the focus is on the interpretation of various charts and on when to use each chart. In our coverage of hypothesis testing in Chapters 9 through 12, and regression and multiple regression in Chapters 13 through 15, extensive computer results have been included so that the p -value approach can be emphasized.

Pedagogical Aids—An active writing style is used, with boxed numbered equations, set-off examples to provide reinforcement for learning concepts, student tips, problems divided into “Learning the Basics” and “Applying the Concepts,” key equations, and key terms.

Digital Cases—In the Digital Cases, available for download as explained in Appendix C, learners must examine interactive PDF documents to sift through various claims and information in order to discover the data most relevant to a business case scenario. Learners then determine whether the conclusions and claims are supported by the data. In doing so, learners discover and learn how to identify common misuses of statistical information. (Instructional tips for using the Digital Cases and solutions to the Digital Cases are included in the Instructor’s Solutions Manual.)

Answers—Most answers to the even-numbered exercises are included at the end of the book.

Flexibility Using Excel—For almost every statistical method discussed, this book presents more than one way of using Excel. Students can use *In-Depth Excel* instructions to directly work with worksheet solution details *or* they can use either the *PHStat* instructions *or* the *Analysis ToolPak* instructions to automate the creation of those worksheet solutions.

PHStat—PHStat is the Pearson Education statistics add-in that you use with Microsoft Excel to help build solutions to statistical problems. With PHStat, you fill in simple-to-use dialog boxes and watch as PHStat creates a worksheet solution for you. PHStat allows you to use the Microsoft Excel statistical functions without having to first learn advanced Excel techniques or worrying about building worksheets from scratch. As a student studying statistics, you can focus mainly on learning statistics and not worry about having to fully master Excel as well.

Unlike other programs, PHStat solutions are real worksheets that contain real Excel calculations (called formulas in Excel). You can examine the contents of worksheet solutions to learn the appropriate functions and calculations necessary to apply a particular statistical method. With most of these worksheet solutions, you can change worksheet data and immediately see how those changes affect the results. This book uses PHStat version 4 which includes over 60 procedures that create Excel worksheets and charts for these statistical methods:

Descriptive Statistics: boxplot, descriptive summary, dot scale diagram, frequency distribution, histogram & polygons, Pareto diagram, scatter plot, stem-and-leaf display, one-way tables & charts, and two-way tables & charts

Probability and probability distributions: simple & joint probabilities, normal probability plot, and binomial, exponential, hypergeometric, and Poisson probability distributions

Sampling: sampling distributions simulation

Confidence interval estimation: for the mean, sigma unknown; for the mean, sigma known, for the population variance, for the proportion, and for the total difference

Sample size determination: for the mean and the proportion

One-sample tests: Z test for the mean, sigma known; t test for the mean, sigma unknown; chi-square test for the variance; and Z test for the proportion

Two-sample tests (unsummarized data): pooled-variance t test, separate-variance t test, paired t test, F test for differences in two variances, and Wilcoxon rank sum test

Two-sample tests (summarized data): pooled-variance t test, separate-variance t test, paired t test, Z test for the differences in two means, F test for differences in two variances, chi-square test for differences in two proportions, Z test for the difference in two proportions, and McNemar test

Multiple-sample tests: chi-square test, Marascuilo procedure Kruskal-Wallis rank test, Levene test, one-way ANOVA, Tukey-Kramer procedure randomized block design, and two-way ANOVA with replication

Regression: simple linear regression, multiple regression, best subsets, stepwise regression, and logistic regression

Control charts: p chart, c chart, and R and $Xbar$ charts.

Decision-making: covariance and portfolio management, expected monetary value, expected opportunity loss, and opportunity loss

Data preparation: stack and unstack data

See Appendix Section C.4 for more information about PHStat.

Visual Explorations—The series of Excel workbooks that allow students to interactively explore important statistical concepts in descriptive statistics, the normal distribution, sampling distributions, and regression analysis. For example, in descriptive statistics, students observe the effect of changes in the data on the mean, median, quartiles, and standard deviation. With the normal distribution, students see the effect of changes in the mean and standard deviation on the areas under the normal curve. In sampling distributions, students use simulation to explore the effect of sample size on a sampling distribution. In regression analysis, students have the opportunity to fit a line and observe how changes in the slope and intercept affect the goodness of fit. The Visual Explorations workbooks are available for download as explained in Appendix C. (See Appendix Section C.4 to learn more about the workbooks that comprise Visual Explorations.)

Chapter-by-Chapter Changes Made for This Edition

Besides the new and innovative content described in “What’s New and Innovative in This Edition?” the thirteenth edition of *Basic Business Statistics* contains the following specific changes to each chapter. Highlights of the changes to the individual chapters are as follows:

Getting Started: Important Things to Learn First—This all-new chapter includes new material on business analytics and introduces the DCOVA framework and a basic vocabulary of statistics, both of which were introduced in Chapter 1 of the twelfth edition.

Chapter 1—Collecting data has been relocated to this chapter from Section 2.1. Sampling methods and types of survey errors have been relocated from Sections 7.1 and 7.2. There is a new subsection on data cleaning. The CardioGood Fitness and Clear Mountain State Surveys cases are included.

Chapter 2—Section 2.1, “Data Collection,” has been moved to Chapter 1. The chapter uses a new data set that contains a sample of 316 mutual funds and a new set of restaurant cost data. The CardioGood Fitness, The Choice *Is* Yours Follow-up, and Clear Mountain State Surveys cases are included.

Chapter 3—For many examples, this chapter uses the new mutual funds data set that is introduced in Chapter 2. There is increased coverage of skewness and kurtosis. There is a new example on

computing descriptive measures from a population using “Dogs of the Dow.” The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Surveys cases are included.

Chapter 4—The chapter example has been updated. There are new problems throughout the chapter. The CardioGood Fitness, The Choice *Is* Yours Follow-up, and Clear Mountain State Surveys cases are included.

Chapter 5—There is an additional example on applying probability distributions in finance, and there are many new problems throughout the chapter. The notation used has been made more consistent.

Chapter 6—This chapter has an updated Using Statistics scenario and some new problems. The CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Surveys cases are included.

Chapter 7—Sections 7.1 and 7.2 have been moved to Chapter 1. An additional example of sampling distributions from a larger population has been included.

Chapter 8—This chapter includes an updated Using Statistics scenario and new examples and exercises throughout the chapter. The Sure Value Convenience Stores, CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Surveys cases are included. The section “Applications of Confidence Interval Estimation in Auditing” has been moved online. There is an online section on bootstrapping.

Chapter 9—This chapter includes additional coverage of the pitfalls of hypothesis testing. The Sure Value Convenience Stores case is included.

Chapter 10—This chapter has an updated Using Statistics scenario, a new example on the paired *t*-test on textbook prices, and a new example on the *Z*-test for the difference between two proportions. The Sure Value Convenience Stores, CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Surveys cases are included. There is a new online section on Effect Size.

Chapter 11—The chapter has a new Using Statistics scenario that relates to a mobile electronics merchandiser that replaces the Perfect Parachutes scenario. This chapter includes the Sure Value Convenience Stores, CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Surveys cases. It now includes an online section on fixed effects, random effects, and mixed effects models.

Chapter 12—The chapter includes many new problems. This chapter includes the Sure Value Convenience Stores, CardioGood Fitness, More Descriptive Choices Follow-up, and Clear Mountain State Surveys cases. The McNemar test and the Chi-square test for a standard deviation or variance are now online sections.

Chapter 13—The Using Statistics scenario has been updated and changed, with new data used throughout the chapter. This chapter includes the Brynne Packaging case.

Chapter 14—The online section on influence analysis has been moved into the text.

Chapter 15—This chapter includes the Sure Value Convenience Stores, Craybill Instrumentation, and More Descriptive Choices Follow-up cases.

Chapter 16—This chapter includes new data involving movie attendance in Section 16.3 and updated data for The Coca-Cola Company in Sections 16.4 through 16.6 and Wal-Mart Stores, Inc., in Section 16.7. In addition, most of the problems are new or updated.

Chapter 17—This is the new business analytics chapter already discussed in *Innovations* on page xxiv. This chapter has been designed so that the descriptive methods or any of the predictive analytics methods can be taught separately and apart from the rest of the chapter should time not permit coverage of the entire chapter.

Chapter 18—This chapter now includes some new problems.

Chapter 19—The “Statistical Applications in Quality Management” chapter has been renumbered as Chapter 19 and moved online, where it is available for download as explained in Appendix C.

Chapter 20—The “Decision Making” chapter has been renumbered as Chapter 20 and remains available for download as explained in Appendix C.

About Our Educational Philosophy

In *Our Starting Point* at the beginning of this preface, we stated that we are guided by these key learning principles:

- Help students see the relevance of statistics to their own careers by providing examples drawn from the functional areas in which they may be specializing.
- Emphasize interpretation of statistical results over mathematical computation.
- Give students ample practice in understanding how to apply statistics to business.
- Familiarize students with how to use statistical software to assist business decision making.
- Provide clear instructions to students for using statistical applications.

The following further explains these principles:

1. **Help students see the relevance of statistics to their own careers by providing examples drawn from the functional areas in which they may be specializing.** Students need a frame of reference when learning statistics, especially when statistics is not their major. That frame of reference for business students should be the functional areas of business, such as accounting, finance, information systems, management, and marketing. Each statistics topic needs to be presented in an applied context related to at least one of these functional areas. The focus in teaching each topic should be on its application in business, the interpretation of results, the evaluation of the assumptions, and the discussion of what should be done if the assumptions are violated.
2. **Emphasize interpretation of statistical results over mathematical computation.** Introductory business statistics courses should recognize the growing need to *interpret* statistical results that computerized processes create. This makes the interpretation of results more important than knowing how to execute the tedious hand calculations required to produce them.
3. **Give students ample practice in understanding how to apply statistics to business.** Both classroom examples and homework exercises should involve actual or realistic data as much as possible. Students should work with data sets, both small and large, and be encouraged to look beyond the statistical analysis of data to the interpretation of results in a managerial context.
4. **Familiarize students with how to use statistical software to assist business decision making.** Introductory business statistics courses should recognize that programs with statistical functions are commonly found on a business decision maker's desktop computer. Integrating statistical software into all aspects of an introductory statistics course allows the course to focus on interpretation of results instead of computations (see point 2).
5. **Provide clear instructions to students for using statistical applications.** Books should explain clearly how to use programs such as Microsoft Excel and Minitab with the study of statistics, without having those instructions dominate the book or distract from the learning of statistical concepts.

Student Resources

Student Solutions Manual, by Professor Pin Tian Ng of Northern Arizona University and accuracy checked by Annie Puciloski, provides detailed solutions to virtually all the even-numbered exercises and worked-out solutions to the self-test problems (ISBN-10: 0-321-92670-6; ISBN-13: 978-0-321-92670-8).

Online resources—The complete set of online resources are discussed fully in Appendix C, which also explains how to download these resources. These resources include the **Excel and Minitab Data Files** that contain the data used in chapter examples or named in problems and end-of-chapter cases; the **Excel Guide Workbooks** that contain templates or model solutions for applying Excel to a particular statistical method; the **Digital Cases** PDF files that support the end-of-chapter Digital Cases; the **Visual Explorations Workbooks** that interactively demonstrate various key statistical concepts; and the **PHStat** add-in that simplifies the use of Microsoft Windows or OS X Microsoft Excel with this book, as explained in Section EG.1.

The online resources also include the **Chapter Short Takes** and **Online Topic Sections** that expand and extend the discussion of statistical concepts worksheet-based solutions as well as the full text of two additional chapters, “Statistical Applications in Quality Management” and “Decision Making.”

Instructor Resources

The following supplements are among the resources available to adopting instructors at the Instructor’s Resource Center, located at www.pearsonhighered.com/irc.

- **Instructor’s Solutions Manual**, by Professor Pin Tian Ng of Northern Arizona University and accuracy checked by Annie Puciloski, includes solutions for end-of-section and end-of-chapter problems, answers to case questions, where applicable, and teaching tips for each chapter.
- **Lecture PowerPoint Presentations**, by Professor Patrick Schur of Miami University and accuracy checked by David Levine and Kathryn Szabat, are available for each chapter. The PowerPoint slides provide an instructor with individual lecture outlines to accompany the text. The slides include many of the figures and tables from the text. Instructors can use these lecture notes as is or can easily modify the notes to reflect specific presentation needs.
- **Test Bank**, by Professor Pin Tian Ng of Northern Arizona University, contains true/false, multiple-choice, fill-in, and problem-solving questions based on the definitions, concepts, and ideas developed in each chapter of the text.
- **TestGen**[®] (www.pearsoned.com/testgen) enables instructors to build, edit, print, and administer tests using a computerized bank of questions developed to cover all the objectives of the text. TestGen is algorithmically based, allowing instructors to create multiple but equivalent versions of the same question or test with the click of a button. Instructors can also modify test bank questions or add new questions. The software and test bank are available for download from Pearson Education’s online catalog.

MathXL[®] **MathXL**[®] for Statistics Online Course (access code required) MathXL[®] is the homework and assessment engine that runs MyStatLab. (MyStatLab is MathXL plus a learning management system.)

With *MathXL for Statistics*, instructors can:

- Create, edit, and assign online homework and tests using algorithmically generated exercises correlated at the objective level to the textbook.
- Create and assign their own online exercises and import TestGen tests for added flexibility.
- Maintain records of all student work, tracked in MathXL’s online gradebook.

With *MathXL for Statistics*, students can:

- Take chapter tests in MathXL and receive personalized study plans and/or personalized homework assignments based on their test results.
- Use the study plan and/or the homework to link directly to tutorial exercises for the objectives they need to study.
- Access supplemental animations directly from selected exercises.
- Knowing that students often use external statistical software, we make it easy to copy our data sets, both from the eText and the MyStatLab questions, into StatCrunch[™], Microsoft Excel, Minitab, and a variety of other software packages.

MathXL for Statistics is available to qualified adopters. For more information, visit www.mathxl.com or contact your Pearson representative.

MyStatLab[™]

MyStatLab[™] Online Course (access code required) MyStatLab from Pearson is the world’s leading online resource for statistics learning, integrating interactive homework, assessment, and media in a flexible, easy to use format. MyStatLab is a course management systems that delivers **proven results** in helping individual students succeed.

- MyStatLab can be successfully implemented in any environment—lab-based, hybrid, fully online, traditional—and demonstrates the quantifiable difference that integrated usage has on student retention, subsequent success, and overall achievement.
- MyStatLab’s comprehensive online gradebook automatically tracks students’ results on tests, quizzes, and homework and in the study plan. Instructors can use the gradebook to provide positive feedback or intervene if students have trouble. Gradebook data can be easily exported to a variety of spreadsheet programs, such as Microsoft Excel. You can determine which points of data you want to export and then analyze the results to determine success.

MyStatLab provides **engaging experiences** that personalize, stimulate, and measure learning for each student. In addition to the resources below, each course includes a full interactive online version of the accompanying textbook.

- **Tutorial Exercises with Multimedia Learning Aids:** The homework and practice exercises in MyStatLab align with the exercises in the textbook, and they regenerate algorithmically to give students unlimited opportunity for practice and mastery. Exercises offer immediate helpful feedback, guided solutions, sample problems, animations, videos, and eText clips for extra help at the point of use.
- **MyStatLab Accessibility:** MyStatLab is compatible with the JAWS 12/13 screen reader and enables multiple-choice and free-response problem types to be read and interacted with via keyboard controls and math notation input.
- **StatTalk Videos:** Fun-loving statistician Andrew Vickers takes to the streets of Brooklyn, NY to demonstrate important statistical concepts through interesting stories and real-life events. This series of 24 fun and engaging videos will help students actually understand statistical concepts. Available with an instructor’s user guide and assessment questions.
- **Business Insight Videos:** Ten engaging videos show managers at top companies using statistics in their everyday work. Assignable questions encourage debate and discussion.
- **Additional Question Libraries:** In addition to algorithmically regenerated questions that are aligned with your textbook, the MyStatLab courses come with two additional question libraries:
 - **450 Getting Ready for Statistics** covers the developmental math topics students need for the course. These can be assigned as a prerequisite to other assignments, if desired.
 - **1000 Conceptual Question Library** requires students to apply their statistical understanding.
- **Integration of Statistical Software:** We make it easy to copy our data sets, both from the eText and the MyStatLab questions, into software such as StatCrunch, Minitab, Excel, and more. Students have access to a variety of support tools—Technology Tutorial Videos, Technology Study Cards, and Technology Manuals for select titles—to learn how to effectively use statistical software.
- **Expert Tutoring:** Although many students describe the whole of MyStatLab as “like having your own personal tutor,” students also have access to live tutoring from Pearson, from qualified statistics instructors.
- **StatCrunch®:** MyStatLab integrates the web-based statistical software StatCrunch within the online assessment platform so that students can easily analyze data sets from exercises and the text. In addition, MyStatLab includes access to **www.statcrunch.com**, a website where users can access tens of thousands of shared data sets, conduct online surveys, perform complex analyses using the powerful statistical software, and generate compelling reports.

And, MyStatLab comes from an **experienced partner** with educational expertise and an eye on the future.

- Knowing that you are using a Pearson product means knowing that you are using quality content. That means that our eTexts are accurate and our assessment tools work. It means we are committed to making MyMathLab as accessible as possible.
- Whether you are just getting started with MyStatLab, or have a question along the way, we’re here to help you learn about our technologies and how to incorporate them into your course.

To learn more about how MyStatLab combines proven learning applications with powerful assessment, visit **www.mystatlab.com** or contact your Pearson representative.

StatCrunch® is powerful web-based statistical software that allows users to perform complex analyses, share data sets, and generate compelling reports of their data. The vibrant online community offers tens of thousands shared data sets for students to analyze.

Full access to StatCrunch is available with a MyStatLab access kit, and StatCrunch is available by itself to qualified adopters. StatCrunch is now compatible with most mobile devices. To access, visit www.statcrunch.com/mobile from the browser on your smartphone or tablet. For more information, visit our website at www.statcrunch.com, or contact your Pearson representative.

Acknowledgments

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Creating a new edition of a textbook is a team effort, and we would like to thank our Pearson Education editorial, marketing, and production teammates: Sonia Ashraf, Dana Bettez, Kathleen DeChavez, Erin Lane, Deirdre Lynch, Kathy Manley, Christine Stavrou, Marianne Stepanian, and Joe Vetere. We also thank our statistical reader and accuracy checker Annie Puciloski for her diligence in checking our work and Nancy Kincade for overseeing and managing these efforts on behalf of PreMediaGlobal.

Finally, we would like to thank our families for their patience, understanding, love, and assistance in making this book a reality. It is to them that we dedicate this book.

Concluding Remarks

Please email us at authors@davidlevinstatistics.com if you have a question or require clarification about something discussed in this book. We also invite you to communicate any suggestions you may have for a future edition of this book. And while we have strived to make this book both pedagogically sound and error-free, we encourage you to contact us if you discover an error. When contacting us electronically, please include “BBS edition 13” in the subject line of your message.

You can also visit davidlevinstatistics.com, where you will find an email contact form and links to additional information about this book. For technical assistance using Microsoft Excel or any of the Excel add-ins that you can use with this book including PHStat, review Appendices D and G and follow the technical support links discussed in Appendix Section G.1, if necessary.

Mark L. Berenson
David M. Levine
Kathryn A. Szabat

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GETTING STARTED

Important Things to Learn First

CONTENTS

- GS.1 Statistics: A Way of Thinking
- GS.2 Data: What Is It?
- GS.3 Business Analytics: The Changing Face of Statistics
“Big Data”
Statistics: An Important Part of Your Business Education

How to Use This Book

- GS.4 Software and Statistics

EXCEL GUIDE

- EG.1 Getting Started with Microsoft Excel
- EG.2 Entering Data
- EG.3 Opening and Saving Workbooks
- EG.4 Creating and Copying Worksheets
- EG.5 Printing Worksheets

MINITAB GUIDE

- MG.1 Getting Started with Minitab
- MG.2 Entering Data
- MG.3 Opening and Saving Worksheets and Projects
- MG.4 Creating and Copying Worksheets
- MG.5 Printing Parts of a Project

OBJECTIVES

- That the volume of data that exists in the world makes learning about statistics critically important
- That statistics is a way of thinking that can help you make better decisions
- How the DCOVA framework for applying statistics can help you solve business problems
- What business analytics is and how these techniques represent an opportunity for you
- How to make best use of this book
- How to prepare for using Microsoft Excel or Minitab with this book

USING STATISTICS

“You Cannot Escape from Data”

Not so long ago, business students were unfamiliar with the word *data* and had little experience handling data. Today, every time you visit a search engine website or “ask” your mobile device a question, you are handling data. And if you “check in” to a location or indicate that you “like” something, you are *creating* data as well.

You accept as almost true the premises of stories in which characters collect “a lot of data” to uncover conspiracies, to foretell disasters, or to catch a criminal. You hear concerns about how the government or business might be able to “spy” on you in some ways or how large social media companies “mine” your personal data for profit.

You hear the word *data* everywhere and may even have a “data plan” for your smartphone. You know, in a general way, that data are facts about the world and that most data seem to be, ultimately, a set of numbers—that 49% of students recently polled dreaded taking a business statistics course, or that 50% of citizens believe the country is headed in the right direction, or that unemployment is down 3%, or that your best friend’s social media account has 835 friends and 202 recent posts.

You cannot escape from data in this digital world. What, then, should you do? You could try to ignore data and conduct business by relying on hunches or your “gut feelings.” However, if you only want to use gut feelings, then you probably shouldn’t be reading this book or taking business courses in the first place.

You could note that there is so much data in the world—or just in your own little part of the world—that you couldn’t possibly get a handle on it. You could accept other people’s data summaries and their conclusions without first reviewing the data yourself. That, of course, would expose yourself to fraudulent practices.

Or, you could do things the proper way and realize that you cannot escape learning the methods of statistics, the subject of this book . . .



Angela Waye/Shutterstock

GS.1 Statistics: A Way of Thinking

Statistics is a way of thinking that can help you make better decisions. Statistics helps you solve problems that involve decisions that are based on data that have been collected. You may have had some statistics instruction in the past. If you ever created a chart to summarize data or calculated values such as averages to summarize data, you have used statistics. But there's even more to statistics than these commonly taught techniques, as the detailed table of contents shows.

Statistics is undergoing important changes today. There are new ways of visualizing data that either did not exist, were not practical to do, or were not widely known until recently. And, more and more, statistics today is being used to “listen” to what the data might be telling you (the subject of Chapter 17) rather than just being a way to use data to prove something you want to say.

If you associate statistics with doing a lot of mathematical calculations, you will quickly learn that business statistics uses software to perform the calculations for you (and, generally, the software calculates with more precision and efficiency than you could do manually). But while you do not need to be a good manual calculator to apply statistics, because statistics is a way of thinking, you do need to follow a framework, or plan, to minimize possible errors of thinking and analysis. The **DCOVA framework** is one such framework.

THE DCOVA FRAMEWORK

The DCOVA framework consists of the following tasks:

- **Define** the data that you want to study in order to solve a problem or meet an objective.
- **Collect** the data from appropriate sources.
- **Organize** the data collected by developing tables.
- **Visualize** the data collected by developing charts.
- **Analyze** the data collected to reach conclusions and present those results.

The DCOVA framework uses the five tasks **Define**, **Collect**, **Organize**, **Visualize**, and **Analyze** to help apply statistics to business decision making. Typically, you do the tasks in the order listed. You must always do the first two tasks to have meaningful outcomes, but, in practice, the order of the other three can change or appear inseparable. Certain ways of visualizing data help you to organize your data while performing preliminary analysis as well. In any case, when you apply statistics to decision making, you should be able to identify all five tasks, and you should verify that you have done the first two tasks before the other three.

Using the DCOVA framework helps you to apply statistics to these four broad categories of business activities:

- Summarize and visualize business data
- Reach conclusions from those data
- Make reliable forecasts about business activities
- Improve business processes

Throughout this book, and especially in the Using Statistics scenarios that begin the chapters, you will discover specific examples of how DCOVA helps you apply statistics. For example, in one chapter, you will learn how to demonstrate whether a marketing campaign has increased sales of a product, while in another you will learn how a television station can reduce unnecessary labor expenses.

GS.2 Data: What Is It?

Defining data in a general way as “facts about the world,” to quote the opening essay, can prove confusing as such facts could be singular, a value associated with something, or collective, a list of values associated with something. For example, “David Levine” is a singular fact, a coauthor of this book, whereas “Mark, David, and Kathy” is the *collective* list of authors of this book. Furthermore, if everything is data, how do you distinguish “David Levine” from “Basic Business Statistics,” two very different facts (coauthor and title) about this book. Statisticians avoid this confusion by using a more specific definition of data and by defining a second word, *variable*.

Data are “the values associated with a trait or property that help distinguish the occurrences of something.” For example, the names “David Levine” and “Kathryn Szabat” are data because they are both values that help distinguish one of the authors of this book from another. In this book, *data* is always plural to remind you that data are a collection, or set, of values. While one could say that a single value, such as “David Levine,” is a *datum*, the phrases *data point*, *observation*, *response*, and *single data value* are more typically encountered.

The trait or property of something that values (data) are associated with is what statisticians define as a **variable**. For example, you might define the variables “coauthor” and “title” if you were defining data about a set of textbooks.

Substituting the word *characteristic* for the phrase “trait or property” and using the phrase “an item or individual” instead of the vague word “something” produces the definitions of *variable* and *data* used in this book.

Student Tip

Business convention places the data, the *set* of values, for a variable in a column when using a worksheet or similar object. The Excel and Minitab data worksheets used in this book follow this convention. Because of this convention, people sometimes use the word *column* as a substitute for *variable*.

VARIABLE

A characteristic of an item or individual.

DATA

The set of individual values associated with a variable.

Think about characteristics that distinguish individuals in a human population. Name, height, weight, eye color, marital status, adjusted gross income, and place of residence are all characteristics of an individual. All of these traits are possible *variables* that describe people.

Defining a variable called author-name to be the first and last names of the authors of this text makes it clear that valid values would be “Mark Berenson,” “David Levine,” and “Kathryn Szabat” and not, say, “Berenson,” “Levine,” and “Szabat.” Be careful of cultural or other assumptions in definitions—for example, is “last name” a family name, as is common usage in North America, or an individual’s own unique name, as is common usage in most Asian countries?

Having defined *data* and *variable*, you can define the subject of this book, **statistics**.

STATISTICS

The methods that help transform data into useful information for decision makers.

Statistics allows you to determine whether your data represent information that could be used in making better decisions. Therefore, statistics helps you determine whether differences in the numbers are meaningful in a significant way or are due to chance. To illustrate, consider the following news reports about various data findings:

- “Acceptable Online Ad Length Before Seeing Free Content” (*USA Today*, February 16, 2012, p. 1B) A survey of 1,179 adults 18 and over reported that 54% thought that 15 seconds was an acceptable online ad length before seeing free content.

- **“First Two Years of College Wasted?”** (M. Marklein, *USA Today*, January 18, 2011, p. 3A) A survey of more than 3,000 full-time, traditional-age students found that the students spent 51% of their time on socializing, recreation, and other activities; 9% of their time attending class/lab; and 7% of their time studying.
- **“Follow the Tweets”** (H. Rui, A. Whinston, and E. Winkler, *The Wall Street Journal*, November 30, 2009, p. R4) In this study, the authors found that the number of times a specific product was mentioned in comments in the Twitter social messaging service could be used to make accurate predictions of sales trends for that product.

Without statistics, you cannot determine whether the “numbers” in these stories represent useful information. Without statistics, you cannot validate claims such as the claim that the number of tweets can be used to predict the sales of certain products. And without statistics, you cannot see patterns that large amounts of data sometimes reveal.

When talking about statistics, you use the term **descriptive statistics** to refer to methods that primarily help summarize and present data. Counting physical objects in a kindergarten class may have been the first time you used a *descriptive* method. You use the term **inferential statistics** to refer to methods that use data collected from a small group to reach conclusions about a larger group. If you had formal statistics instruction in a lower grade, you were probably mostly taught descriptive methods, the focus of the early chapters of this book, and you may be unfamiliar with many of the inferential methods discussed in later chapters.

GS.3 Business Analytics: The Changing Face of Statistics

The Using Statistics scenario that opens this chapter notes the increasing use of new statistical techniques that either did not exist, were not practical to do, or were not widely known in the past. Of all these new techniques, business analytics best reflects the changing face of statistics. These methods combine traditional statistical methods with methods from management science and information systems to form an interdisciplinary tool that supports fact-based management decision making. Business analytics enables you to

- Use statistical methods to analyze and explore data to uncover unforeseen relationships.
- Use management science methods to develop optimization models that impact an organization’s strategy, planning, and operations.
- Use information systems methods to collect and process data sets of all sizes, including very large data sets that would otherwise be hard to examine efficiently.

Business analytics allows you to interpret data, reach conclusions, and make decisions and, in doing that, it combines many of the tasks of the DCOVA framework into one integrated process. And because you apply business analytics in the context of *organizational* decision making and problem solving (see reference 7), successful application of business analytics requires an understanding of a business and its operations. Chapter 17 examines business analytics more closely, including its implications for the future.

“Big Data”

Relatively recent advances in information technology allow businesses to collect, process, and analyze very large volumes of data. Because the operational definition of “very large” can be partially dependent on the context of a business—what might be “very large” for a sole proprietorship might be commonplace and small for a multinational corporation—many use the term *big data*.

Big data is more of a fuzzy concept than a term with a precise operational definition, but it implies data that are being collected in huge volumes and at very fast rates (typically in real time) and data that arrive in a variety of forms, organized and unorganized. These attributes of “volume, velocity, and variety,” first identified in 2001 (see reference 5), make big data different from any of the data sets used in this book.

Big data increases the use of business analytics because the sheer size of these very large data sets makes preliminary exploration of the data using older techniques impractical to do. This effect is explored in Chapter 17.

Statistics: An Important Part of Your Business Education

As business analytics becomes increasingly important in business, and especially as the use of big data increases, statistics, an essential component of business analytics, becomes increasingly important to your business education. In the current data-driven environment of business, you need general analytical skills that allow you to manipulate data, interpret analytical results, and incorporate results in a variety of decision-making applications, such as accounting, finance, HR management, marketing, strategy/planning, and supply chain management.

The decisions you make will be increasingly based on data and not on gut or intuition supported by personal experience. Data-guided practice is proving to be successful; studies have shown an increase in productivity, innovation, and competition for organizations that embrace business analytics. The use of data and data analysis to drive business decisions cannot be ignored. Having a well-balanced mix of technical skills—such as statistics, modeling, and basic information technology skills—and managerial skills—such as business acumen, problem-solving skills, and communication skills—will best prepare you for today’s, and tomorrow’s, workplace (see reference 1).

If you thought that you could artificially separate statistics from other business subjects, take a statistics course, and then forget about statistics, you have overlooked the changing face of statistics. The changing face is the reason that Hal Varian, the chief economist at Google, Inc., noted as early as 2009, “the sexy job in the next 10 years will be statisticians. And I’m not kidding” (see references 8 and 9).

How to Use This Book

This book helps you develop the skills necessary to use the DCOVA framework to apply statistics to the four types of business activities listed on page 2. Chapter 1 discusses the **D**efine and **C**ollect tasks, the necessary starting point for all statistical activities. Chapters 2 and 3 explain the **O**rganize and **V**isualize tasks and present methods that summarize and visualize business data (the first activity listed in Section GS.1). Chapter 3 also presents statistics used in the **A**nalyze task. Chapters 4 through 12 discuss methods that use sample data to reach conclusions about populations (the second activity listed). Chapters 13 through 16 review methods to make reliable forecasts (the third activity). The online Chapter 19 introduces methods that you can use to improve business processes (the fourth activity) and the online Chapter 20 introduces decision-making methods. (As previously noted, Chapter 17 discusses business analytics.) Chapter 18 summarizes the methods of this book and provides you with a roadmap for analyzing data.

Each chapter begins with a Using Statistics scenario that puts you in a realistic business situation. You will face problems that the statistical concepts and methods introduced in the chapter will help solve. Later, near the end of the chapter, a Using Statistics Revisited section reviews how the statistical methods discussed in the chapter can be applied to help solve the problems you faced.

Each chapter ends with a variety of features that help you review what you have learned in the chapter. Summary, Key Equations, and Key Terms concisely present the important points of a chapter.

Checking Your Understanding tests your understanding of basic concepts, and Chapter Review Problems allow you to practice what you have learned.

Throughout this book, you will find Excel and Minitab solutions to example problems. You will also find many *Student Tips*, margin notes that help clarify and reinforce significant details about particular statistical concepts. Selected chapters include Visual Explorations features that allow you to interactively explore statistical concepts. And many chapters include a “Think About This” essay that explains important statistical concepts in further depth.

This book contains numerous case studies that give you an opportunity to enhance your analytic and communication skills. Appearing in most chapters is the continuing case study *Managing Ashland MultiComm Services* that details problems managers of a residential telecommunications provider face and a Digital Case, which asks you to sort through information in electronic documents and then apply your statistical knowledge to resolve a business problem or issue. Besides these two cases, you will find a number of other cases, including some that reoccur in several chapters, in this book.

Don’t worry if your instructor does not cover every section of every chapter. Introductory business statistics courses vary in terms of scope, length, and number of college credits earned. Your functional area of study (accounting, management, finance, marketing, etc.) may also affect what you learn in class or what you are assigned to read in this book.

GS.4 Software and Statistics

You use software to assist you in applying statistical methods to business decision making. Microsoft Excel and Minitab are examples of applications that people use for statistics. Excel is the Microsoft Office data analysis application that evolved from earlier electronic spreadsheets used in accounting and financial applications. Minitab, a dedicated statistical application, or **statistical package**, was developed from the ground up to perform statistical analysis as accurately as possible. Versions of Minitab run on larger computer systems and can perform sophisticated analyses of large data sets.

Although you are probably more familiar with Excel than with Minitab, both programs share many similarities, starting with their shared use of **worksheets** (or spreadsheets) to store data for analysis. Worksheets are tabular arrangements of data, in which the intersections of rows and columns form **cells**, boxes into which you make entries. In Minitab, the data for each variable are placed in separate columns, and this is also the standard practice when using Excel. Generally, to perform a statistical analysis in either program, you select one or more columns of data and then apply the appropriate command.

Both Excel and Minitab allow you to save worksheets, programming information, and results as one file, called a **workbook** in Excel and a **project** in Minitab. In Excel, workbooks are collections of worksheets and chart sheets. You save a workbook when you save “an Excel file” (either as an **.xlsx** or **.xls** file). In Minitab, a project includes data worksheets, all the results shown in a *session window*, and all graphs created for the data. Unlike in Excel, in Minitab you can save individual worksheets (as **.mtw** worksheet files) as well as save the entire project (as an **.mpj** project file).

Excel and Minitab Guides

You can use either Excel or Minitab to learn and practice the statistical methods learned in this book. Immediately following each chapter are Excel and Minitab Guides. For this chapter, special guides explain how the guides have been designed to support your learning with this book. To prepare for using Excel or Minitab, review and complete the checklist in Table GS.1 below.

TABLE GS.1

Checklist for Preparing to Use Excel or Minitab with This Book

- Determine which program, Excel or Minitab, you will use with this book.
- Read and review the Excel or Minitab Guide for this chapter to verify your knowledge of required basic skills.
- Read Appendix C to learn about the online resources you need to make best use of this book. Appendix C includes a complete list of the data files that are used in the examples and problems found in this book. Names of data files appear in this distinctive type face—**Retirement Funds**—throughout this book.
- Download the online resources that you will need to use this book, using the instructions in Appendix C.
- Check for updates to the program that you plan to use with this book, using the Appendix Section D.1 instructions.
- If you plan to use Excel with PHStat, the Visual Explorations add-in workbooks, or the Analysis ToolPak and you maintain your own computer system, read the special instructions in Appendix D.
- Examine Appendix G to learn answers to frequently asked questions (FAQs).

In later chapters, these guides are keyed to the in-chapter section numbers and present detailed Excel and Minitab instructions for performing the statistical methods discussed in chapter sections. Table GS.2 presents the typographic conventions that the guides use to present computer operations. Excel Guides additionally identify the key Excel technique that is used for a statistical method and include instructions for using PHStat, the Pearson Education statistics add-in that simplifies the operation of Microsoft Excel.

TABLE GS.2

Computing Conventions
Used in This Book

Operation and Examples	Notes
Keyboard keys Enter Ctrl Shift	Names of keys are always the object of the verb <i>press</i> , as in “press Enter .”
Keystroke combinations Ctrl+C Ctrl+Shift+Enter Command+Enter	Keyboarding actions that require you to press more than one key at the same time. Ctrl+C means press C while holding down Ctrl . Ctrl+Shift+Enter means press Enter while holding down both Ctrl and Shift .
Click or select operations click OK select the first 2-D Bar gallery item	Mouse pointer actions that require you to single click an onscreen object. This book uses the verb <i>select</i> when the object is either a worksheet cell or an item in a gallery, menu, list, or Ribbon tab.
Menu or ribbon selection File → New Layout → Legend → None	A sequence of Ribbon or menu selections. File → New means first select the File tab and then select New from the list that appears.
Placeholder object <i>variable 1 cell range</i> <i>bins cell range</i>	An italicized boldfaced phrase is a placeholder for an object reference. In making entries, you enter the reference, e.g., A1:A10 , and not the placeholder.

The guides presume that you have knowledge of the basic computing skills listed in Table GS.3. If you have not mastered these skills, you can read the online pamphlet *Basic Computing Skills*. (Appendix C explains how you can download a copy of this and other online sections.)

TABLE GS.3

Basic Computing Skills

Basic Skill	Specifics
Identification of application window objects	Title bar, minimize/resize/close buttons, scroll bars, formula bar, workbook area, cell pointer, shortcut menu. For Excel only, panes and these Ribbon parts: tab, group, gallery, and launcher button
Knowledge of mouse operations	Click (also called select), check and clear, double-click, right-click, drag/drag-and-drop
Identification of dialog box objects	Command button, list box, drop-down list, edit box, option button, check box

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KEY TERMS

big data	4	inferential statistics	4	variable	3
cells	6	project	6	workbook	6
data	3	statistical package	6	worksheet	6
DCOVA framework	2	statistics	3		
descriptive statistics	4	template	8		

EXCEL GUIDE

EG.1 GETTING STARTED with MICROSOFT EXCEL

You can use Excel to learn and apply the statistical methods discussed in this book and as an aid in solving end-of-section and end-of-chapter problems. How you use Excel is up to you (or perhaps your instructor), and the Excel Guides give you two complementary ways to use Excel.

If you are focused more on getting results as quickly as possible, consider using PHStat. PHStat, available for users of this book, is an example of an add-in, an application that extends the functionality of Microsoft Excel. The PHStat add-in simplifies the task of operating Excel while creating *real* Excel worksheets that use in-worksheet calculations. With PHStat, you can create worksheets that are identical to the ones featured in this book while minimizing the potential for making worksheet entry errors. In contrast, most other add-ins create results that are mostly text pasted into an empty worksheet.

For many topics, you may choose to use the *In-Depth Excel* instructions. These instructions use pre-constructed worksheets as models or **templates** for a statistical solution. You learn how to adapt these worksheets to construct your own solutions. Many of these sections feature a specific *Excel Guide workbook* that contains worksheets that are *identical* to the worksheets that PHStat creates. Because both of these ways create the same results and the same worksheets, you can use a combination of both ways as you read through this book.

The In-Depth Excel instructions and the Excel Guide workbooks work best with the latest versions of Microsoft Excel, including Excel 2010 and Excel 2013 (Microsoft Windows), Excel 2011 (OS X), and Office 365. Where incompatibilities arise with versions older than Excel 2010, the incompatibilities are noted and alternative worksheets are provided for use. (Excel Guides also contain instructions for using the Analysis ToolPak add-in that is included with some Microsoft Excel versions, when appropriate.)

You will want to master the Table EG.A basic skills before you begin using Excel to understand statistical concepts and solve problems. If you plan to use the *In-Depth Excel* instructions, you will also need to master the skills listed in the second half of the table. While you do not necessarily need these skills if you plan to use PHStat, knowing them will be useful if you expect to customize the Excel worksheets that PHStat creates or expect to be using Excel beyond the course that uses this book.

TABLE EG.A
Skills Set for Using
Microsoft Excel with
This Book

Basic Microsoft Office Skill	Specifics
Excel data entry	Organizing worksheet data in columns, entering numerical and categorical data
File operations	Open, save, print
Worksheet operations	Create, copy
<i>In-Depth Excel Skill</i>	Specifics
Formula skills	Concept of a formula, cell references, absolute and relative cell references, how to enter a formula, how to enter an array formula
Workbook presentation	How to apply format changes that affect the display of worksheet cell contents
Chart formatting correction	How to correct the formatting of charts that Excel improperly creates
Discrete histogram creation	How to create a properly formatted histogram for a discrete probability distribution

This guide reviews the basic Microsoft Office skills and Appendix B teaches you the *In-Depth Excel* skills. If you start by studying Sections B.1 through B.4 of that appendix, you will have the skills you need to make effective use of the *In-Depth Excel* instructions when you first encounter them in Chapter 1. (You can read other sections in Appendix B as needed.)

EG.2 ENTERING DATA

As noted in Section GS.4, you enter data into the rows and columns of a worksheet. By convention, and the style used in this book, when you enter data for a set of variables, you enter the name of each variable into the cells of the first row, beginning with column A. Then you enter the data for the variable in the subsequent rows to create a DATA worksheet similar to the one shown in Figure EG.1.

FIGURE EG.1

An example of a DATA worksheet

	A	B	C	D	E	F	G	H	I	J	K	L
1	Fund Number	Market Cap	Type	Assets	Turnover Ratio	Beta	SD	Risk	1YrReturn%	3YrReturn%	5YrReturn%	10YrReturn%
2	RF001	Large	Growth	309.90	12.21	1.15	18.72	Low	28.99	24.26	11.06	8.97
3	RF002	Large	Growth	23.30	0.00	2.19	35.72	High	33.40	22.72	-4.89	0.02
4	RF003	Large	Growth	141.50	147.00	2.24	36.69	High	33.98	21.91	1.53	12.55
5	RF004	Large	Growth	118.50	5.00	2.24	36.63	High	33.78	21.89	1.57	12.69
6	RF005	Large	Growth	575.30	171.00	0.88	14.56	Low	21.62	16.47	9.40	10.30

Student Tip

Most of the Excel data workbooks that you can download and use with this book (see Appendix C) contain a DATA worksheet that follows the rules of this section. You can use any of those worksheets as an additional model for data entry.

To enter data in a specific cell, either use the cursor keys to move the cell pointer to the cell or use your mouse to select the cell directly. As you type, what you type appears in the formula bar. Complete your data entry by pressing **Tab** or **Enter** or by clicking the checkmark button in the formula bar.

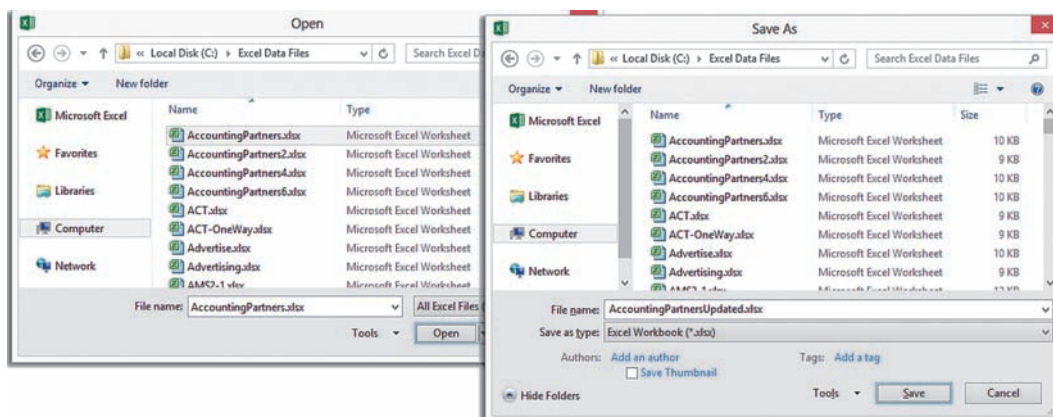
When you enter data, never skip any rows in a column, and as a general rule, also avoid skipping any columns. Also try to avoid using numbers as row 1 variable headings; if you cannot avoid their use, precede such headings with apostrophes. Pay attention to any special instructions that occur throughout the book for the order of the entry of your data. For some statistical methods, entering your data in an order that Excel does not expect will lead to incorrect results.

EG.3 OPENING and SAVING WORKBOOKS

You open and save a workbook by first selecting the folder that stores the workbook and then specifying the file name of the workbook. In most Excel versions, select **File** → **Open** to open a workbook file and **File** → **Save As** to save a workbook. (In Excel 2007, select **Office Button** → **Open** to open a workbook file and **Office Button** → **Save As** to save a workbook.) **Open** and **Save As** display nearly identical dialog boxes that vary only slightly among the different Excel versions. Figure EG.2 shows the Excel 2013 Open and Save As dialog boxes. To see these dialog boxes in Excel 2013, double-click **Computer** in the Open or Save As panels, a step that other Excel versions do not require.

FIGURE EG.2

Excel 2013 Open and Save As dialog boxes



You select the storage folder by using the drop-down list at the top of either of these dialog boxes. You enter, or select from the list box, a file name for the workbook in the **File name** box. You click **Open** or **Save** to complete the task. Sometimes when saving files, you may want to change the file type before you click **Save**.

In Microsoft Windows Excel versions, to save your workbook in the format used by versions older than Excel 2007, select **Excel 97-2003 Workbook (*.xls)** from the **Save as type** drop-down list before you click **Save**.

To save data in a form that can be opened by programs that cannot open Excel workbooks, you might select either **Text (Tab delimited) (*.txt)** or **CSV (Comma delimited) (*.csv)** as the save type. In OS X Excel versions, the equivalent selections are to select **Excel 97-2004 Workbook (.xls)**, **Tab Delimited Text (.txt)**, or **Windows Comma Separated (.csv)** from the **Format** drop-down list before you click **Save**.

When you want to open a file and cannot find its name in the list box, double-check that the current folder being searched is the proper folder. If it is, change the file type to **All Files (*.*)** (**All Files** in OS X Excel) to see all files in the current folder. This technique can help you discover inadvertent misspellings or missing file extensions that otherwise prevent the file from being displayed.

Although all versions of Microsoft Excel include a **Save** command, you should avoid this choice until you gain experience. Using **Save** makes it too easy to inadvertently overwrite your work. Also, you cannot use the **Save** command for any open workbook that Excel has marked as read-only. (Use **Save As** to save such workbooks.)