## A FIRST COURSE IN



TWELFTH EDITION

# James T. McClave

Info Tech, Inc.

University of Florida



University of South Florida



330 Hudson Street, NY, NY 10013

# Contents

Preface 11 Applications Index 19

#### **Chapter 1** Statistics, Data, and Statistical Thinking 25 1.1 The Science of Statistics 26 1.2 Types of Statistical Applications 27 1.3 Fundamental Elements of Statistics 29 1.4 Types of Data 33 1.5 Collecting Data: Sampling and Related Issues 35 1.6 The Role of Statistics in Critical Thinking and Ethics 40 Statistics in Action: Social Media Network Usage-Are You Linked In? 26 Using Technology: MINITAB: Accessing and Listing Data 49 **Chapter 2** Methods for Describing Sets of Data 53 2.1 Describing Qualitative Data 55 2.2 Graphical Methods for Describing Quantitative Data 66 2.3 Numerical Measures of Central Tendency 78 2.4 Numerical Measures of Variability 89

- **2.5** Using the Mean and Standard Deviation to Describe Data 95
- **2.6** Numerical Measures of Relative Standing 103
- 2.7 Methods for Detecting Outliers: Box Plots and *z*-Scores 107
- **2.8** Graphing Bivariate Relationships (Optional) 117
- **2.9** Distorting the Truth with Descriptive Statistics 122
- Statistics in Action: Body Image Dissatisfaction: Real or Imagined? 54
- Using Technology: MINITAB: Describing Data 136

TI-83/TI-84 Plus Graphing Calculator: Describing Data 137

### Chapter 3

### Probability 139

- 3.1 Events, Sample Spaces, and Probability 141
  3.2 Unions and Intersections 154
  3.3 Complementary Events 157
- **3.4** The Additive Rule and Mutually Exclusive Events 159
- **3.5** Conditional Probability 166
- **3.6** The Multiplicative Rule and Independent Events 169

Statistics in Action:Lotto Buster! Can You Improve Your Chance of Winning?140Using Technology:TI-83/TI-84 Plus Graphing Calculator:Combinations and Permutations189

#### **Chapter 4** Random Variables and Probability Distributions 190 4.1 Two Types of Random Variables 192 4.2 Probability Distributions for Discrete Random Variables 195 4.3 The Binomial Random Variable 207 4.4 Probability Distributions for Continuous Random Variables 218 4.5 The Normal Distribution 220 4.6 Descriptive Methods for Assessing Normality 233 Approximating a Binomial Distribution with a Normal Distribution 4.7 (Optional) 242 4.8 Sampling Distributions 247 4.9 The Sampling Distribution of $\bar{x}$ and the Central Limit Theorem 254 Statistics in Action: Super Weapons Development-Is the Hit Ratio Optimized? 191 Using Technology: MINITAB: Binomial Probabilities, Normal Probability, and Simulated Sampling Distribution 271 **Chapter 5** Inferences Based on a Single Sample 276 5.1 Identifying and Estimating the Target Parameter 277 5.2 Confidence Interval for a Population Mean: Normal (z) Statistic 279 5.3 Confidence Interval for a Population Mean: Student's t-Statistic 289 5.4 Large-Sample Confidence Interval for a Population Proportion 299 5.5 Determining the Sample Size 306 5.6 Confidence Interval for a Population Variance (Optional) 313 Statistics in Action: Medicare Fraud Investigations 277 **Using Technology:** MINITAB: Confidence Intervals 326 TI-83/TI-84 Plus Graphing Calculator: Confidence Intervals 328 **Chapter 6** Inferences Based on a Single Sample 330 6.1 The Elements of a Test of Hypothesis 331 6.2 Formulating Hypotheses and Setting Up the Rejection Region 337 6.3 Observed Significance Levels: p-Values 342 6.4 Test of Hypothesis about a Population Mean: Normal (z) Statistic 347 6.5 Test of Hypothesis about a Population Mean: Student's *t*-Statistic 355 6.6 Large-Sample Test of Hypothesis about a Population Proportion 362 6.7 Test of Hypothesis about a Population Variance (Optional) 370 6.8 A Nonparametric Test about a Population Median (Optional) 376

Statistics in Action: Diary of a KLEENEX<sup>®</sup> User—How Many Tissues in a Box? 331 Using Technology: MINITAB: Tests of Hypotheses 388 TI-83/TI-84 Plus Graphing Calculator: Tests of Hypotheses 390

Chapter 7	Con	Comparing Population Means 391	
	7.1	7.1 Identifying the Target Parameter 392	
	7.2	Comparing Two Population Means: Independent Sampling 393	
	7.3	Comparing Two Population Means: Paired Difference Experiments 411	
	7.4	Determining the Sample Size 423	
	7.5	A Nonparametric Test for Comparing Two Populations: Independent Samples (Optional) 427	
	7.6	A Nonparametric Test for Comparing Two Populations: Paired Difference Experiment (Optional) 436	
	7.7	Comparing Three or More Population Means: Analysis of Variance (Optional) 445	
	Statisti	<b>Statistics in Action</b> : ZixIt Corp. v. Visa USA Inc. – A Libel Case 392 Using Technology: MINITAB: Comparing Means 467 TI-83/TI-84 Plus Graphing Calculator: Comparing Means 469	
	Using T		
	TI-83/1		
Chapter 8	Comparing Population Proportions 473		
	8.1	Comparing Two Population Proportions: Independent Sampling 475	
	8.2	Determining the Sample Size 482	
	8.3	Testing Category Probabilities: Multinomial Experiment 485	
	8.4	Testing Categorical Probabilities: Two-Way (Contingency) Table 494	
	Statistics in Action: The Case of the Ghoulish Transplant Tissue 474		
	Using Technology: MINITAB: Categorized Data Analysis 520		
	TI-83/TI-84 Plus Graphing Calculator:Categorical Data Analyses 521		
Chapter 9	Simple Linear Regression 523		
	9.1	Probabilistic Models 525	
	9.2	Fitting the Model: The Least Squares Approach 529	
	9.3	Model Assumptions 542	
	9.4	Assessing the Utility of the Model: Making Inferences about the Slope $\beta_1$ 547	
	9.5	The Coefficients of Correlation and Determination 556	
	9.6	Using the Model for Estimation and Prediction 566	
	9.7	A Complete Example 574	
	9.8	A Nonparametric Test for Correlation (Optional) 578	
	Statistics in Action: Can "Dowsers" Really Detect Water? 524		
	Using Technology: MINITAB: Simple Linear Regression 597		
	TI-83/TI-84 Plus Graphing Calculator: Simple Linear Regression 599		

## Appendices

Appendix A	Summation Notation 601
Appendix B	Tables 603
Table I	Binomial Probabilities 604
Table II	Normal Curve Areas 608
Table III	Critical Values of $t = 609$
Table IV	Critical Values of $\chi^2$ 610
Table V	Critical Values of $T_L$ and $T_U$ for the Wilcoxon Rank Sum Test 612
Table VI	Critical Values of $T_0$ in the Wilcoxon Signed Rank Test 613
Table VII	Percentage Points of the <i>F</i> -Distribution, $\alpha = .10$ 614
Table VIII	Percentage Points of the <i>F</i> -Distribution, $\alpha = .05$ 616
Table IX	Percentage Points of the <i>F</i> -Distribution, $\alpha = .025$ 618
Table X	Percentage Points of the <i>F</i> -Distribution, $\alpha = .01$ 620
Table XI	Critical Values of Spearman's Rank Correlation Coefficient 622
Appendix C	Calculation Formulas for Analysis of Variance
	(Independent Sampling) 623
Short Answers to Selected Odd-Nu	mbered Exercises 624
Index C21	

Index 631

**Credits** 636

Selected Formulas 638