## Contents

Pr	reface	page xv
	New to the Second Edition Manufacture of the Design and Edition Manufacture of the Second Edition Manufactur	XV
	Guiding Principles Underlying Our Approach	xvi
	Overview of Content Coverage and Intended Audience	xvii
Ac	cknowledgments	xix
	Characterizing the Skeymasnofial Distribution to available of the Skeyma	
1	INTRODUCTION	181
	The Role of Statistical Software in Data Analysis	181
	Statistics: Descriptive and Inferential	2
	Variables and Constants state and U and W stall! luigible	3
	The Measurement of Variables	3
	Nominal Level house Equation house and additional level	4
	Ordinal Level	4
	Interval Level	5
	Ratio Level	6
	Choosing a Scale of Measurement	6
	Discrete and Continuous Variables	8
	Setting a Context with Real Data	11
	Exercises	14
	Summary of Stata Commandaoituditaid a lo squad sett no toelld sell	210
2	EXAMINING UNIVARIATE DISTRIBUTIONS	26
	Counting the Occurrence of Data Values	26
	When Variables are Measured at the Nominal Level	26
	Frequency and Percent Distribution Tables	27
	Bar Charts	28
	Pie Charts	31
	When Variables are Measured at the Ordinal, Interval, or Ratio Level	32
	Frequency and Percent Distribution Tables	32
	Stem-and-Leaf Displays	35
	Histograms	38
	Line Graphs	40
	Describing the Shape of a Distribution	42
	Accumulating Data	44
	Cumulative Percent Distributions	44
	Ogive Curves	45
	Percentile Ranks	46
	Percentiles	47
	Five-Number Summaries and Boxplots	51
	Modifying the Appearance of Graphs	56

	Summary of Graphical Selection	56
	Summary of Stata Commands	56
	Exercises	58
3	MEASURES OF LOCATION, SPREAD, AND SKEWNESS	74
	Characterizing the Location of a Distribution	74
	The Mode	74
	The Median	78
	The Arithmetic Mean	80
	Interpreting the Mean of a Dichotomous Variable	82
	The Weighted Mean	83
	Comparing the Mode, Median, and Mean	84
	Characterizing the Spread of a Distribution	86
	The Range and Interquartile Range	89
	The Variance	91
	The Standard Deviation	93
	Characterizing the Skewness of a Distribution	95
	Selecting Measures of Location and Spread	99
	Applying What We Have Learned	99
	Summary of Stata Commands	104
	Helpful Hints When Using Stata	105
	Online Resources	106
	The Stata Command	106
	Stata Tips	108
	Exercises Exercises	109
4	RE-EXPRESSING VARIABLES	118
	Linear and Nonlinear Transformations	118
	Linear Transformations: Addition, Subtraction, Multiplication, and	
	Division	119
	The Effect on the Shape of a Distribution	121
	The Effect on Summary Statistics of a Distribution	121
	Common Linear Transformations	124
	Standard Scores	126
	z-Scores esidaT noltudinielO mesos 9 bas yonsuperil	127
	Using z-Scores to Detect Outliers	130
	Using z-Scores to Compare Scores in Different Distributions	133
	Relating z-Scores to Percentile Ranks	134
	Nonlinear Transformations: Square Roots and Logarithms	135
	Nonlinear Transformations: Ranking Variables	142
	Other Transformations: Recoding and Combining Variables	144
	Recoding Variables	144
	Combining Variables	147
	Data Management Fundamentals: The Do-File	147
	Summary of Stata Commands	150
	Exercises Exercises	151
5	THE PARTY OF THE P	159
	When Both Variables are at Least Interval-Leveled	159
	Scatterplots adjustible sommergy And grittibole	160

	The Pearson Product-Moment Correlation Coefficient	166
	Interpreting the Pearson Correlation Coefficient	170
	Judging the Strength of the Linear Relationship	170
	The Correlation Scale Itself Is Ordinal	171
	Correlation Does Not Imply Causation	172
	The Effect of Linear Transformations	172
	Restriction of Range	173
	The Shape of the Underlying Distributions	174
	The Reliability of the Data	174
	When at Least One Variable Is Ordinal and the Other Is at Least Ordinal:	
	The Spearman Rank Correlation Coefficient	174
	When at Least One Variable Is Dichotomous: Other Special Cases of the	
	Pearson Correlation Coefficient	176
	The Point Biserial Correlation Coefficient: The Case of One at Least	
	Interval and One Dichotomous Variable	176
	The Phi Coefficient: The Case of Two Dichotomous Variables	181
	Other Visual Displays of Bivariate Relationships	185
	Selection of Appropriate Statistic or Graph to Summarize a Relationship	188
	Summary of Stata Commands	189
	Exercises	189
		395
6	SIMPLE LINEAR REGRESSION	202
	The "Best-Fitting" Linear Equation	202
	The Accuracy of Prediction Using the Linear Regression Model	209
	The Standardized Regression Equation	210
	R As a Measure of the Overall Fit of the Linear Regression Model	210
	Simple Linear Regression When the Independent Variable Is	
	Dichotomous assert to top the state of the s	214
	Using r and R As Measures of Effect Size	217
	Emphasizing the Importance of the Scatterplot	217
	Summary of Stata Commands	219
	Exercises	219
7	PROBABILITY FUNDAMENTALS	228
	The Discrete Case	228
	The Complement Rule of Probability	230
	The Additive Rules of Probability	231
	First Additive Rule of Probability	231
	Second Additive Rule of Probability	232
	The Multiplicative Rule of Probability	233
	The Relationship between Independence and Mutual Exclusivity	236
	Conditional Probability	236
	The Law of Total Probability	239
	Bayes' Theorem	239
	The Law of Large Numbers	240
	Exercises	240
8	THEORETICAL PROBABILITY MODELS	244
	The Binomial Probability Model and Distribution	244
	The Applicability of the Binomial Probability Model	249

	The Normal Probability Model and Distribution Using the Normal Distribution to Approximate the Binomial Distribution Summary of Stata Commands Exercises	254 260 260 261
9	THE ROLE OF SAMPLING IN INFERENTIAL STATISTICS	269
	Samples and Populations	269
	Random Samples	270
	Obtaining a Simple Random Sample	271
	Sampling with and without Replacement	273
	Sampling Distributions	275
	Describing the Sampling Distribution of Means Empirically	275
	Describing the Sampling Distribution of Means Theoretically	280
	The Central Limit Theorem	281
	Estimators and Bias	285
	Summary of Stata Commands	286
	Exercises The the Management of the Exercises of the Exercises	287
10	INFERENCES INVOLVING THE MEAN OF A SINGLE	
	POPULATION WHEN σ IS KNOWN	291
	Estimating the Population Mean, $\mu$ , When the Population Standard	
	Deviation, $\sigma$ , Is Known	291
	Interval Estimation	293
	Relating the Length of a Confidence Interval, the Level of Confidence,	207
	and the Sample Size	296 296
	Hypothesis Testing The Relationship between Hypothesis Testing and Interval Estimation	305
	Effect Size	306
	Type II Error and the Concept of Power	307
	Increasing the Level of Significance, $\alpha$	310
	Increasing the Effect Size, $\delta$	310
	Decreasing the Standard Error of the Mean, $\sigma_{\overline{x}}$	311
	Closing Remarks	312
	Summary of Stata Commands	313
	Exercises	314
11	INFERENCES INVOLVING THE MEAN WHEN σ IS NOT	
11	KNOWN: ONE- AND TWO-SAMPLE DESIGNS	319
	Single Sample Designs When the Parameter of Interest Is the Mean	134
	and $\sigma$ Is Not Known	319
	The <i>t</i> -Distribution	320
	Degrees of Freedom for the One-Sample <i>t</i> -Test	321
	Violating the Assumption of a Normally Distributed Parent Population in	
	the One-Sample <i>t</i> -Test	322
	Confidence Intervals for the One-Sample <i>t</i> -Test	323
	Hypothesis Tests: The One-Sample <i>t</i> -Test	330
	Effect Size for the One-Sample <i>t</i> -Test	333
	Two-Sample Designs When the Parameter of Interest Is $\mu$ , and $\sigma$ Is Not	225
	Known	336
	Independent (or Unrelated) and Dependent (or Related) Samples	337

	Independent Samples t-Test and Confidence Interval	338
	The Assumptions of the Independent Samples <i>t</i> -Test	340
	Effect Size for the Independent Samples t-Test	349
	Paired Samples t-Test and Confidence Interval	353
	The Assumptions of the Paired Samples <i>t</i> -Test	354
	Effect Size for the Paired Samples t-Test	359
	The Bootstrap	360
	Conducting Power Analyses for t-Tests on Means	364
	Summary Summar	369
	Summary of Stata Commands	372
	Exercises	374
	Balanced versus Unbalanced Factorial Designs noiseargas	> 558
12	RESEARCH DESIGN: INTRODUCTION AND OVERVIEW	391
	Questions and their Link to Descriptive, Relational, and Causal Research	
	Studies Studies	391
	The Need for a Good Measure of our Construct: Weight	391
	The Descriptive Study	392
	From Descriptive to Relational Studies	393
	From Relational to Causal Studies	393
	The Gold Standard of Causal Studies: The True Experiment and Random	
	Assignment	395
	Comparing Two Kidney Stone Treatments Using a Non-Randomized	
	Controlled Study	396
	Including Blocking in a Research Design	397
	Underscoring the Importance of Having a True Control Group Using	
	Randomization	398
	Analytic Methods for Bolstering Claims of Causality from Observational	
	Data Data Additional Control of the	402
	Quasi-Experimental Designs	404
	Threats to the Internal Validity of a Quasi-Experimental Design	404
	Threats to the External Validity of a Quasi-Experimental Design	405
	Threats to the Validity of a Study: Some Clarifications and Caveats	406
	Threats to the Validity of a Study: Some Examples	407
	Exercises Salad for world below to the Control of Amelogical Control of Contr	408
		613
13	ONE-WAY ANALYSIS OF VARIANCE	412
	The Disadvantage of Multiple t-Tests	412
	The One-Way Analysis of Variance	414
	A Graphical Illustration of the Role of Variance in Tests on Means	414
	ANOVA As an Extension of the Independent Samples <i>t</i> -Test	416
	Developing an Index of Separation for the Analysis of Variance	416
	Carrying Out the ANOVA Computation	417
	The Between Group Variance $(MS_B)$	418
	The Within Group Variance (MS <sub>W</sub> )	418
	The Assumptions of the One-Way ANOVA	419
	Testing the Equality of Population Means: The F-Ratio	420
	How to Read the Tables and Use Stata Functions for the F-Distribution	422
	ANOVA Summary Table	425
	Measuring the Effect Size	426
	Post-Hoc Multiple Comparison Tests	431

	The Bonferroni Adjustment: Testing Planned Comparisons	444
	The Bonferroni Tests on Multiple Measures	446
	Conducting Power Analyses for One-Way ANOVA	447
	Summary of Stata Commands	450
	Exercises	451
	Effect Size for the Paired Samples 1-1 cs	101
14	TWO-WAY ANALYSIS OF VARIANCE	457
	The Two-Factor Design	457
	The Concept of Interaction	460
	The Hypotheses That are Tested by a Two-Way Analysis of Variance	465
	Assumptions of the Two-Way Analysis of Variance	466
	Balanced versus Unbalanced Factorial Designs	467
	Partitioning the Total Sum of Squares	468
	Using the F-Ratio to Test the Effects in Two-Way ANOVA	469
	Carrying Out the Two-Way ANOVA Computation by Hand	469
	Decomposing Score Deviations about the Grand Mean	474
	Modeling Each Score As a Sum of Component Parts	475
	Explaining the Interaction As a Joint (or Multiplicative) Effect	475
	Measuring Effect Size	476
	Fixed versus Random Factors	479
	Post-Hoc Multiple Comparison Tests	479
	Simple Effects and Pairwise Comparisons	482
	Summary of Steps to Be Taken in a Two-Way ANOVA Procedure	487
	Conducting Power Analyses for Two-Way ANOVA	491
	Summary of Stata Commands	493
	Exercises	495
		70.0
15	CORRELATION AND SIMPLE REGRESSION AS INFERENTIAL	
	TECHNIQUES	503
	The Bivariate Normal Distribution	503
	Testing whether the Population Pearson Product-Moment Correlation Equals	
	Zero	506
	Using a Confidence Interval to Estimate the Size of the Population Correlation	
	Coefficient, $\rho$	509
	Revisiting Simple Linear Regression for Prediction	512
	Estimating the Population Standard Error of Prediction, $\sigma_{Y X}$	513
	Testing the <i>b</i> -Weight for Statistical Significance	514
	Explaining Simple Regression Using an Analysis of Variance Framework	518
	Measuring the Fit of the Overall Regression Equation: Using $R$ and $R^2$	520
	Relating $R^2$ to $\sigma^2_{Y X}$	521
	Testing $R^2$ for Statistical Significance	522
	Estimating the True Population $R^2$ : The Adjusted $R^2$	523
	Exploring the Goodness of Fit of the Regression Equation: Using Regression	
	Diagnostics Application of the Control of the Contr	524
	Residual Plots: Evaluating the Assumptions Underlying Regression	526
	Detecting Influential Observations: Discrepancy and Leverage	529
	Using Stata to Obtain Leverage	530
	Using Stata to Obtain Discrepancy	531
	Using Stata to Obtain Influence	531
	Using Diagnostics to Evaluate the Ice Cream Sales Example	533

Using the Prediction Model to Predict Ice Cream Sales	536
Simple Regression When the Predictor Is Dichotomous	536
Conducting Power Analyses for Correlation and Simple Regression	538
Summary of Stata Commands and III and Italian III will be a state of the state of t	540
Exercises Exercises Organization Variation Application of The Exercises	541
16 AN INTRODUCTION TO MULTIPLE REGRESSION	553
The Basic Equation with Two Predictors	554
Equations for $b$ , $\beta$ and $R_{Y,12}$ When the Predictors Are Not Correlated	555
Equations for $b$ , $\beta$ , and $R_{Y,12}$ When the Predictors Are Correlated	556
Summarizing and Expanding on Some Important Principles of Multiple	
Regression	558
Testing the b-Weights for Statistical Significance	563
Assessing the Relative Importance of the Predictors in the Equation	565
Measuring the Drop in $R^2$ Directly: An Alternative to the Squared Semipartial	000
Correlation	566
Evaluating the Statistical Significance of the Change in $\mathbb{R}^2$	566
The b-Weight As a Partial Slope in Multiple Regression	568
	300
Multiple Regression When One of the Two Independent Variables Is	571
Dichotomous  Controlling Variables Statistically, A Closer Look	576
Controlling Variables Statistically: A Closer Look	577
A Hypothetical Example	580
Conducting Power Analyses for Multiple Regression	582
Summary of Stata Commands	583
Exercises	303
17 TWO-WAY INTERACTIONS IN MULTIPLE REGRESSION	590
Testing the Statistical Significance of an Interaction Using Stata	593
Comparing the Y-Hat Values from the Additive and Interaction Models	598
Centering First-Order Effects if the Equation Has an Interaction	599
Probing the Nature of a Two-Way Interaction	600
Interaction When One of the Independent Variables Is Dichotomous	
and the Other Is Continuous	603
Methods Useful for Model Selection	610
Conducting a Power Analysis to Detect an Interaction	613
Summary of Stata Commands	614
Exercises	617
18 NONPARAMETRIC METHODS	622
Parametric versus Nonparametric Methods	622
Nonparametric Methods When the Dependent Variable Is at the Nominal	
Level	623
The Chi-Square Distribution $(\chi^2)$	623
The Chi-Square Goodness-of-Fit Test	625
The Chi-Square Test of Independence	630
Assumptions of the Chi-Square Test of Independence	633
Fisher's Exact Test	635
Calculating the Fisher's Exact Test by Hand Using the Hypergeometric	333
Distribution	637

Non	parametric Methods When the Dependent Variable Is				
Ordi	nal-Leveled	639			
W	lcoxon Sign Test	640			
Th	e Mann-Whitney U-Test or Wilcoxon's Rank-Sum Test	642			
Th	e Kruskal-Wallis Analysis of Variance	647			
Sumi	nary of Stata Commands	649			
Exerc		650			
19 <b>COMM</b> (	UNICATING YOUR STATA RESULTS VIA EXCEL	655			
	ng the Working Directory	655			
	oducing a Table of Univariate Summary Statistics in Excel	656			
Us	ing estpost and esttab	656			
	ing putexcel	657			
	oducing a Correlation Matrix As a Table in Excel	661			
Using estpost and esttab Using putexcel Reproducing Regression Output As a Table in Excel Using outreg2 to obtain a table of model statistics in Excel					
			Usi	ng eststo and esttab to obtain a table of model statistics in Excel	663
			Usi	ng putexcel to reproduce a table of regression coefficients in Excel	664
			Repro	oducing a Graph in Excel (Using putexcel)	666
Conc	usion A Hypothetical Example annual example A	668			
Sumr	nary of Stata Commands	668			
Exerc	ises	671			
Appendix A	Data Set Descriptions	673			
Appendix B	Stata .Do-files and Data Sets in Stata Format	686			
Appendix C	Statistical Tables	688			
Appendix D	Solutions				
References		708			
Index		709			
THUEX		713			