

---

# STATISTICAL METHODS FOR THE SOCIAL SCIENCES

Fifth Edition

Alan Agresti

*University of Florida*

# Contents

Preface ix

Acknowledgments xi

## 1 INTRODUCTION 1

---

1.1 Introduction to Statistical Methodology 1

1.2 Descriptive Statistics and Inferential Statistics 4

1.3 The Role of Computers and Software in Statistics 6

1.4 Chapter Summary 8

## 2 SAMPLING AND MEASUREMENT 11

---

2.1 Variables and Their Measurement 11

2.2 Randomization 14

2.3 Sampling Variability and Potential Bias 17

2.4 Other Probability Sampling Methods\* 21

2.5 Chapter Summary 23

## 3 DESCRIPTIVE STATISTICS 29

---

3.1 Describing Data with Tables and Graphs 29

3.2 Describing the Center of the Data 35

3.3 Describing Variability of the Data 41

3.4 Measures of Position 46

3.5 Bivariate Descriptive Statistics 51

3.6 Sample Statistics and Population Parameters 55

3.7 Chapter Summary 55

## 4 PROBABILITY DISTRIBUTIONS 67

---

4.1 Introduction to Probability 67

4.2 Probability Distributions for Discrete and Continuous Variables 69

4.3 The Normal Probability Distribution 72

4.4 Sampling Distributions Describe How Statistics Vary 80

4.5 Sampling Distributions of Sample Means 85

4.6 Review: Population, Sample Data, and Sampling Distributions 91

4.7 Chapter Summary 94

## 5 STATISTICAL INFERENCE: ESTIMATION 103

---

5.1 Point and Interval Estimation 103

5.2 Confidence Interval for a Proportion 106

5.3 Confidence Interval for a Mean 113

5.4 Choice of Sample Size 120

5.5 Estimation Methods: Maximum Likelihood and the Bootstrap\* 126

5.6 Chapter Summary 130

## 6 STATISTICAL INFERENCE: SIGNIFICANCE TESTS 139

---

6.1 The Five Parts of a Significance Test 140

6.2 Significance Test for a Mean 143

6.3 Significance Test for a Proportion 152

6.4 Decisions and Types of Errors in Tests 155

6.5 Limitations of Significance Tests 159

6.6 Finding  $P(\text{Type II Error})^*$  163

6.7 Small-Sample Test for a Proportion—the Binomial Distribution\* 165

6.8 Chapter Summary 169

## 7 COMPARISON OF TWO GROUPS 179

---

7.1 Preliminaries for Comparing Groups 179

7.2 Categorical Data: Comparing Two Proportions 182

7.3 Quantitative Data: Comparing Two Means 187

- 7.4 Comparing Means with Dependent Samples **190**
- 7.5 Other Methods for Comparing Means\* **193**
- 7.6 Other Methods for Comparing Proportions\* **198**
- 7.7 Nonparametric Statistics for Comparing Groups\* **201**
- 7.8 Chapter Summary **204**

## 8 ANALYZING ASSOCIATION BETWEEN CATEGORICAL VARIABLES **215**

---

- 8.1 Contingency Tables **215**
- 8.2 Chi-Squared Test of Independence **218**
- 8.3 Residuals: Detecting the Pattern of Association **225**
- 8.4 Measuring Association in Contingency Tables **227**
- 8.5 Association Between Ordinal Variables\* **233**
- 8.6 Chapter Summary **238**

## 9 LINEAR REGRESSION AND CORRELATION **247**

---

- 9.1 Linear Relationships **247**
- 9.2 Least Squares Prediction Equation **250**
- 9.3 The Linear Regression Model **256**
- 9.4 Measuring Linear Association: The Correlation **259**
- 9.5 Inferences for the Slope and Correlation **266**
- 9.6 Model Assumptions and Violations **272**
- 9.7 Chapter Summary **277**

## 10 INTRODUCTION TO MULTIVARIATE RELATIONSHIPS **287**

---

- 10.1 Association and Causality **287**
- 10.2 Controlling for Other Variables **290**
- 10.3 Types of Multivariate Relationships **294**
- 10.4 Inferential Issues in Statistical Control **299**
- 10.5 Chapter Summary **301**

## 11 MULTIPLE REGRESSION AND CORRELATION **307**

---

- 11.1 The Multiple Regression Model **307**
- 11.2 Multiple Correlation and  $R^2$  **316**
- 11.3 Inferences for Multiple Regression Coefficients **320**
- 11.4 Modeling Interaction Effects **325**
- 11.5 Comparing Regression Models **329**
- 11.6 Partial Correlation\* **331**
- 11.7 Standardized Regression Coefficients\* **334**
- 11.8 Chapter Summary **337**

## 12 REGRESSION WITH CATEGORICAL PREDICTORS: ANALYSIS OF VARIANCE METHODS **351**

---

- 12.1 Regression Modeling with Dummy Variables for Categories **351**
- 12.2 Multiple Comparisons of Means **355**
- 12.3 Comparing Several Means: Analysis of Variance **358**
- 12.4 Two-Way ANOVA and Regression Modeling **362**
- 12.5 Repeated-Measures Analysis of Variance\* **369**
- 12.6 Two-Way ANOVA with Repeated Measures on a Factor\* **373**
- 12.7 Chapter Summary **378**

## 13 MULTIPLE REGRESSION WITH QUANTITATIVE AND CATEGORICAL PREDICTORS **387**

---

- 13.1 Models with Quantitative and Categorical Explanatory Variables **387**
- 13.2 Inference for Regression with Quantitative and Categorical Predictors **394**
- 13.3 Case Studies: Using Multiple Regression in Research **397**

- 13.4** Adjusted Means\* **401**
- 13.5** The Linear Mixed Model\* **406**
- 13.6** Chapter Summary **411**

## **14** MODEL BUILDING WITH MULTIPLE REGRESSION **419**

---

- 14.1** Model Selection Procedures **419**
- 14.2** Regression Diagnostics **426**
- 14.3** Effects of Multicollinearity **433**
- 14.4** Generalized Linear Models **435**
- 14.5** Nonlinear Relationships: Polynomial Regression **439**
- 14.6** Exponential Regression and Log Transforms\* **444**
- 14.7** Robust Variances and Nonparametric Regression\* **448**
- 14.8** Chapter Summary **450**

## **15** LOGISTIC REGRESSION: MODELING CATEGORICAL RESPONSES **459**

---

- 15.1** Logistic Regression **459**
- 15.2** Multiple Logistic Regression **465**
- 15.3** Inference for Logistic Regression Models **470**
- 15.4** Logistic Regression Models for Ordinal Variables\* **472**
- 15.5** Logistic Models for Nominal Responses\* **477**
- 15.6** Loglinear Models for Categorical Variables\* **480**

- 15.7** Model Goodness-of-Fit Tests for Contingency Tables\* **484**
- 15.8** Chapter Summary **488**

## **16** AN INTRODUCTION TO ADVANCED METHODOLOGY **497**

---

- 16.1** Missing Data: Adjustment Using Multiple Imputation\* **497**
- 16.2** Multilevel (Hierarchical) Models\* **501**
- 16.3** Event History Models\* **503**
- 16.4** Path Analysis\* **506**
- 16.5** Factor Analysis\* **510**
- 16.6** Structural Equation Models\* **515**
- 16.7** Markov Chains\* **519**
- 16.8** The Bayesian Approach to Statistical Inference\* **520**

Appendix: R, Stata, SPSS, and SAS for Statistical Analyses **527**

Answers to Selected Odd-Numbered Exercises **565**

Bibliography **579**

Credits **583**

Index **585**