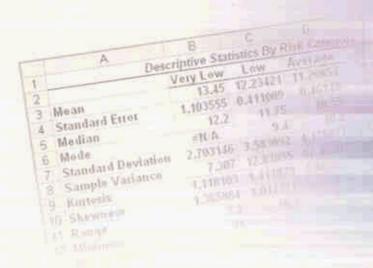
INTERNATIONAL EDITION

Statistics for Ath Edition Managers



LEVINE STEPHAN KREHBIEL BERENSON

www.prenhall.com/levine



Using Microsoft® Excel



CONTENTS

Preface xix

1 INTRODUCTION AND DATA COLLECTION 1

Using	Statistics:	Good	Tunes	2
-------	--------------------	------	-------	---

- 1.1 What Is Statistics 2
- 1.2 The Growth of Statistics and Information Technology 3
- 1.3 Microsoft Excel: The Solution to a Problem or a Problem Itself? 3
- 1.4 Learning about Business Statistics 4
- 1.5 Learning Statistics with Microsoft Excel 5
- 1.6 Using Microsoft Excel in the Best Way Possible 5
- 1.7 Learning Business Statistics Using This Text 6
- 1.8 The Importance of Collecting Data 8
- 1.9 Identifying Sources of Data 8
- 1.10 Types of Survey Sampling Methods 9

Simple Random Sample 11

Systematic Sample 13

Stratified Sample 13

The Cluster Sample 14

1.11 Types of Data 15

Levels of Measurement and Types of Measurement Scales 16

1.12 Evaluating Survey Worthiness 19

Survey Errors 19

Ethical Issues 21

Summary 22

Key Terms 22

Chapter Review Problems 23

EXCEL PRIMER 29

- EP1 Introduction to Microsoft Excel 30
- EP2 The Microsoft Excel User Interface 30
- EP3 Common Workbook Operations 36
- EP4 Basic Worksheet Concepts and Operations 39
- EP5 Advanced Workbook Operations 41
- EP6 Using the Microsoft Excel Chart Wizard 43
- EP7 Using the Microsoft Excel PivotTable Wizard 45
- EP8 Understanding and Using Add-Ins 46

Key Terms 48

2 PRESENTING DATA IN TABLES AND CHARTS 49

Using Statistics: Comparing the Performance of Mutual Funds 50

2.1 Organizing Numerical Data 50

The Ordered Array 51

The Stem-and-Leaf Display 52

viii Contents

2.2 Tables and Charts for Numerical Data 55

The Frequency Distribution 55

Selecting the Number of Classes 55

Obtaining the Class Intervals 55

Establishing the Boundaries of the Classes 56

Subjectivity in Selecting Class Boundaries 57

The Relative Frequency Distribution and the Percentage Distribution 57

The Cumulative Distribution 58

The Histogram 60

The Polygon 60

The Cumulative Percentage Polygon (Ogive) 61

2.3 Graphing Bivariate Numerical Data 65

2.4 Tables and Charts for Categorical Data 68

The Summary Table 68

The Bar Chart 69

The Pie Chart 69

The Pareto Diagram 70

2.5 Tabulating and Graphing Bivariate Categorical Data 75

The Contingency Table 75

The Side-by-Side Bar Chart 76

2.6 Graphical Excellence 80

Principles of Graphical Excellence 80

Summary 84

Key Terms 84

Chapter Review Problems 85

Managing the Springville Herald 93

Web Case 93

Excel Handbook 94

3 NUMERICAL DESCRIPTIVE MEASURES 103

Using Statistics: Evaluating the Performance of Mutual Funds 104

3.1 Exploring Numerical Data and Their Properties 104

3.2 Measures of Central Tendency, Variation, and Shape 105

The Arithmetic Mean 105

The Median 108

The Mode 109

Quartiles 110

The Geometric Mean 111

The Range 113

The Interquartile Range 114

The Variance and the Standard Deviation 114

The Coefficient of Variation 118

Visual Explorations: Exploring Descriptive Statistics 119

Shape 120

Microsoft Excel Descriptive Statistics Output 121

3.3 Obtaining Descriptive Summary Measures from a Population 126

The Population Mean 127

The Population Variance and Standard Deviation 127

The Empirical Rule 128

The Bienaymé-Chebyshev Rule 129

3.4 Exploratory Data Analysis 131

The Five-Number Summary 131

The Box-and-Whisker Plot 132

3.5 The Covariance and Coefficient of Correlation 137

3.6 Pitfalls in Numerical Descriptive Measures and Ethical Issues 143

Ethical Issues 144

Summary 144

Key Terms 145

Chapter Review Problems 146

Managing the Springville Herald 152

Web Case 152

Excel Handbook 153

4 BASIC PROBABILITY 157

Using Statistics: The Consumer Electronics Company 158

4.1 Basic Probability Concepts 158

Sample Spaces and Events 159

Contingency Tables 160

Simple (Marginal) Probability 160

Joint Probability 161

General Addition Rule 162

Addition Rule for Mutually Exclusive Events 164

Addition Rule for Collectively Exhaustive Events 165

4.2 Conditional Probability 168

Computing Conditional Probabilities 168

Decision Trees 170

Statistical Independence 171

Multiplication Rule 172

- 4.3 Bayes' Theorem 176
- 4.4 Ethical Issues and Probability 180

Summary 181

Key Terms 181

Chapter Review Problems 182

Web Case 184

Excel Handbook 185

5 SOME IMPORTANT DISCRETE PROBABILITY DISTRIBUTIONS 187

Using Statistics: The Accounting Information System of the Saxon Home Improvement Company 188

5.1 The Probability Distribution for a Discrete Random Variable 188

Expected Value of a Discrete Random Variable 189

Variance and Standard Deviation of a Discrete Random Variable 189

X Contents

5.2 Covariance and Its Application in Finance 192

The Covariance 192

The Expected Value, Variance, and Standard Deviation of the Sum of Two Random Variables 193

Portfolio Expected Return and Portfolio Risk 194

5.3 Binomial Distribution 197

Characteristics of the Binomial Distribution 202

- 5.4 Hypergeometric Distribution 205
- 5.5 Poisson Distribution 208
- 5.6 **©** CD-ROM Topic: Using the Poisson Distribution to Approximate the Binomial Distribution 212

Summary 212

Key Terms 212

Chapter Review Problems 212

Managing the Springville Herald 216

Web Case 217

Excel Handbook 218

6 THE NORMAL DISTRIBUTION AND OTHER CONTINUOUS DISTRIBUTIONS 223

Using Statistics: Download Time for a Web Site Home Page 224

6.1 The Normal Distribution 224

Visual Explorations: Exploring the Normal Distribution 234

6.2 Evaluating the Normality Assumption 241

Evaluating the Properties 241

Constructing the Normal Probability Plot 242

- 6.3 The Uniform Distribution 248
- 6.4 The Exponential Distribution 250

Using Statistics: Cereal-Fill Packaging Process 253

- 6.5 Introduction to Sampling Distributions 253
- 6.6 Sampling Distribution of the Mean 253

The Unbiased Property of the Arithmetic Mean 253

Standard Error of the Mean 255

Sampling from Normally Distributed Populations 256

Sampling from Nonnormally Distributed Populations 260

Visual Explorations: Exploring Sampling Distributions 262

- 6.7 Sampling Distribution of the Proportion 266
- 6.8 © CD-ROM Topic: The Normal Approximation to the Binomial Distributions 269
- 6.9 CD-ROM Topic: Sampling from Finite Populations 269

Summary 269

Key Terms 269

Chapter Review Problems 270

Managing the Springville Herald 274

Web Case 274

Excel Handbook 276

7 CONFIDENCE INTERVAL ESTIMATION 281

Using Statistics:	Auditing	Sales	Invoices	at the	Saxon	Home	Improvemen
Company	282						

- 7.1 Confidence Interval Estimation of the Mean (o Known) 283
- 7.2 Confidence Interval Estimation of the Mean (σ Unknown) 287

Student's t Distribution 287

The Concept of Degrees of Freedom 289

The Confidence Interval Statement 290

- 7.3 Confidence Interval Estimation for the Proportion 295
- 7.4 Determining Sample Size 299

Sample Size Determination for the Mean 299

Sample Size Determination for a Proportion 302

7.5 Applications of Confidence Interval Estimation in Auditing 307

Estimating the Population Total Amount 307

Difference Estimation 310

One-Sided Confidence Interval Estimation of the Rate of Noncompliance with Internal Controls 313

- 7.6 Confidence Interval Estimation and Ethical Issues 315
- 7.7 CD-ROM Topic: Estimation and Sample Size Determination for Finite Populations 316

Summary 316

Key Terms 317

Chapter Review Problems 317

Managing the Springville Herald 321

Web Case 323

Excel Handbook 324

8 FUNDAMENTALS OF HYPOTHESIS TESTING: ONE SAMPLE TESTS 331

Using Statistics: The Oxford Cereal Company 332

8.1 Hypothesis-Testing Methodology 332

The Null and Alternative Hypotheses 332

The Critical Value of the Test Statistic 333

Regions of Rejection and Nonrejection 334

Risks in Decision Making Using Hypothesis-Testing Methodology 335

8.2 Z Test of Hypothesis for the Mean (σ Known) 337

The Critical Value Approach to Hypothesis Testing 338

The p-Value Approach to Hypothesis Testing 339

A Connection Between Confidence Interval Estimation and Hypothesis Testing 342

8.3 One-Tail Tests 344

Critical Value Approach 344

p-Value Approach 346

8.4 t Test of Hypothesis for the Mean (σ Unknown) 348

Assumptions of the One-Sample t Test 351

- 8.5 Z Test of Hypothesis for the Proportion 355
- 8.6 Potential Hypothesis-Testing Pitfalls and Ethical Issues 360

Xii Contents

Summary 362

Key Terms 363

Chapter Review Problems 363

Managing the Springville Herald 366

Web Case 366

Excel Handbook 368

9 TWO-SAMPLE TESTS 373

Using Statistics: Comparing Sales from End-Aisle Displays and Normal Displays 374

9.1 Comparing Two Independent Samples: Tests for the Difference Between Two Means 374

Z Test for the Difference Between Two Means 374

Pooled-Variance t Test for the Difference Between Two Means 375

Confidence Interval Estimate for the Difference Between Two Means 380

Separate-Variance t Test for the Difference Between Two Means 381

- 9.2 Comparing Two Related Samples: Tests for the Mean Difference 385
- 9.3 Z Test for the Difference Between Two Proportions 392

Confidence Interval Estimate for the Difference Between the Proportions of Two Independent Groups 396

9.4 F Test for the Difference Between Two Variances 398

Obtaining Lower-Tail Critical Values 400

Summary 407

Key Terms 408

Chapter Review Problems 408

Managing the Springville Herald 412

Web Case 413

Excel Handbook 414

10 ANALYSIS OF VARIANCE 419

Using Statistics: The Perfect Parachute Company 420

10.1 The Completely Randomized Design: One-Way Analysis of Variance 420

F Test for Difference in More than Two Means 420

Multiple Comparisons: The Tukey-Kramer Procedure 429

ANOVA Assumptions 430

Levene's Test for Homogeneity of Variance 432

10.2 The Factorial Design: Two-Way Analysis of Variance 437

Testing for Factor and Interaction Effects 438

Interpreting Interaction Effects 444

Multiple Comparisons 446

10.3 CD-ROM Topic: The Randomized Block Design 449

Summary 450

Key Terms 450

Chapter Review Problems 450

Managing the Springville Herald 454

Excel Handbook 456

11 CHI-SQUARE TESTS AND NONPARAMETRIC TESTS 459

Using Statistics: Guest Satisfaction at T. C. Resort Properties 460

- 11.1 γ² Test for Differences Between Two Proportions 460
- 11.2 χ^2 Test for Differences In More than Two Proportions 468
- 11.3 χ^2 Test of Independence 476
- 11.4 Wilcoxon Rank Sum Test: Nonparametric Method for Two Independent Populations 483
- 11.5 Kruskal-Wallis Rank Test: A Nonparametric Method for the Completely Randomized Design 490

Summary 495

Key Terms 496

Chapter Review Problems 496

Managing the Springville Herald 500

Web Case 501

Excel Handbook 503

12 SIMPLE LINEAR REGRESSION 511

Using Statistics: Forecasting Sales for a Clothing Store 512

- 12.1 Types of Regression Models 512
- 12.2 Determining the Simple Linear Regression Equation 515

The Least-Squares Method 515

Visual Explorations: Exploring Simple Linear Regression Coefficients 517

Predictions in Regression Analysis: Interpolation versus Extrapolation 519

12.3 Measures of Variation 523

Obtaining the Sum of Squares 523

The Coefficient of Determination 525

Standard Error of the Estimate 525

- 12.4 Assumptions 527
- 12.5 Residual Analysis 528

Evaluating the Aptness of the Fitted Model 528

Evaluating the Assumptions 530

12.6 Measuring Autocorrelation: The Durbin-Watson Statistic 533

Residual Plots to Detect Autocorrelation 533

The Durbin-Watson Statistic 535

12.7 Inferences about the Slope and Correlation Coefficient 539

t Test for the Slope 539

F Test for the Slope 540

Confidence Interval Estimate of the Slope (β_1) 542

t Test for a Correlation Coefficient 542

12.8 Estimation of Mean Values and Prediction of Individual Values 546

Obtaining the Confidence Interval Estimate 546

Obtaining the Prediction Interval 547

xiv Contents

12.9 Pitfalls in Regression and Ethical Issues 551

12.10 Computations in Simple Linear Regression 554

Computing the Y Intercept b_0 and the Slope b_1 554

Computing the Measures of Variation 556

Computing the Standard Error of the Slope 557

Summary 560

Key Terms 560

Chapter Review Problems 562

Managing the Springville Herald 568

Web Case 568

Excel Handbook 570

13 INTRODUCTION TO MULTIPLE REGRESSION 575

Using Statistics: Predicting OmniPower Sales 576

13.1 Developing the Multiple Regression Model 576

Interpreting the Regression Coefficients 576

Predicting the Dependent Variable Y 579

Coefficients of Multiple Determination 580

- 13.2 Residual Analysis for the Multiple Regression Model 584
- 13.3 Testing for the Significance of the Multiple Regression Model 587
- 13.4 Inferences Concerning the Population Regression Coefficients 589

Tests of Hypothesis 589

Confidence Interval Estimation 591

13.5 Testing Portions of the Multiple Regression Model 592

Coefficient of Partial Determination 596

13.6 Using Dummy Variables and Interaction Terms in Regression Models 599

Interactions 601

Summary 611

Key Terms 611

Chapter Review Problems 611

Managing the Springville Herald 614

Web Case 614

Excel Handbook 615

14 MULTIPLE REGRESSION MODEL BUILDING 619

Using Statistics: Predicting Standby Hours for Unionized Artists 620

14.1 The Quadratic Regression Model 620

Finding the Regression Coefficients and Predicting Y 621

Testing for the Significance of the Quadratic Model 623

Testing for the Contribution of a Quadratic Effect 624

Obtaining the Coefficient of Multiple Determination 626

14.2 Using Transformations in Regression Analysis 628

The Square-Root Transformation 628

The Log Transformation 629

14.3 Collinearity 632

14.4 Model Building 634

The Stepwise Regression Approach to Model Building 635

The Best-Subsets Approach to Model Building 637

14.5 Pitfalls in Multiple Regression and Ethical Issues 644

Pitfalls in Multiple Regression 644

Ethical Issues 644

Summary 644

Key Terms 646

Chapter Review Problems 646

Mountain States Potato Company Case 649

Web Case 649

15 TIME-SERIES FORECASTING AND INDEX NUMBERS 651

Using Statistics: Forecasting Revenues for Three Companies 652

- 15.1 The Importance of Business Forecasting 652
- 15.2 Component Factors of the Classical Multiplicative Time-Series Model 653
- 15.3 Smoothing the Annual Time Series 655

Moving Averages 656

Exponential Smoothing 657

15.4 Least-Squares Trend-Fitting and Forecasting 663

The Linear Trend Model 663

The Quadratic Trend Model 665

The Exponential Trend Model 667

Model Selection Using First, Second, and Percentage Differences 673

15.5 Autoregressive Modeling for Trend-Fitting and Forecasting 678

15.6 Choosing an Appropriate Forecasting Model 689

Performing a Residual Analysis 690

Measuring the Magnitude of the Residual Error Through Squared or Absolute Differences 690

Principle of Parsimony 691

A Comparison of Four Forecasting Methods 691

15.7 Time-Series Forecasting of Seasonal Data 694

Least-Squares Forecasting with Monthly or Quarterly Data 695

15.8 Index Numbers 702

The Price Index 702

Aggregate Price Indexes 704

Weighted Aggregate Price Indexes: Laspeyres and Paasche 705

Some Common Price Indexes 707

15.9 Pitfalls Concerning Time-Series Forecasting 710

Summary 710

Key Terms 711

Chapter Review Problems 712

Managing the Springville Herald 715

Web Case 716

Excel Handbook 717

XVi Contents

16 DECISION MAKING 721

Using Statistics: Selecting a Stock 722

- 16.1 Payoff Tables and Decision Trees 722
- 16.2 Criteria for Decision Making 727

Expected Monetary Value 727

Expected Opportunity Loss 728

Return-to-Risk Ratio 731

- 16.3 Decision Making with Sample Information 736
- 16.4 Utility 741

Summary 742

Key Terms 743

Chapter Review Problems 743

Web Case 746

Excel Handbook 747

17 STATISTICAL APPLICATIONS IN QUALITY AND PRODUCTIVITY MANAGEMENT 751

Using Statistics: Service Quality at the Beachcomber Hotel 752

- 17.1 Total Quality Management 752
- 17.2 Six Sigma® Management 755
- 17.3 The Theory of Control Charts 756
- 17.4 Control Chart for the Proportion of Nonconforming Items—The p Chart 757
- 17.5 The Red Bead Experiment: Understanding Process Variability 764
- 17.6 Control Charts for the Range and the Mean 766

The R Chart: A Control Chart for Dispersion 766

The \overline{X} Chart 768

17.7 Process Capability 773

Customer Satisfaction and Specification Limits 774

Capability Indices 775

CPL, CPU, C_{nk} 776

Summary 779

Key Terms 780

Chapter Review Problems 780

The Harnswell Sewing Machine Company Case 782

Managing the Springville Herald 784

Excel Handbook 787

Answers to Even-Numbered Problems 793

Appendices 821

- A. Review of Arithmetic, Algebra, and Logarithms 822
- B. Summation Notation 824
- C. Statistical Symbols and Greek Alphabet 828
- D. CD-ROM Contents 829
- E. Tables 839
- F. Configuring and Customizing Microsoft Excel for Use with This Text 865
- G. PHStat2 User's Guide 867
- H. Preparing Data for Reports and Presentations Using Microsoft Office 869

Index 879

Excel Index 884

CD-ROM Topics

- 3.7 Obtaining Descriptive Summary Measures from a Frequency Distribution CD3-1
- 4.5 Counting Rules CD4-1
- 5.6 Using the Poisson Distribution to Approximate the Binomial Distribution CD5-1
- 6.1a Using the Standardized Normal Distribution Table CD6-1
- 6.8 The Normal Approximation to the Binomial and Poisson Distributions CD6-12
- 6.9 Sampling from Finite Populations CD6-17
- 7.7 Estimation and Sample Size Determination for Finite Populations CD7-1
- 8.8 The Power of a Test CD8-1
- 10.3 The Randomized Block Design CD10-1
- 11.6 χ^2 Test of Hypothesis for the Variance or Standard Deviation CD11-1
- 11.7 χ^2 Goodness of Fit Tests CD11-8