

STATISTICAL TECHNIQUES IN BUSINESS AND ECONOMICS

ninth edition

001000010111
000111001010

8 - 11 UAH 1 UAH 2
5 FSACF614 -

110001110010100
001000001100110
001000111010010
000101110001110
010100001000001
110010001000111
010010000101110
001110010100001
000001110010000
000111010010000
101110001110010
100001000001
010001000100000
010000101000001

11001000
100011101001000
010 001
110010100001000
001110010001
1101

Robert D. Mason

Douglas A. Lind

William G. Marchal

Tenth Edition

Statistical Techniques in **BUSINESS AND ECONOMICS**

Robert D. Mason

Late of The University of Toledo

Douglas A. Lind

William G. Marchal

Both of The University of Toledo



**Irwin
McGraw-Hill**

Boston • Burr Ridge, IL • Dubuque, IA • Madison, WI
New York • San Francisco • St. Louis
Bangkok • Bogotá • Caracas • Lisbon • London
Madrid • Mexico City • Milan • New Delhi • Seoul
Singapore • Sydney • Taipei • Toronto

Irwin/McGraw-Hill

A Division of The McGraw-Hill Companies

STATISTICAL TECHNIQUES IN BUSINESS AND ECONOMICS

Copyright © 1999 by The McGraw-Hill Companies, Inc. All rights reserved. Previous editions © 1967, 1970, 1974, 1978, 1982, 1986, 1990, 1993, and 1996 by Richard D. Irwin, a Times Mirror Higher Education Group, Inc. company. Printed in the United States of America. Except as permitted under the United States Copyright Act of 1976, no part of this publication may be reproduced or distributed in any form or by any means, or stored in a data base or retrieval system, without the prior written permission of the publisher.

This book is printed on acid-free paper.

International 2 3 4 5 6 7 8 9 0 VNH/VNH 9 3 2 1 0 9
Domestic 2 3 4 5 6 7 8 9 0 VNH/VNH 9 3 2 1 0 9

ISBN 0-07-303935-7 (student's edition)

ISBN 0-07-303936-5 (instructor's edition)

Vice president and editorial director: *Michael W. Junior*

Publisher: *Jeffrey J. Shelstad*

Executive editor: *Richard T. Hercher, Jr.*

Senior developmental editor: *Gail Korosa*

Marketing manager: *Zina Craft*

Project manager: *Carrie Sestak*

Production supervisor: *Scott M. Hamilton*

Senior designer: *Crispin Prebys*

Senior photo research coordinator: *Keri Johnson*

Supplement coordinator: *Rose M. Range*

Compositor: *GAC/Shepard Poorman Communications*

Typeface: *9.5/11 Helvetica Neue 45*

Printer: *Von Hoffman Press*

Library of Congress Cataloging-in-Publication Data

Mason, Robert Deward

Statistical techniques in business and economics / Robert D.

Mason, Douglas A. Lind, William G. Marchal. — 10th ed.

p. cm.

ISBN 0-07-303935-7 (student's ed.). — ISBN 0-07-303936-5
(instructor's ed.)

Includes bibliographical references and index.

1. Social sciences—Statistical methods. 2. Economics—
Statistical methods. 3. Commercial statistics. I. Lind, Douglas
A. II. Marchal, William G. III. Title.

HA29.M268 1999

519.5—dc21

98-26640

INTERNATIONAL EDITION

Copyright © 1999. Exclusive rights by The McGraw-Hill Companies, Inc. for manufacture and export.

This book cannot be re-exported from the country to which it is consigned by McGraw-Hill. The International Edition is not available in North America.

When ordering the title, use ISBN 0-07-115808-1

<http://www.mhhe.com>

To Jane and Andrea

*In memory of Robert D. Mason
Author, mentor, colleague, and friend*

Preface

As the name implies, the objective of *Statistical Techniques in Business and Economics* is to provide students majoring in economics, finance, marketing, accounting, management, and other fields of business administration, with an introductory survey of the many business applications of descriptive and inferential statistics.

When Bob Mason wrote the first edition of this text back in 1967, locating relevant data was a problem. That has changed! Today, locating data is not a problem. The number of items you purchase at the grocery store is automatically recorded. The phone company keeps track of the length of a call, the time of the day the call was made, and the number of the people called. Medical devices automatically monitor and record our heart rate, blood pressure, and temperature. A large amount of business information is recorded and reported almost instantly. CNN, *USA Today*, and NBC News, for example, have web sites where you can track stock prices with a delay of less than 20 minutes. There are volumes of information on sports.

Today, skills are needed to deal with all this numerical information. First, we need to be critical consumers of information presented by others. Second, we need to be able to reduce large amounts of data into a meaningful form so that we can make effective decisions.

When we began teaching, only a few students had calculators. Today, many students have a computer at home or in their dorm room, and most have access to a computer in a Computer Lab. Statistical software is widely available, as is electronically stored data. In response to these changes, we have made some changes in the text, such as adding Excel screen captures within chapters and commands at the end of chapters, replacing some calculation examples with interpretation ones, and so forth. In this edition we continue the use of MINITAB software but add Excel spreadsheet examples because much of the current world uses Microsoft applications.

Users of previous editions will notice another change, the addition of William G. Marchal as a coauthor. Bill is a longtime friend and colleague at The University of Toledo. We have collaborated for years on book writing projects, including, informally, this one. I am pleased to welcome him and acknowledge his significant contribution to this edition. On a sad note, Bob Mason, the original author of this text, passed away during this revision. We dedicate this edition to his memory. We will miss him as a coauthor, mentor, colleague, and most importantly as a friend.

I Acknowledgments

The tenth edition of *Statistical Techniques in Business and Economics* is the product of many people: students, colleagues, reviewers, and the staff at Irwin/McGraw-Hill. We thank them all. We wish to express our sincere gratitude to the reviewers:

Paul Arnold
McNeese State University

Mary Jo Boehms
Jackson State Community College

Frederick Derrick
Loyola College—Maryland

Jonas Falik
Queensborough Community College

Charles Fishburn
Pacific Christian College

Leonard Gaston
Central State University

Creig Kronstedt
Cardinal Stritch University

Denise Kummer
St. Louis Community College

John Leipold
University of Phoenix

John McCreery
North Carolina State University

Chester Piascik
Bryant College

Anastasia Pikas
Niagara University

Elizabeth Polenzani
Pasadena Community College

Christopher Rogers
Miami-Dade Community College

Sue Schou
Idaho State University

Dang Tran
California State University—Los Angeles

Rama Yelkur
Texas A&M International University

Their suggestions and thorough review of the previous edition and the manuscript for this edition made this a better text.

Special thanks go to a number of people. Dr. Louis A. Patille, of the University of Phoenix, and Mr. Ray Pohlman each solved all of the exercises and checked our answers for accuracy. Gwen H. Terwilliger and Walter H. Lange, both of The University of Toledo, prepared the Test Bank and the Study Guide, respectively. Ms. Denise Heban and the text authors prepared the Instructor's Manual, and Mr. Christopher B. X. Marchal the Power Point Presentation. We appreciate their efforts on the project.

We also would like to thank the staff at Irwin/McGraw-Hill. This includes: Richard T. Hercher, Jr, the Executive Editor; Gail Korosa, Senior Development Editor; Carrie Sestak, Project Manager; and others who we don't know personally, but who we know made valuable contributions.

D.A.L.
W.G.M.

A Note to the Student

As the name implies, the purpose of the tenth edition of *Statistical Techniques in Business and Economics* is to provide students in marketing, accounting, finance, international business, sales, management, marketing, and other fields of business and economics with a sound introduction to descriptive and inferential statistics. The book, however, is also appropriate for use in other subject areas, such as the various social sciences. You will find the text provides excellent preparation for decision-making problems in various facets of business and economics and a good background for advanced courses involving statistical analysis.

I Learning Aids

We have designed the text to assist you in approaching the course without the anxiety often associated with statistics. These learning aids are all intended to help you in your study.

Objectives Each chapter begins with a set of learning objectives. They are designed to provide focus for the chapter and to motivate learning. These objectives indicate what you should be able to do after completing the chapter. We include a photo that ties these chapter objectives to one of the exercises within the chapter.

Introduction At the start of each chapter, we review the important concepts of the previous chapter(s) and provide a link to what the current chapter will cover.

Definitions Definitions of new terms or terms unique to the study of statistics are set apart from the text and highlighted. This allows easy reference and review.

Formulas Formulas used for the first time are boxed and numbered for easy reference. In addition, a formula card that summarizes these key formulas is bound into the text.

Margin Notes There are more than 300 concise notes in the margin. Each emphasizes the key concept being presented immediately adjacent to it.

Examples/Solutions We include numerous examples with solutions. These are designed to show applications of the concepts being presented.

Statistics in Action Statistics in Action articles are scattered throughout the text, usually about two per chapter. They provide unique and interesting applications and historical insights into statistics.

Self-Reviews Self-reviews are interspersed throughout the chapter and each is closely patterned after the preceding **Example/Solution**. They will help you monitor your progress and provide immediate reinforcement for that particular technique. The answers and methods of solution are located at the end of the chapter.

Exercises We include exercises within the chapter, after the **Self-Reviews**, and at the end of the chapter. The answers and method of solution for all odd-numbered exercises are at the end of the book. For exercises with more than 20 observations, the data can be found on the CD-ROM supplied with the text.

Chapter Outline As a summary, each chapter includes a chapter outline. This learning aid provides an opportunity to review material, particularly vocabulary, and to see and review the formulas again.

Web Exercises Almost all chapters have references to Internet Web sites for companies, government organizations, and university data sets. These Web sites contain interesting and relevant information to enhance the exercises at the end of the chapters.

Computer Data Exercises In most chapters, the last four exercises are written around four data sets. A complete listing of the data is available in the back of the text and on the CD-ROM included with the text.

Section Reviews After selected groups of chapters, a section review is included. This includes a brief review of the chapters, a glossary of the key terms, and a practice examination of the material covered. This review also includes cases that let you make decisions using tools and techniques from a variety of chapters.

I Supplements

Student CD-ROM packaged free with all copies of the text, features practice quizzes, PowerPoint slides, the data files (in MINITAB, Excel, and ASCII formats) for the end of book large data sets and for exercises having 20 or more data values, and an Internet link to the text web site and to the web sites listed in the Web exercises in the text. Also included is MegaStat for Excel, by J. B. Orris, software that enhances the power of Excel in statistical analysis.

A comprehensive **Study Guide**, written by Professor Walter Lange, is organized much like the textbook. Each chapter includes objectives, a brief summary of the chapter, problems and their solution, self-review exercises, and assignments.

*Douglas A. Lind
William G. Marchal*

Brief Contents

1	What Is Statistics?	1
2	Describing Data: Frequency Distributions and Graphic Presentation	21
3	Describing Data: Measures of Location	64
4	Describing Data: Measures of Dispersion	97
5	A Survey of Probability Concepts	141
6	Discrete Probability Distributions	185
7	The Normal Probability Distribution	220
8	Sampling Methods and Sampling Distributions	257
9	Tests of Hypothesis: Large Samples	304
10	Tests of Hypothesis: Small Samples	352
11	Analysis of Variance	385
12	Linear Regression and Correlation	424
13	Multiple Regression and Correlation Analysis	466
14	Nonparametric Methods: Chi-Square Applications	511
15	Nonparametric Methods: Analysis of Ranked Data	540
16	Statistical Quality Control	580
17	Index Numbers	610
18	Time Series and Forecasting	639
19	An Introduction to Decision Making	678
	Appendixes: Tables and Data Sets	699
	Answers to Odd-Numbered Chapter Exercises	727
	Answers to Odd-Numbered Review Exercises	777
	Index	781

Contents

1 What Is Statistics? 1

Introduction	2
What Is Meant by Statistics?	2
Why Study Statistics?	4
Types of Statistics	5
Descriptive Statistics	5
Inferential Statistics	6
Types of Variables	8
Sources of Statistical Data	9
Levels of Measurement	11
Nominal Level Data	12
Ordinal Level Data	13
Interval Level Data	13
Ratio Level Data	14
Exercises	15
Uses and Abuses of Statistics	15
Computer Applications	16
CHAPTER OUTLINE	17
CHAPTER EXERCISES	18
COMPUTER DATA EXERCISES	19
ANSWERS TO SELF-REVIEW	20

2 Describing Data: Frequency Distributions and Graphic Presentation 21

Introduction	22
Constructing a Frequency Distribution	22
Class Intervals and Class Midpoints	25
A Computer Software Example	25
Suggestions on Constructing Frequency Distributions	25

Relative Frequency Distribution	29
---------------------------------	----

Exercises	31
Stem-and-Leaf Displays	31
Exercises	34
Graphic Presentation of a Frequency Distribution	35
Histogram	36
Frequency Polygon	38
Exercises	44
Less-Than Cumulative Frequency Polygons	41
Exercises	44
Other Graphic Presentations of Data	45
Misuses of Statistics	50
Exercises	52
CHAPTER OUTLINE	53
CHAPTER EXERCISES	54
WWW.EXERCISES.COM	60
COMPUTER DATA EXERCISES	60
COMPUTER COMMANDS	61
ANSWERS TO SELF-REVIEW	63

3 Describing Data: Measures of Location 64

Introduction	65
The Population Mean	65
The Sample Mean	67
The Properties of the Arithmetic Mean	68
Exercises	69
Weighted Mean	70
Exercises	71
The Median	71
The Mode	73
Exercises	75

Computer Solution	76
The Geometric Mean	79
Exercises	79
The Mean, Median, and Mode of Grouped Data	79
The Arithmetic Mean	79
Exercises	81
The Median	82
The Mode	84
Exercises	85
Selecting an Average for Data in a Frequency Distribution	86
CHAPTER OUTLINE	87
PRONUNCIATION KEY	88
CHAPTER EXERCISES	89
WWW.EXERCISES.COM	93
COMPUTER DATA EXERCISES	94
COMPUTER COMMANDS	95
ANSWERS TO SELF-REVIEW	96

4 Describing Data: Measures of Dispersion 97

Introduction	98
Why Study Dispersion?	98
Measures of Dispersion	99
Range	99
Mean Deviation	100
Exercises	101
Variance and Standard Deviation	102
Exercises	103
Exercises	106
Measures of Dispersion for Data Grouped into a Frequency Distribution	106
Range	106
Standard Deviation	106
Exercises	109
Interpretation and Uses of the Standard Deviation	110
Chebyshev's Theorem	110
The Empirical Rule	111
Exercises	112
Relative Dispersion	113
Exercises	115
Skewness	115

Exercises	116
Other Measures of Dispersion	117
Quartiles, Deciles, and Percentiles	117
Exercises	119
Box Plots	120
Exercises	122
CHAPTER OUTLINE	123
PRONUNCIATION KEY	125
CHAPTER EXERCISES	125
WWW.EXERCISES.COM	129
COMPUTER DATA EXERCISES	130
COMPUTER COMMANDS	131
ANSWERS TO SELF-REVIEW	133
A Review of Chapters 1–4	134
Glossary	134
Exercises	135
Cases	139

5 A Survey of Probability Concepts 141

Introduction	142
What Is a Probability?	143
Case 1	145
Case 2	145
Approaches to Probability	145
Classical Probability	145
Empirical Concept	147
Subjective Probability	147
Exercises	148
Some Rules of Probability	150
Rules of Addition	150
Exercises	155
Rules of Multiplication	156
Tree Diagrams	160
Exercises	162
Bayes' Theorem	163
Exercises	167
Principles of Counting	167
The Multiplication Formula	168
The Permutation Formula	169
The Combination Formula	171
Exercises	172

CHAPTER OUTLINE	173
PRONUNCIATION KEY	174
CHAPTER EXERCISES	174
COMPUTER DATA EXERCISES	181
ANSWERS TO SELF-REVIEW	183

6 Discrete Probability

Distributions 185

Introduction	186
What Is a Probability Distribution?	186
Random Variables	188
Discrete Random Variable	189
Continuous Random Variable	189
The Mean, Variance, and Standard Deviation of a Probability Distribution	189
Mean	189
Variance and Standard Deviation	190
Exercises	192
Binomial Probability Distribution	194
How Is a Binomial Probability Distribution Constructed?	195
Using Binomial Probability Tables	196
Exercises	201
Cumulative Probability Distributions	202
Exercises	204
Hypergeometric Probability Distribution	204
Exercises	207
Poisson Probability Distribution	207
Exercises	211
CHAPTER OUTLINE	211
CHAPTER EXERCISES	212
COMPUTER DATA EXERCISES	215
COMPUTER COMMANDS	215
ANSWERS TO SELF-REVIEW	219

7 The Normal Probability

Distribution 220

Introduction	221
The Family of Normal Probability Distributions	221
The Standard Normal Probability Distribution	223
Applications of the Standard Normal Distribution	225

Areas under the Normal Curve	226
Exercises	228
Exercises	230
Exercises	237
The Normal Approximation to the Binomial	237
Continuity Correction Factor	238
How to Apply the Correction Factor	240
Exercises	241
CHAPTER OUTLINE	242
CHAPTER EXERCISES	242
COMPUTER DATA EXERCISES	246
ANSWERS TO SELF-REVIEW	248
A Review of Chapters 5–7	250
Glossary	251
Exercises	252
Cases	255

8 Sampling Methods and Sampling Distributions 257

Introduction	258
Sampling the Population	258
Probability Sampling Methods	259
Simple Random Sampling	260
Systematic Random Sampling	261
Stratified Random Sampling	263
Cluster Sampling	264
Exercises	264
Sampling "Error"	266
Sampling Distribution of the Sample Means	267
Exercises	270
The Central Limit Theorem	272
The Central Limit Theorem—A Second Example	276
Exercises	278
Point Estimates and Confidence Intervals	279
The Standard Error of the Sample Mean	280
A Computer Simulation	283
Exercises	285
Confidence Interval for a Population Proportion	286
Exercises	287
Finite-Population Correction Factor	288
Exercises	290

Choosing an Appropriate Sample Size	290
Exercises	293
CHAPTER OUTLINE	293
PRONUNCIATION KEY	295
CHAPTER EXERCISES	295
WWW.EXERCISES.COM	300
COMPUTER DATA EXERCISES	300
COMPUTER COMMANDS	301
ANSWERS TO SELF-REVIEW	303

9 Tests of Hypothesis:

Large Samples 304

Introduction	305
What Is a Hypothesis?	305
What Is Hypothesis Testing?	306
Five-Step Procedure for Testing a Hypothesis	306
Step 1: State the Null Hypothesis and the Alternate Hypothesis	306
Step 2: Select the Level of Significance	307
Step 3: Compute the Test Statistic	309
Step 4: Formulate the Decision Rule	309
Step 5: Make a Decision	310
One-Tailed and Two-Tailed Tests of Significance	310
Testing for the Population Mean: Large Sample, Population Standard Deviation Known	312
A Two-Tailed Test	312
A One-Tailed Test	315
p -Value in Hypothesis Testing	316
Testing for the Population Mean: Large Sample, Population Standard Deviation Unknown	317
Exercises	319
Hypothesis Testing: Two Population Means	320
Exercises	324
Tests Concerning Proportions	325
Exercises	328
A Test Involving the Difference between Two Population Proportions	329
Exercises	332
Type II Error	333
Exercises	336
CHAPTER OUTLINE	336
PRONUNCIATION KEY	338
CHAPTER EXERCISES	338

WWW.EXERCISES.COM	342
COMPUTER DATA EXERCISES	343
ANSWERS TO SELF-REVIEW	344
A Review of Chapters 8 and 9	346
Glossary	346
Exercises	347
Cases	350

10 Tests of Hypothesis:

Small Samples 352

Introduction	353
Characteristics of Student's t Distribution	353
A Test for the Population Mean	354
Exercises	357
A Computer Solution	360
Exercises	362
Comparing Two Independent Population Means	363
Software Example Using Excel	366
Exercises	367
Hypothesis Testing with Dependent Samples	368
Comparing Dependent and Independent Samples	372
Exercises	373
CHAPTER OUTLINE	375
PRONUNCIATION KEY	376
CHAPTER EXERCISES	376
WWW.EXERCISES.COM	380
COMPUTER DATA EXERCISES	381
COMPUTER COMMANDS	382
ANSWERS TO SELF-REVIEW	384

11 Analysis of Variance 385

Introduction	386
The F Distribution	386
Comparing Two Population Variances	387
Exercises	389
ANOVA Assumptions	390
The ANOVA Test	392
Exercises	397
Inferences about Treatment Means	399
Exercises	401

Two-Way Analysis of Variance 402

Exercises 407

CHAPTER OUTLINE 408

PRONUNCIATION KEY 409

CHAPTER EXERCISES 410

WWW.EXERCISES.COM 415

COMPUTER DATA EXERCISES 415

COMPUTER COMMANDS 416

ANSWERS TO SELF-REVIEW 418

A Review of Chapters 10 and 11 419

Glossary 419

Exercises 420

Cases 423

12 Linear Regression and Correlation 424

Introduction 425

What Is Correlation Analysis? 425

The Coefficient of Correlation 427

The Coefficient of Determination 430

A Word of Caution 431

Exercises 431

Testing the Significance of the Correlation Coefficient 433

Exercises 435

Regression Analysis 435

Least Squares Principle 436

Drawing the Line of Regression 438

Exercises 439

The Standard Error of Estimate 441

Assumptions Underlying Linear Regression 444

Exercises 445

Confidence Intervals and Prediction Intervals 446

Exercises 449

More on the Coefficient of Determination 449

Exercises 452

The Relationships among the Coefficient of Correlation, the Coefficient of Determination, and the Standard Error of Estimate 453

Exercises 456

CHAPTER OUTLINE 456

PRONUNCIATION KEY 458

CHAPTER EXERCISES 458

WWW.EXERCISES.COM 462

COMPUTER DATA EXERCISES 463

COMPUTER COMMANDS 464

ANSWERS TO SELF-REVIEW 465

13 Multiple Regression and Correlation Analysis 466

Introduction 467

Multiple Regression Analysis 467

Exercises 471

Multiple Standard Error of Estimate 473

Assumptions about Multiple Regression and Correlation 475

The ANOVA Table 475

Exercises 477

Evaluating the Regression Equation 478

Using a Scatter Diagram 478

Correlation Matrix 478

Global Test: Testing Whether the Multiple Regression Model Is Valid 479

Evaluating Individual Regression Coefficients 481

Qualitative Independent Variables 482

Exercises 485

Analysis of Residuals 485

CHAPTER OUTLINE 488

PRONUNCIATION KEY 489

CHAPTER EXERCISES 489

WWW.EXERCISES.COM 501

COMPUTER DATA EXERCISES 502

COMPUTER COMMANDS 503

ANSWERS TO SELF-REVIEW 506

A Review of Chapters 12 and 13 507

Glossary 507

Exercises 508

Cases 509

14 Nonparametric Methods: Chi-Square Applications 511

Introduction 512

Goodness-of-Fit Test: Equal Expected Frequencies 512

Exercises 517

Goodness-of-Fit Test: Unequal Expected Frequencies	519
Limitations of Chi-Square	521
Exercises	523
Using the Goodness-of-Fit Test to Test for Normality	524
Exercises	527
Contingency Table Analysis	527
Exercises	531
CHAPTER OUTLINE	532
PRONUNCIATION KEY	533
CHAPTER EXERCISES	533
WWW.EXERCISES.COM	537
COMPUTER DATA EXERCISES	537
COMPUTER COMMANDS	538
ANSWERS TO SELF-REVIEW	539

15 Nonparametric Methods: Analysis of Ranked Data 540

Introduction	541
The Sign Test	541
Exercises	545
Using the Normal Approximation to the Binomial	546
Exercises	548
Testing a Hypothesis about a Median	548
Exercises	549
Wilcoxon Signed-Rank Test	550
Exercises	553
Wilcoxon Rank-Sum Test	555
Exercises	557
Kruskal-Wallis Test: Analysis of Variance by Ranks	558
Exercises	562
Rank-Order Correlation	563
Testing the Significance of r_s	565
Exercises	566
CHAPTER OUTLINE	567
PRONUNCIATION KEY	569
CHAPTER EXERCISES	569
WWW.EXERCISES.COM	572
COMPUTER DATA EXERCISES	572
COMPUTER COMMANDS	573

ANSWERS TO SELF-REVIEW	575
A Review of Chapters 14 and 15	577
Glossary	577
Exercises	578
Cases	578

16 Statistical Quality Control 580

Introduction	581
A Brief History of Quality Control	581
Causes of Variation	583
Diagnostic Charts	584
Pareto Charts	584
Fishbone Diagram	586
Exercises	587
Purpose and Types of Quality Control Charts	588
Control Charts for Variables	588
Range Chart	592
Some In-Control and Out-of-Control Situations	593
Exercises	595
Attribute Control Charts	596
Percent Defective Chart	596
$\bar{c}$ -Bar Chart	598
Exercises	599
Acceptance Sampling	600
Exercises	603
CHAPTER OUTLINE	603
PRONUNCIATION KEY	604
CHAPTER EXERCISES	604
COMPUTER COMMANDS	607
ANSWERS TO SELF-REVIEW	609

17 Index Numbers 610

Introduction	611
Simple Index Numbers	611
Why Convert Data to Indexes?	613
Exercises	614
Construction of Index Numbers	615
Unweighted Indexes	615
Simple Average of the Price Relatives	616
Simple Aggregate Index	617
Weighted Indexes	617
Laspeyres' Price Index	617

Paasche's Price Index	617
Fisher's Ideal Index	620
Exercises	621
Value Index	622
Exercises	623
Special Purpose Indexes	623
Exercises	625
Consumer Price Index	626
Special Uses of the Consumer Price Index	627
Shifting the Base	630
Exercises	631
CHAPTER OUTLINE	632
CHAPTER EXERCISES	633
WWW.EXERCISES.COM	637
COMPUTER COMMANDS	637
ANSWERS TO SELF-REVIEW	638

18 Time Series and Forecasting 639

Introduction	640
Components of a Time Series	640
Secular Trend	640
Cyclical Variation	642
Seasonal Variation	642
Irregular Variation	643
Linear Trend	643
Least Squares Method	645
Plotting the Line	646
Estimation	646
Exercises	648
The Moving-Average Method	648
Nonlinear Trends	652
Exercises	655
Seasonal Variation	655
Determining a Seasonal Index	656
Exercises	661
Deseasonalizing Data	662
Exercises	667
CHAPTER OUTLINE	667
CHAPTER EXERCISES	668
WWW.EXERCISES.COM	675
COMPUTER COMMANDS	675
ANSWERS TO SELF-REVIEW	677

19 An Introduction to Decision Making 678

Introduction	679
Elements of a Decision	679
A Case Involving Decision Making under Conditions of Uncertainty	680
Payoff Table	680
Expected Payoff	681
Exercises	683
Opportunity Loss	683
Exercises	684
Expected Opportunity Loss	684
Exercises	685
Maximin, Maximax, and Minimax Regret Strategies	686
Value of Perfect Information	686
Sensitivity Analysis	688
Exercises	689
Decision Trees	690
CHAPTER OUTLINE	691
CHAPTER EXERCISES	692
ANSWERS TO SELF-REVIEW	697

Appendixes

Appendix A	Binomial Probability Distribution	699
Appendix B	Factors for Control Charts	709
Appendix C	Poisson Distribution	710
Appendix D	Areas under the Normal Curve	711
Appendix E	Table of Random Numbers	712
Appendix F	Student's t Distribution	713
Appendix G	Critical Values of the F Distribution	714
Appendix H	Wilcoxon T Values	716
Appendix I	Critical Values of Chi-Square	717
Appendix J	Data Set 1—Real Estate	718
Appendix K	Data Set 2—1997 Major League Baseball	720

Appendix L	Data Set 3—Magazine Circulation	721
Appendix M	Data Set 4—Northwest Ohio School Districts	723
Appendix N	Banking Data Set—Case	726

Answers to Odd-Numbered Review Exercises	777
---	-----

Index	781
-------	-----

Answers to Odd-Numbered Chapter Exercises	727
--	-----