A FIRST COURSE IN BUSINESS STATISTICS

James T. McClave and P. George Benson

Third Edition

THIRD EDITION

A First Course in Business Statistics

James T. McClave
College of Business Administration
University of Florida

P. George Benson
School of Management
University of Minnesota

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PREFACE

Most business statistics texts contain sufficient material for a two-semester or two-quarter sequence of courses — an introduction to the basic concepts of statistical inference followed by a variety of topics (multiple regression analysis, sample survey design, analysis of variance, decision theory, etc.) which are briefly introduced and covered in single chapters. As such, they are suitable for a first introductory course (since most introductory courses cover the same material) and for those "second courses" in which the instructor wishes to survey a number of topics with limited depth.

This traditional format of a business statistics text possesses shortcomings for certain types of courses. If the course is a one-quarter or one-semester course designed to cover basic statistical concepts and methodology, then these texts cover far more material than is needed for a single course. If the text is designed for a two-course sequence, then the instructor is definitely restricted in the type of "second course" that can be presented; the nature of the material implies a survey treatment of a number of topics.

The third edition of *A First Course in Business Statistics* maintains the same objectives as the earlier editions. It is constructed to provide greater flexibility in designing a one- or two-course introductory sequence. This text contains the material that is usually presented in a one-quarter or one-semester introductory course in statistics. It is intended for use in the traditional one-quarter or one-semester business statistics course that is offered in many two-year colleges. It may also be used in a single introductory business college course that stresses the understanding and application of concepts along with the ability to apply some of the basic statistical methods for analyzing data.

Alternatively, this text is designed for a first course in a two-course sequence where the instructor desires the freedom to devise a second course of his or her choosing. Since most phenomena in business and economics are described by multivariable statistical models, a prime candidate for a (nonsurvey) second course in business statistics is one that provides coverage of model building and multiple regression analysis. Consequently, we are simultaneously publishing a second edition of *A Second Course in Business Statistics: Regression Analysis*, by William Mendenhall and Terry Sincich. This text provides in-depth coverage of regression analysis and its applications and is intended for the second course in the sequence.

We have maintained the same level of presentation in the third edition, but provided greater flexibility in topical coverage by reorganizing the material on comparing population means and proportions and by adding optional sections that permit brief introductions to the analysis of variance and the analysis of contingency tables. Major changes or additions are as follows:

1. **Chapter 2: Graphical Descriptions of Data** New Section 2.4 explains how to construct stem and leaf displays as a means of describing quantitative data. This section leads naturally to a discussion of relative frequency histograms in Section 2.5.
2. **Chapter 3: Numerical Descriptive Measures** New Section 3.10 explains how to use z-scores and box plots to identify outliers. Then this concept is used

to introduce the notion of a rare event and to provide a brief introduction to statistical inference in Section 3.11.

3. **Chapter 6: Continuous Random Variables** In the second edition, all the examples in Section 6.2 were concerned with finding areas under the normal curve between two values of the standard normal random variable z or between two values of a normal random variable x. We have added an example that deals with the reverse problem, finding a value z_0 corresponding to an area under the normal curve.
4. **Chapter 7: Sampling Distributions** We have added the definition of a point estimator in Section 7.2. The section also discusses the concepts of unbiasedness and minimum variance.
5. **Chapter 8: Estimation and Tests of Hypotheses** We have expanded our discussion of the role of the Type II error in testing hypotheses by showing, in new Example 8.3, how to calculate β. Since calculating β helps in understanding its meaning, we have added two exercises at the end of the section. The values of β obtained in the solutions are those shown in Figure 8.7.
6. **Chapter 9: Comparing Two or More Population Means** In the second edition, Chapter 9 presented estimation methods and tests of hypotheses based on two samples. This chapter has been split into two new chapters, Chapters 9 and 10. New Chapter 9 presents methods for comparing two or more population means. Thus, it includes all of the material for comparing two population means that appeared in the second edition. To this we have added a new (Optional) Section 9.5 that explains how an analysis of variance can be used to compare more than two population means. Its addition provides a more complete coverage of the comparison of means and allows the instructor greater flexibility in topical coverage.
7. **Chapter 10: Comparing Two or More Population Proportions** New Chapter 10 presents methods for comparing two or more population proportions. As such, it contains all of the material on proportions from Chapter 9 of the second edition. Two new optional sections have been added. Optional Section 10.3 explains how a chi square test can be used to compare two or more population proportions. Optional Section 10.4 presents the chi square test for a two-way contingency table. Similar to Optional Section 9.5, these two brief optional sections provide a more complete coverage of the comparison of proportions. They also provide more options to the instructor when choosing topics to cover.

In addition to the changes and additions listed above, the third edition of *A First Course in Business Statistics* retains the features of the first two editions. These features, which assist the student in achieving an overview of statistics and an understanding of its relevance in the solution of business problems, are as follows:

1. **Case Studies** (See the list of case studies on page xv.) Many important concepts are emphasized by the inclusion of case studies, which consist of brief summaries of actual business applications of the concepts and are often drawn directly from the business literature. These case studies allow the student to see business applications of important statistical concepts immediately after the introduction of the concepts. The

case studies also help to answer by example the often asked questions, "Why should I study statistics? Of what relevance is statistics to business?" Finally, the case studies constantly remind the student that each concept is related to the dominant theme—statistical inference.

2. **Where We've Been . . . Where We're Going . . .** The first page of each chapter is a "unification" page. Our purpose is to allow the student to see how the chapter fits into the scheme of statistical inference. First, we briefly show how the material presented in previous chapters helps us to achieve our goal (Where We've Been). Then, we indicate what the next chapter (or chapters) contributes to the overall objective (Where We're Going). This feature allows us to point out that we are constructing the foundation block by block, with each chapter an important component in the structure of statistical inference. Furthermore, this feature provides a series of brief résumés of the material covered as well as glimpses of future topics.
3. **Many Examples and Exercises** We believe that most students learn by doing. The text contains many worked examples to demonstrate how to solve various types of problems. We then provide the student with a large number (almost 900) of exercises. The answers for most are included at the end of the text. The exercises are of two types:
   a. **Learning the Mechanics** These exercises are intended to be straightforward applications of the new concepts. They are introduced in a few words and are unhampered by a barrage of background information designed to make them "practical," but which often detracts from instructional objectives. Thus, with a minimum of labor, the student can recheck his or her ability to comprehend a concept or a definition.
   b. **Applying the Concepts** The mechanical exercises described above are followed by realistic exercises that allow the student to see applications of statistics to the solution of problems encountered in business and economics. Once the mechanics are mastered, these exercises develop the student's skills at comprehending realistic problems that describe situations to which the techniques may be applied.
4. **On Your Own . . .** The chapters end with an exercise entitled "On Your Own . . . ." The intent of this exercise is to give the student some hands-on experience with a business application of the statistical concepts introduced in the chapter. In most cases, the student is required to collect, analyze, and interpret data relating to some business phenomenon.
5. **A Simple, Clear Style** We have tried to achieve a simple and clear writing style. Subjects that are tangential to our objective have been avoided, even though some may be of academic interest to those well-versed in statistics. We have not taken an encyclopedic approach in the presentation of material.
6. **Footnotes and Appendix A** Although the text is designed for students with a noncalculus background, footnotes explain the role of calculus in various derivations. Footnotes are also used to inform the student about some of the theory underlying certain results. Appendix A presents some useful counting rules for the instructor who wishes to

place greater emphasis on probability. Consequently, we think the footnotes and Appendix A provide an opportunity for flexibility in the mathematical and theoretical level at which the material is presented.

7. **Supplementary Material** A solutions manual, a study guide, and a 3,000-item test bank are available.

Acknowledgments

As with the first and second editions, we owe thanks to the many people who assisted in reviewing and preparing this edition. Chief among these are the reviewers and the people who assisted in the preparation of exercises for the text and the test bank. Their names are listed below. We particularly acknowledge the editorial assistance of Susan L. Reiland, the outstanding administrative support of Jane Oas Benson, and the typing and assistance of Brenda Dobson and Patricia Brager. Without these four, we never could have completed this work.

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Larry M. Austin
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Philadelphia College of Textiles and Science

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University of Minnesota

Atul Bhatia
University of Minnesota

Jim Branscome
University of Texas at Arlington

Francis J. Brewerton
Middle Tennessee State University

Daniel Brick
College of St. Thomas

Robert W. Brobst
University of Texas at Arlington

Michael Broida
Miami University of Ohio

Larry Claypool
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Edward R. Clayton
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Ken Constantine
University of New Hampshire

Jim Daly
California State Polytechnic Institute

Dileep Dhavale
University of Northern Iowa

Carol Eger
Stanford University

Robert Elrod
Georgia State University

Douglas A. Elvers
University of North Carolina at Chapel Hill

Susan Flach
University of Minnesota

Alan E. Gelfand
University of Connecticut

Michael E. Hanna
University of Texas at Arlington

Don Holbert
Oklahoma State University

James Holstein
University of Missouri

Warren M. Holt
Southeastern Massachusetts University

Steve Hora
Texas Tech University

Marius Janson
University of Missouri

Ross H. Johnson
Madison College

Timothy J. Killeen
University of Connecticut

Richard W. Kulp
Wright-Patterson AFB, Air Force Institute of Technology

Martin Labbe
State University of New York College at New Paltz

James Lackritz
California State University at San Diego

Philip Levine
William Patterson College

Eddie M. Lewis
University of Southern Mississippi

Pi-Erh Lin
Florida State University

Paula M. Oas
University of Minnesota

William M. Partian
Fordham College

Vijay Pisharody
University of Minnesota

P. V. Rao
University of Florida

Jayant Saraph
University of Minnesota

Craig Slinkman
University of Texas at Arlington

Charles Sommer
State University of New York at Brockport

Donald N. Steinnes
University of Minnesota at Duluth

Virgil F. Stone
Texas A and I University

Chipei Tseng
Northern Illinois University

Pankaj Vaish
University of Minnesota

Charles F. Warnock
Colorado State University

William J. Weida
United States Air Force Academy

T. J. Wharton
University of New Hampshire

Edna White
Texas A & M University

James Willis
Louisiana State University

Douglas A. Wolfe
Ohio State University

Fike Zahroon
Moorhead State University

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CONTENTS

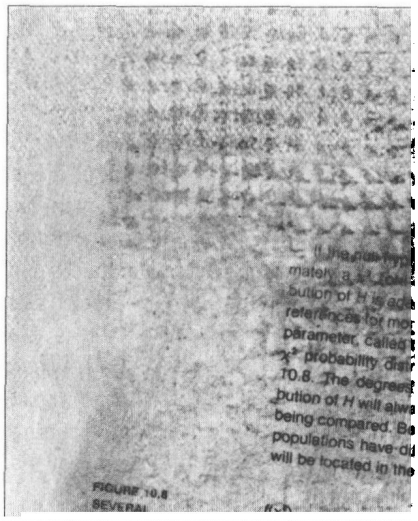
CASE STUDIES

CHAPTER 1

What Is Statistics?

Where We're Going . . .

Statistics? Is it a field of study, a group of numbers that summarize some business operation, or, as the title of a recent book (Tanur et al., 1978) suggests, "a guide to the unknown"? We attempt to answer this question in Chapter 1. Throughout the remainder of the text, we will show you how statistics can be used to aid in making business decisions.



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