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UNDERSTANDING BUSINESS  
STATISTICS



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JOHN E. HANKE

ARTHUR G. REITSCH

# UNDERSTANDING BUSINESS STATISTICS

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BOTH OF EASTERN WASHINGTON UNIVERSITY

**IRWIN**

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# UNDERSTANDING BUSINESS STATISTICS

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THE IRWIN SERIES IN QUANTITATIVE ANALYSIS FOR BUSINESS

*To produce a mighty book, you must choose a mighty theme.  
No great and enduring volume can ever be written on the flea,  
though many there be that have tried—Herman Melville, Moby Dick*

---

*Dedicated to Geri, Harry, Irene, and Jack (who don't need to read it);  
Judy and Judy (who will and won't, respectively);  
Jill, Amy, Julie, Katrina, and Kevin (who should, but probably never will);  
and especially all of our students (who had better).*

## PREFACE

---

But to go to school in a summer morn,  
Oh, it drives all joy away!  
Under a cruel eye outworn,  
The little ones spend the day—  
In sighing and dismay—Blake, *The Schoolboy*

We have written this book to bridge the gap between the theoretical foundations of statistics and the need for business managers to extract useful decision-making information from data collections. We understand that the study of statistics may, at first, not seem a very exciting endeavor. We also know that once the techniques become familiar, exciting results often follow, results that provide assistance and bring insight to the difficult task of making decisions.

We see the learning process as comprising two essential components. First, certain key aspects of statistical theory are necessary to support an understanding of the techniques. Next, the student must understand how the techniques are used in a practical setting and must gain practice in such usage.

Our university colleagues in the education department have shared with us a hierarchy of learning objectives that has guided us in our writing.<sup>1</sup> The first three objectives in this hierarchy are:

1. **Knowledge.** The primary task is memorization, with the objective of being able to recall or recognize previously encountered information.
2. **Comprehension.** The objective is understanding and the ability to explain or interpret.
3. **Application.** The objective is the ability to use or apply concepts to specific situations.

The remaining learning objectives—(4) analysis, (5) synthesis, and (6) evaluation—are beyond the scope of a college textbook such as this one.

We have found that most business statistics textbooks tend to focus on the first objective, acquisition of sufficient knowledge to permit recall or recognition during examinations. It has been our earnest endeavor to move beyond this short-term objective to give students the ability to truly *comprehend* what they are being asked to learn, and especially to *apply* these concepts in practical situations. We all know that

---

<sup>1</sup>B. S. Bloom, ed. *Taxonomy of Educational Objectives, Handbook I: Cognitive Domain* (New York: David McKay, 1956).

knowledge acquired for the purpose of passing exams is soon forgotten; we believe that knowledge applied to simulated real situations is retained if positive practical results are observed.

We have attempted to achieve objective (3), application, through an extensive network of elements throughout the book. Each chapter begins with a reference to a practical journal or magazine in the business field. A *situation* is posed at the beginning of each major chapter section and is resolved once the concepts have been explained. There are numerous examples in each chapter, along with 50 to 100 exercises. These exercises appear at major divisions within each chapter and at each chapter's end.

We have also included solved exercises, exercises to be solved, and extended exercises, or minicases, following the summary in each chapter. These exercises show the student how the concepts of the chapter might prove useful in a simulated business situation. The *applications* section at the end of each chapter lists different functional areas in which chapter concepts are commonly applied.

The purpose of these elements is to answer the unspoken question of every business statistics student: "Why do I have to learn this?" Our extensive class testing of the manuscript for this text has convinced us that we have succeeded.

The use of microcomputers along with powerful mainframes has had a tremendous impact on statistical application. Our goal concerning student exposure to the computer is to keep it as simple as possible for the student to use and understand. We have chosen to use the micro computer package *Computerized Business Statistics* by Hall and Adelman; an application is demonstrated at the end of each chapter. We have also chosen to emphasize an easy-to-use computer package called MINITAB. This package is explained in detail so that the student can use it with no prior preparation. Examples of MINITAB applications appear throughout each chapter. Finally, two other packages, SAS and SPSS<sup>x</sup>, are explained in conjunction with the more difficult topics such as multivariate analysis. Portions of this text, particularly several data sets, are adapted from those that appeared in our *Business Forecasting* text published by Allyn & Bacon, whom we credit for this reuse.

We wish to thank several hundred former students for their guidance in developing our writing style—in particular, those students who helped us with the manuscript during class testing. We are particularly indebted to Judy Johnson, a rate analyst at Washington Water Power, who ran our SAS programs and provided data sets for both examples and exercises. We also thank our nearly 25 colleagues across the country (listed below) who reviewed the manuscript and helped greatly in its refinement. We made an effort to respond to every suggestion, and only where direct contradictions existed among several reviewers could we not do so. Nevertheless, we take responsibility for the final product and trust it will be pleasing to teach and learn from.

Mary Jo Boehms, Jackson State Community College

Mark R. Bomball, Eastern Illinois University

John Briscoe, Indiana State University, Southeast

Alice Griswold, University of Dubuque

J. Morgan Jones, University of North Carolina, Chapel Hill

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Finally, we thank the authors of modern word processors, without whom we might have given up or settled for an inferior product.

To the students who attack the subject of business statistics with this book, we sincerely hope you gain an appreciation of the power of these techniques to assist business managers in their most important task: making decisions in the face of uncertainty.

JOHN E. HANKE  
ARTHUR G. REITSCH

## NOTE TO THE STUDENT

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As you begin your study of this subject, we want you to know that statistics is not included in your business program to weed out the faint of heart. Decision makers in organizations of all kinds and sizes make thousands of important decisions every day, and these decisions are almost always based on information that results from data analysis.

In our consulting work over the years, we have constantly found this to be true. Gone are the days when decisions were made solely on intuition or “feel.” Intuition and good judgment are still important attributes of a good manager, but so is an understanding of statistical procedures. This book will present the key concepts involved in converting mere data into useful decision-making information.

So if you begin to weaken during the course of your business statistics studies, hang in there. You may even end up like one of our students, who now has a key job in a high-tech company and recently told us: “At the time I didn’t know why I had to learn all that stuff, but now I use statistics every day.”

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## CHAPTER ONE

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# 1

# INTRODUCTION TO STATISTICS

*There are three kinds of lies: lies, damned lies, and statistics—B. Disraeli*

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### OBJECTIVES

When you have completed this chapter, you will be able to:

△

Explain the role of statistics in the decision-making process.

△

Explain the role of the computer in statistics.

△

Perform computations using summation notation.