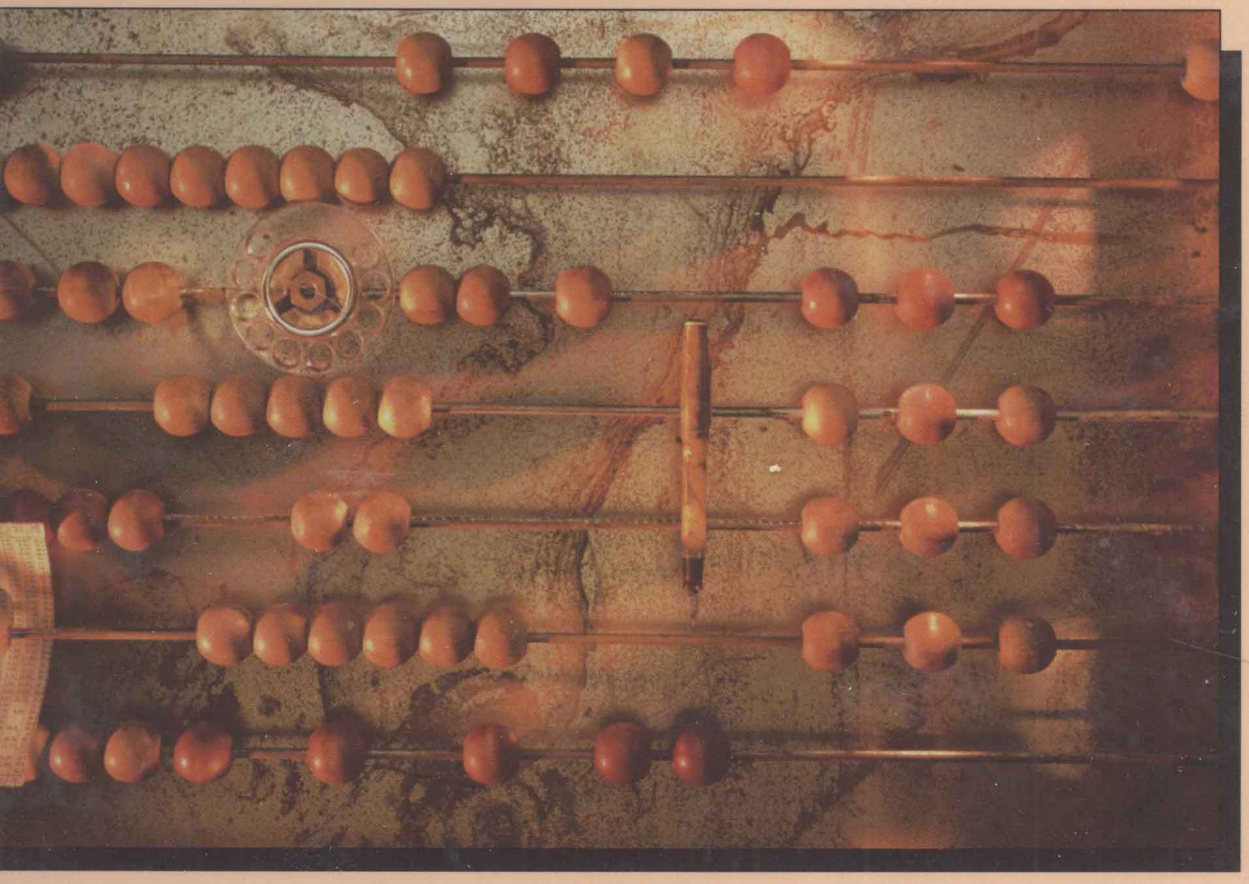
BASIC STATISTICS
FOR BUSINESS AND ECONOMICS



LIND • MASON

BASIC STATISTICS FOR BUSINESS AND ECONOMICS

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Preface to the Student

As the name implies, the purpose of *Basic Statistics for Business and Economics* is to provide students in marketing, accounting, finance, international trade, management, and other fields of business administration and economics with a sound introduction to the many applications of 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 that 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 techniques.

Learning Aids

We have designed the text to assist you in approaching this course without the anxiety often associated with statistics. This teaching-learning orientation has resulted in a large number of very effective learning aids.

Goals. Each chapter opens with a set of goals. They indicate what you should be able to do after completing the chapter.

Examples and solutions. After the discussion of a concept in a chapter, there is at least one example and its solution. Any numbers involved are kept manageable so that you can concentrate on the technique and solution.

Self-review problems. A large number of self-review problems are interspersed throughout each chapter. They are designed to give you an opportunity to work problems similar to the preceding examples. They serve to reinforce understanding of the material just covered. The answers and the method of solution is presented at the end of the chapter.

Exercises. There are exercises within chapters and at the end of the chapters. Usually, the first few chapter exercises stress computations, and the remaining incorporate interesting real-world data. The answer and method of solution to every odd-numbered exercise can be found at the end of the text.

Definitions. The definitions of new terms, such as the coefficient of correlation, are boxed and highlighted in color for emphasis.

Marginal notes. There are nearly 500 concise notes in the margin. Each is aimed at reemphasizing an important concept or facet immediately adjacent to it.

Chapter summary. At the end of the chapter discussion is an outline, including formulas, that brings together in brief form the material covered in the chapter.

Formulas. Formulas in a chapter are numbered starting with 1. Reference is made in the chapter to these formula numbers, giving you quick access to the appropriate formula.

Computer Data Exercise

The last few exercises in most chapters are based on two large data sets found at the end of the book. The first set contains data on 75 homes sold in Sarasota, Florida, during the year. Included for each home is the selling price, the size of the home, the number of bedrooms, and other data. The second set gives the number of games won, team batting average, and other statistics for each of the 26 major league baseball teams for the 1992 season. Since the data sets are large, a computer and software, such as MINITAB, are needed to answer such questions as: What are the mean and median team salary? Can we conclude that the mean selling price for homes with a swimming pool is different from the mean selling price for homes without a swimming pool? What is the relationship between team salary and games won?

Supplements

The **Study Guide** that accompanies the text is written by the authors. Each chapter includes the chapter goals, an introduction, a discussion of the important concepts and terms, a glossary, chapter problems with solutions, student exercises with answers in the back of the guide, and chapter assignments that may be assigned at the option of the instructor. The Study Guide can be purchased from your campus bookstore, or they can order it for you.

A **Data Disk** is also available. This diskette contains the two large data sets and data for many of the examples and exercises. The data are included in both ASCII and MINITAB formats. Ask your instructor for details.

Doug Lind
Bob Mason

Acknowledgments

Basic Statistics in Business and Economics is the product of many people—students, colleagues, reviewers, and the staff at Richard D. Irwin, Inc. We thank them all. The reviewers include: Phillip Beckman, Black Hawk College/Quad Cities; Darrell Christie, University of Wisconsin/Stevens Point; Michael Hanna, University of Houston/Clear Lake; John Ogle, Pace University; Richard Quindley, Bridgewater State College; Andrew Seila, University of Georgia; and Mark Wilson, University of Charleston.

We also wish to express our gratitude to those reviewers of the eighth edition of our book, *Statistical Techniques in Business and Economics,* whose suggestions are incorporated here: Diane L. Stehman, Northeastern Illinois University; Jonas Falik, Queensborough Community College; Louis A. Patille, University of Phoenix; Wendy J. McGuire, Santa Fe Community College; J. B. Orris, Butler University; David R. Hoffman, University of Phoenix; Joseph F. Kearney, Davenport College; Robert J. Miller, Missouri Southern State College; Bob McManus, Algonquin College; Leonard Gaston, Central State University; Linda Stroh, Sacramento City College; John Shannon, Suffolk University; Blake L. Friesen, Saskatchewan Institute of Applied Science and Technology—Palliser Campus.

Special thanks go to Ray Pohlman of Perrysburg High School, who solved all of the exercises and checked our answers for accuracy.

Lloyd Landau of Mercy College prepared the Test Bank and Denise McGinnis of Mesa State College prepared the Transparency Masters. These supplements are a great deal of work to write and we appreciate the work in them which makes teaching the course easier for everyone who uses the text.

Many of the tables in the appendix were computer-generated for greater accuracy. We are indebted to Goldstein Software, Inc., for the program *GoldSpread Statistical,* which was used to generate these tables.

D.A.L.
R.D.M.

Contents in Brief

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CHAPTER

1

INTRODUCTION TO BASIC STATISTICS

Advertising—Courtesy of Jordache Enterprises, Inc.

GOALS

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

1. Define what is meant by statistics.
2. Cite some uses of statistics in business and other areas.
3. Explain what is meant by descriptive statistics and inferential statistics.
4. Distinguish between nominal, ordinal, interval, and ratio levels of measurement.

About 100 years ago H. G. Wells noted that "statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write." He made no mention of business simply because the Industrial Revolution was still in its infancy. Were he to comment on statistical thinking today he would probably say that "statistical thinking is necessary not only for efficient citizenship, but also for effective decision making in various facets of business."

A recent article in the *Washington Post* by Michael Schrage emphasizes the importance of statistics.[1] He states that America is not going to have a quality revolution until its managers and workers get some grasp of probability and statistics.

[1]Michael Schrage, "If Statistics Are the Key to Quality, Our Students Need Some Chance Encounters," *Washington Post* (March 15, 1991).

Unfortunately, corporate statistical literacy is abysmally low, Schrage points out. Brian Joyner, a Wisconsin-based consultant, agrees. To his dismay, he finds that much of his consulting time is spent on remedial statistics. Andrea Gabor, commenting on education in high schools, pointed out that "Japanese students are inundated with statistics in high school. You realize that statistics is now part of their culture. Just as our bookstores have sections on science and technology, their bookstores have sections on quality control and statistics." No doubt the emphasis on quality control, statistics, and probability has played a major part in the huge success of their Toyotas, Hondas, Sonys, Minoltas, and other consumer products.

W. Edwards Deming, noted statistician and quality control expert, insists that we should start statistics education before high school. He likes to tell the story of an 11-year-old who devised a quality control chart to track the on-time performance of his school bus. Deming commented, "He's got a good start in life." It is hoped that this book will give you a solid foundation in statistics for your future life in marketing, accounting, management, or some other facet of business.

What Is Meant by Statistics?

Do you read *The USA Today,* the *New York Times, Sports Illustrated,* or the local newspaper? Did you watch the World Series, the Super Bowl, or any of the college basketball games on ESPN? If so, no doubt you were aware of a constant barrage of figures commonly called *statistics.* Examples of statistics are the number of yards gained by the Dallas Cowboys in the football game against the Denver Broncos, the Dow Jones Average, the number of shares that changed hands during the day, and the price of a can of Campbell's tomato soup. Some diverse statistics from various sources are:

- *Sales and price statistics:* Hewlett-Packard introduced several models of their new HP 486 series starting at $1,200. Third-quarter sales of Chevron were $10,970 million. The dividend on the Blair Corporation stock this year is $2.30 per share.
- *Sports-related statistics:* In the second-round AFC playoff game, held before a record Three Rivers Stadium crowd of 60,407, the Buffalo Bills defeated the Pittsburgh Steelers 24–3. The average annual salary for the Toronto Blue Jays is $1,494,012. Sales of tennis rackets increased from 2.2 million in 1985 to 4.0 million last year.
- *Financial statistics: The USA Today* reported that the three largest retailers, ranked according to their annual revenues, in billions of dollars, were Wal-Mart with $43.4, Kmart with $34.6, and Sears with $31.4.
- *Other assorted statistics:* The U.S. Department of Justice reported that 12.5 percent of the personnel in sheriffs' departments are women, 7.6 percent of local police are women, and 4.2 percent of state police are women. Barbara Franklin is paid $315,600 as the director of seven major corporations. About 5.5 million children in the United States are hungry, and another 6 million are not getting enough to eat. The typical child in the United States watches 42 hours of TV per week. From *The Wall Street Journal:* Florists' Transworld Delivery Association handled 55,200 orders for flowers last Father's Day, up from 49,600 the previous year. The number of people who consider flowers appropriate for men has risen to 63 percent from just 44 percent in 1982.

Statistic

One figure is called a **statistic** (singular). The closing price of Boeing common stock (44½) is a statistic. Your cumulative grade point average (4.0) is a statistic. The total retail sales for May, $131.88 billion, is a statistic. A collection of figures or facts is referred to as **statistics** (plural). For example, a collection of data such as 55,200 flower orders for Father's Day, 30,000 travel agencies in the United States, 2.2 percent of the labor force employed in farming, and $10,000 for a fly rod is commonly referred to as statistics.

Statistics

Another Definition of Statistics

The subject of statistics as we will explore it in this text has a much broader meaning than just collecting and publishing numerical facts and figures. Statistics is defined as:

Statistics defined

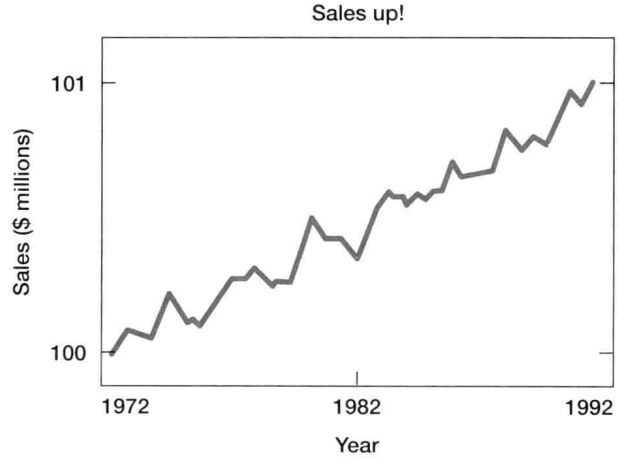
> Statistics The science of collecting, organizing, presenting, analyzing, and interpreting numerical data for the purpose of assisting in making a more effective decision.

Just as attorneys have "rules of evidence" and accountants have "commonly accepted practices," persons dealing with numerical data follow some standard guidelines. Some of the basic statistical techniques they use in decision problems are presented in the following chapters.

Many first approach the application of numerical data to solve a problem with some trepidation. They have heard such often-quoted phrases as "statistics lie," and they might have seen a book in the bookstore entitled *How to Lie with Statistics.* Statistics "lie" only if they are not applied correctly. For illustration, suppose the sales of Carter Marine for the past 20 years were depicted as in Chart 1–1. Initially, you might conclude that sales increased at a very rapid rate since 1972 (the lie).

Chart 1–1

Sales of Carter Marine since 1972



However, a closer look reveals that sales increased only about 1 percent—from $100 million to $101 million (the truth). The designer of the chart—intentionally or unintentionally—scaled the vertical (sales) axis incorrectly, leaving us with the wrong impression regarding the trend of sales since 1972.

Our objectives in this book are many. One, of course, is to alert you of possible misuses of charts, averages, correlation and regression techniques, and other statistical tools. Another is to introduce you to the usefulness of statistical techniques in marketing, accounting, finance, international trade, economics, law enforcement, and other fields. Specifically, who uses statistics?

Who Uses Statistics?

Use in business and other fields

As noted, statistical techniques are used extensively by marketing, accounting, quality control, and other departments; consumers; professional sports people; hospital administrators; educators; political parties; physicians; and others involved in making decisions. The following examples suggest the wide use of statistics in decision problems.

Some specific uses of statistics in problem solving

1. The research analysts for such firms as Merrill Lynch evaluate many facets of a stock before making a "buy" or "sell" recommendation. They collect the past sales data of the company and estimate future earnings. Other factors, such as projected worldwide demand for the company's products, the strength of the competition, and the effect of the new management-union contract, are also considered before a recommendation is made.
2. The Republican party wants to determine its chances of winning at least five of the seven contested seats in the Senate. How can the chances of challenger A. J. Farley in Oklahoma be assessed? A sample survey of potential voters in the state could be conducted. The party could hire pollsters, such as Gallup or Harris; or the party could undertake the survey. Scientifically selecting, say, 2,000 registered voters in Oklahoma and evaluating the results require a knowledge of the techniques of probability and sampling (covered in Chapters 4–7).

Statistics imperative in quality assurance

3. Management must make decisions on the quality of current production. For example, automatic drill presses do not produce a perfect hole 1.3000 inches in diameter each time a hole is drilled (because of drill wear, vibration of the machine, and other factors). Slight tolerances are permitted, but when the hole is too small or too large, production is considered defective (not usable). The quality assurance department is charged with continually monitoring production using sampling and other standard statistical techniques (covered in Chapter 15).
4. The hospital administrator must act on a proposal that a new wing be added to alleviate crowded conditions. To determine whether or not a new wing is actually needed, the administrator must gather and evaluate data such as bed occupancy rates. Then data must be collected on the cost of the wing, sources of financing, and projected income, in order to justify the construction to the board of directors.
5. Internally, the controller and the accounting department of a firm are charged with the accuracy of various financial documents. Since it is physically impossible to check every document for accuracy, a sampling of the invoices