An abstract graphic on a dark background. On the left, a stylized city skyline is depicted with several skyscrapers. The most prominent is a tall, thin tower with a pointed top, rendered in red and purple lines. To its left is another tall, thinner tower. In the foreground, a large, complex 3D bar chart is shown, composed of many rectangular blocks of varying heights, rendered in yellow and orange lines. The overall style is graphic and modern.

Basic Statistics in Business and Economics

Fourth Edition

Summers Peters Armstrong

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Basic Statistics in Business and Economics

FOURTH EDITION

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University of Arizona



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University of New Mexico

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University of Rhode Island



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Students: There is extra help available . . .

This text has been written to make your study of statistics as simple and rewarding as possible. But even so there may be concepts or techniques that will be difficult for you. Or you may want a little "insurance" for success as mid-terms and finals come up. If so, you will want to buy a copy of the *Student Supplement for Basic Statistics in Business and Economics*. It's described in the preface of this book. Your campus bookstore either has it in stock or will order it for you.

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PREFACE

Basic Statistics in Business and Economics, Fourth Edition, is intended primarily for business students taking beginning statistics courses. These courses may be as short as one quarter or as long as an academic year. Chapter sequences can be designed to fit either extreme.

Our main emphasis is on presenting statistical concepts in an applied context, developing the underlying statistical methods through verbal explanation and example. Careful attention is paid to necessary assumptions and to the consequences of violating them, and to interpretation of results. Knowledge of algebra is assumed, but concepts and procedures are explained with minimal use of mathematics. Our objective is to promote appreciation for underlying concepts without overmathematizing or oversimplifying.

Concrete applications from functional areas of business, industry, and government are used extensively in text examples and exercises. Many of these applications are based on situations reported by managers of statistical departments at a number of companies, who responded to the authors' requests for real-world uses of statistics. In addition, we have employed examples from the business literature. Sources are cited where appropriate. A brief list of selected applications follows.

Accounting

Comparison of operating ratios with control group (Exercise 6-24, page 171)

Sampling audit of accounts payable (Exercise 9-30, page 288)

Estimation of the proportion of delinquent charge accounts (Exercise 8-6, page 230)

Advertising

Hardware buying; cooperative regression study of sales results from three media (page 455)

Newspaper readership (page 121)

Response to TV spot ads (Exercise 10-17, page 317)

Media market penetration (Exercise 4-38, page 116)

Economics

- Recession and balance of trade assessments (Exercise 4-18, page 106)
- Distribution of number of employees per firm (Exercise 3-18, page 65)
- Relationship of collective bargaining law to movement in wage offers (Exercise 11-10, page 355)

Finance, Insurance, and Real Estate

- Selling price, floor area, age of single-family residences—a regression study (page 436)
- Mergers and stock price changes (Exercise 4-23, page 107)
- Life insurance premiums and actuarial probabilities (page 133)
- Stock portfolio performance (Exercise 4-10, page 98)

General Management

- W.R. Grace: major sources of net sales 1950, 1962, 1977 (Figure 2-5, page 23)
- Ages of chief executive officers of larger corporations (Exercise 3-14, page 61)
- Functional areas of business from which chief executives came (Exercise 2-23, page 48)

Marketing

- Connecticut Peak-load Pricing Study: electricity consumption change for large users (page 354)
- Packaging effects on sales (Exercise 16-6, page 524)
- Effects of point-of-sale displays (page 402)
- Effect of message on telephone sales appointment rate (Exercise 11-14, page 364)
- Effectiveness of endorsements (page 496)

Operations Management

- Machine maintenance cost versus age (Exercise 10-23, page 324)
- Multiple-head machine control (page 492)
- Product development cost ratios (Exercise 3-32, page 82)
- Warehouse space control (Exercise 14-1, page 446)
- Acceptance sampling by attributes (Exercise 6-26, page 176)
- Product spoilage for two shifts (Exercise 11-4, page 349)

Personnel

- Estimation of employee absenteeism (Exercise 8-42, page 252)
- Factors influencing job performance (Exercise 14-4, page 447)

Recruiting professional athletes (Exercise 16-7, page 524)

Public Administration

Growth policies of county commissioners (Exercise 11-12, page 356)

Pedestrian fatalities from motor vehicles (Exercise 8-44, page 253)

Probability of arrest versus police response time (Exercise 10-3, page 303)

The changes made for this edition are not major, but are designed to advance our objectives of making the study of statistics interesting and accessible.

Exercise sets have been edited, winnowed, and updated where needed. In Chapters 1 through 10 especially, more drill exercises have been included as the first group in a set.

Further materials emphasizing the use of computers in statistics have been introduced. These include end-of-chapter sections on interpreting computer output and extended sets of computer exercises. The computer exercises draw from data files on real estate transactions, 50 leading utilities' and 50 leading retailers' operating data, a company personnel file, and baseball team statistics.

Optional sections have been included on exploratory data analysis. These include Stem and Leaf Displays in Chapter 2, Boxplots in Chapter 3, Robust Estimation in Chapter 8, and Resistant Regression in Chapter 10.

Chapters 8 and 9 on estimation and hypothesis tests for means and proportions have been streamlined. Material employing the finite population multiplier has been moved to optional end-of-chapter sections. Summarizing tests by means of P -values is covered.

Chapter 15, Two-Way Analysis of Variance, is new. This chapter includes the use of randomized blocks, analysis of factorial experiments, use of regression programs in ANOVA data processing, and two extended case studies.

The book is divided into five parts: Descriptive Statistics, Background for Statistical Inference, Basic Statistical Inference, Further Topics in Statistical Inference, and Additional Topics. The first three parts form a sequence that we recommend for a one-semester course. Optional topics can be omitted in shorter courses; some instructors may wish to include Inferences from Two Samples (Chapter 11) in such a course.

The additional topics in Chapters 11 through 20 provide ample material for a second semester. Instructors may wish to emphasize the multiple regression and analysis of variance chapters (13, 14, and 15), analysis of frequencies (chi-square) and nonparametric statistics (12 and 16), time series, index numbers, and forecasting (17 and 18), and (Bayesian) decision making (19 and 20), or some combination of these.

A *Student Supplement* furnishes additional learning and practice aids, including programmed learning modules, self-correcting exercises with solutions, and practice examinations.

We wish to express our appreciation to the organizations and firms that responded to our requests for real applications of statistical methods. We want to thank Stephanie Surfus of Wadsworth Publishing Company and Greg Hubit Book-

works for their helpful and expert editing and production efforts. We wish to thank Jay M. Bennett from Analytics and John A. Flueck of Temple University for furnishing the baseball data file which is referenced in their article "An Evaluation of Major League Baseball Offensive Performance Models," *The American Statistician*, February, 1983. Thanks are also due to the Academic Computer Center at the University of Rhode Island and its Director, David Clayton. Special thanks are due to Mike Shaughnessy and Roger Greenall for their advice on computer applications. We also want to acknowledge the many helpful suggestions made by colleagues, students, and reviewers. The reviewers for this Fourth Edition were Charles Barrett, Habib Bazyari, William Beaty, Bruce Bowerman, P. L. Claypool, Douglas C. Darran, Frank Kelly, Ron Koot, Leonard Presby, John Stack, and William Stein. Finally, we want to thank the authors and publishers who gave us permission to reprint figures and tables. Their permissions are acknowledged in footnotes.

George W. Summers
William S. Peters
Charles P. Armstrong

Basic Statistics in Business and Economics

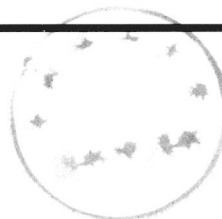
FOURTH EDITION

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