Basic Statistics

for Business & Economics

Douglas A. Lind
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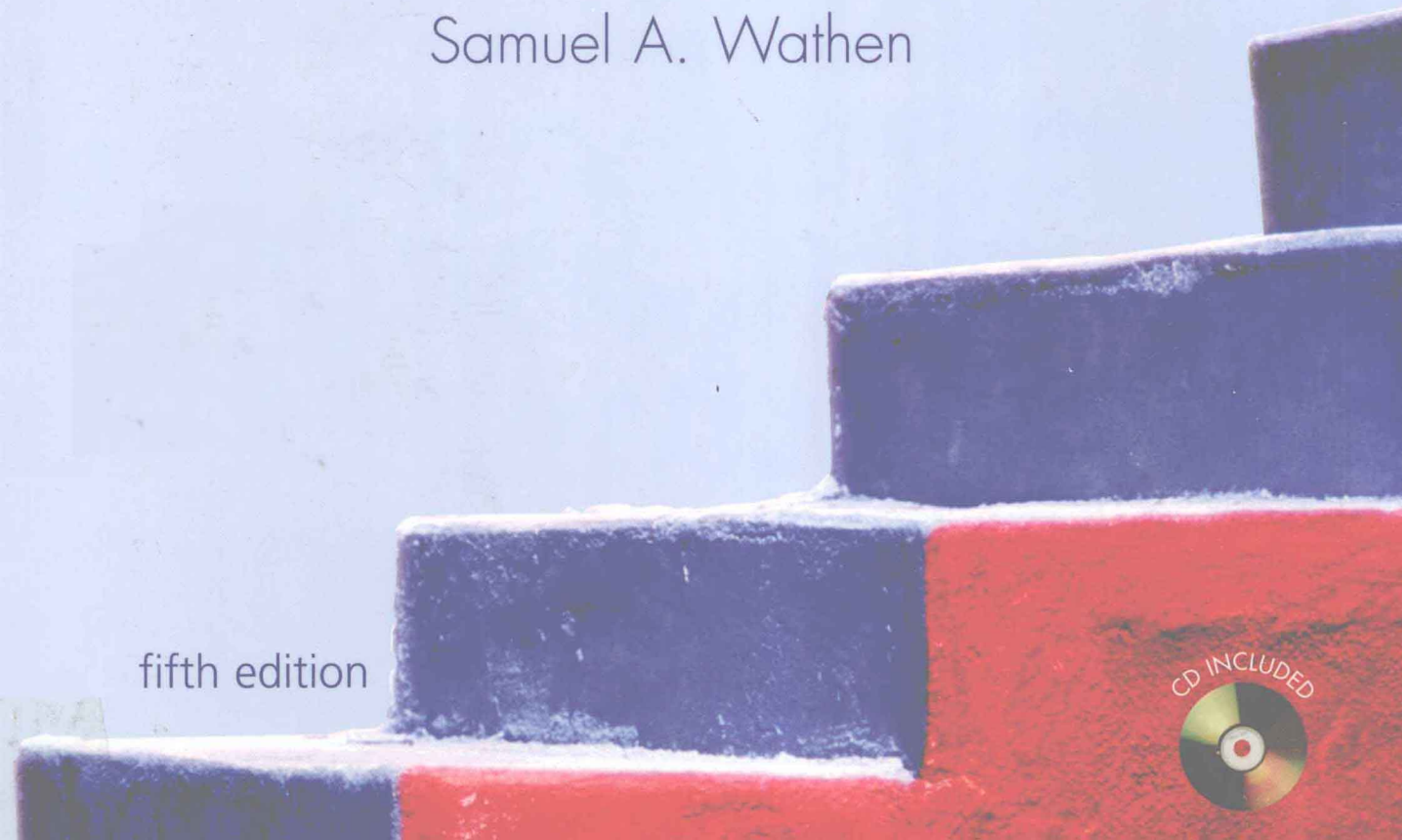

fifth edition

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Basic Statistics for Business & Economics

Fifth Edition

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McGraw-Hill Irwin

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

BASIC STATISTICS FOR BUSINESS AND ECONOMICS
Published by McGraw-Hill/Irwin, a business unit of The McGraw-Hill Companies, Inc. 1221 Avenue of the Americas, New York, NY, 10020.

This book is printed on acid-free paper.

2 3 4 5 6 7 8 9 0 DOW/DOW 0 9 8 7 6 5

ISBN 0-07-298396-5 (student edition)
ISBN 0-07-298401-5 (instructor's edition)

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Cover design: *Allison Traynham*
Typeface: *9.5/11 Helvetica Neue 55*
Compositor: *Cenveo*
Printer: *R. R. Donnelley*

Library of Congress Cataloging-in-Publication Data

Lind, Douglas A.
Business statistics for business & economics / Douglas A. Lind, William G. Marchal, Samuel A. Wathen.—5th ed.
p. cm—(McGraw-Hill/Irwin series Business statistics)
Includes index.
ISBN 0-07-298396-5 (student ed. : alk. paper)—ISBN 0-07-298401-5 (instructor's ed. : alk. paper)
1. Social sciences—Statistical methods. 2. Economics—Statistical methods. 3. Industrial management—Statistical methods. 4. Commercial statistics. I. Title: Basic statistics for business and economics. II. Marchal, William G. III. Wathen, Samuel Adam. IV. Title. V. Series.

HA29.L75 2006
519.5—dc22

2004057810

www.mhhe.com

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To Jane, my wife and best friend, and to our sons and their wives, Mike (Sue), Steve (Kathryn), and Mark (Sarah).
Douglas A. Lind

To Andrea, my children, and our first grandchild, Elizabeth Anne.
William G. Marchal

To my wonderful family: Isaac, Hannah, and Barb.
Samuel A. Wathen

A Note to the Student

We have tried to make this material "no more difficult than it needs to be." By that we mean we always keep the explanations practical without oversimplifying. We have used examples similar to those you will encounter in the business world or that you encounter in everyday life. When you have completed this book, you will understand how to apply statistical tools to help make business decisions. In addition, you will find that many of the topics and methods you learn can be used in other courses in your business education, and that they are consistent with what you encounter in other quantitative or statistics electives.

There is more data available to a business than there has been in previous years. People who can interpret data and convert it into useful information are not so easy to find. If you thoughtfully work through this text, you will be well prepared to contribute to the success and development of your company. Remember, as one of the authors read recently in a fortune cookie, "None of the secrets of success will work unless you do."

Learning Aids

We have designed the text to assist you in taking this 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 describe how they 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 for easy reference and review.

Formulas Whenever a formula is used for the first time, it is boxed and numbered for easy reference. In addition, a formula card that summarizes the key formulas is bound into the text. This can be removed and carried for quick reference as you do homework or review for exams.

Margin Notes There are 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 you immediately, in detail, how the concepts can be applied to business situations.

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 most exercises with more than 20 observations, the data are on the CD-ROM in 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 review the formulas.

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

Dataset Exercises In most chapters, the last four exercises refer to four large business 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.

Supplements

The **Student CD,** packaged free with all copies of the text, features self-graded practice quizzes, software tutorials, PowerPoint slides, the data files (in MINITAB and Excel formats) for the end-of-chapter data and for exercises having 20 or more data values. Also included on the CD is an Internet link to the text website and to the websites listed in the Web exercises in the text. **MegaStat** and **Visual Statistics** are included. MegaStat provides software that enhances the power of Excel in statistical analysis. Visual Statistics is a software program designed for interactive experimentation and visualization.

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

The Online Learning Center includes online content for assistance and reference. The site provides chapter objectives, a summary, glossary of key terms, solved problems, downloadable data files, practice quizzes, PowerPoint, web links and much more. Visit the text website at http://www.mhhe.com/lindbasics5e.

ALEKS for Business Statistics (Assessment and Learning in Knowledge Spaces) is an artificial intelligence based system that acts much like a human tutor and can provide individualized assessment, practice, and learning. By assessing your knowledge, ALEKS focuses clearly on what you are ready to learn next and helps you master the course content more quickly and clearly. You can visit ALEKS at www.business.aleks.com.

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William G. Marchal
Samuel A. Wathen

Preface

The objective of *Basic Statistics for Business and Economics* is to provide students majoring in management, marketing, finance, accounting, economics, and other fields of business administration with an introductory survey of the many applications of descriptive and inferential statistics. While we focus on business applications, we also use many problems and examples that are student oriented and do not require previous courses.

When Professor Robert Mason wrote the first edition of this series of texts in 1967 locating relevant business data was difficult. That has changed! Today locating data is not difficult. The number of items you purchase at the grocery store is automatically recorded at the checkout counter. Phone companies track the time of our calls, the length of calls, and the number of the person called. Credit card companies maintain information on the number, time and date, and amount of our purchases. Medical devices automatically monitor our heart rate, blood pressure, and temperature. A large amount of business information is recorded and reported almost instantly. *CNN, USA Today,* and *MSNBC,* for example, all have websites where you can track stock prices with a delay of less than twenty minutes.

Today, skills are needed to deal with the large volume of 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 information into a concise and meaningful form to enable us to make effective interpretations, judgments, and decisions.

All students have calculators and most have either personal computers or access to personal computers in a campus lab. Statistical software, such as Microsoft Excel and MINITAB, is available on these computers. The commands necessary to achieve the software results are available in a special section at the end of each chapter. We use screen captures within the chapters, so the student becomes familiar with the nature of the software output. Because of the availability of computers and software it is no longer necessary to dwell on calculations. We have replaced many of the calculation examples with interpretative ones, to assist the student in understanding and interpreting the statistical results. In addition we now place more emphasis on the conceptual nature of the statistical topics. While making these changes, we have not moved away from presenting, as best we can, the key concepts, along with supporting examples.

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

Jodey Lingg
City University

Miren Ivankovic
Southern Wesleyan University

Michael Bitting
John Logan College

Vadim Shilov
Towson University

James Dulgeroff
San Bernardino Valley College

Gordon Johnson
California State University Northridge

Andrew Parkes
University of Northern Iowa

Abu Wahid
Tennessee State University

William F. Younkin
University of Miami

Michael Kazlow
Pace University

Jim Mirabella
Webster University

John Yarber, Jr.
Northeast Mississippi Community College

Stanley D. Stephenson
Texas State University-San Marcos

Hope Baker
Kennesaw State University

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

Special thanks go to a number of people. Dr. Jacquelynne Mclellan of Frostburg University and Lawrence Moore reviewed the manuscript and checked exercises for accuracy. Professor Walter Lange, of the University of Toledo, prepared the study guide. Dr. Temoleon Rousos checked the study guide for accuracy. Dr. Samuel Wathen, of Coastal Carolina University, prepared the test bank. Professor Joyce Keller, of St. Edward's University, prepared the PowerPoint Presentation. Ms. Denise Heban and the authors prepared the Instructor's Manual.

We also wish to thank the staff at McGraw-Hill/Irwin. This includes Richard T. Hercher, Jr., Executive Editor; Christina Sanders, Developmental Editor; Douglas Reiner, Marketing Manager; James Labeots, Project Manager, and others we do not know personally, but who made valuable contributions.

Brief Contents

CD Chapters

- Statistical Quality Control
- Time Series and Forecasting

Contents

1

What Is Statistics?

High speed conveyor belts and state-of-the-art technology efficiently move merchandise through Wal-Mart's distribution centers to keep its nearly 3,000 stores in stock. In 2004, the five largest American companies, ranked by sales were Wal-Mart, BP, Exxon Mobil, General Motors, and Ford Motor Company. (See Goal 5 and Statistics in Action box, page 4.)

GOALS

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

1. **Understand why we study statistics.**
2. **Explain what is meant by *descriptive statistics* and *inferential statistics.***
3. **Distinguish between a *qualitative variable* and a *quantitative variable.***
4. **Distinguish between a *discrete variable* and a *continuous variable.***
5. **Distinguish among the *nominal, ordinal, interval,* and *ratio* levels of measurement.**
6. **Define the terms *mutually exclusive* and *exhaustive.***