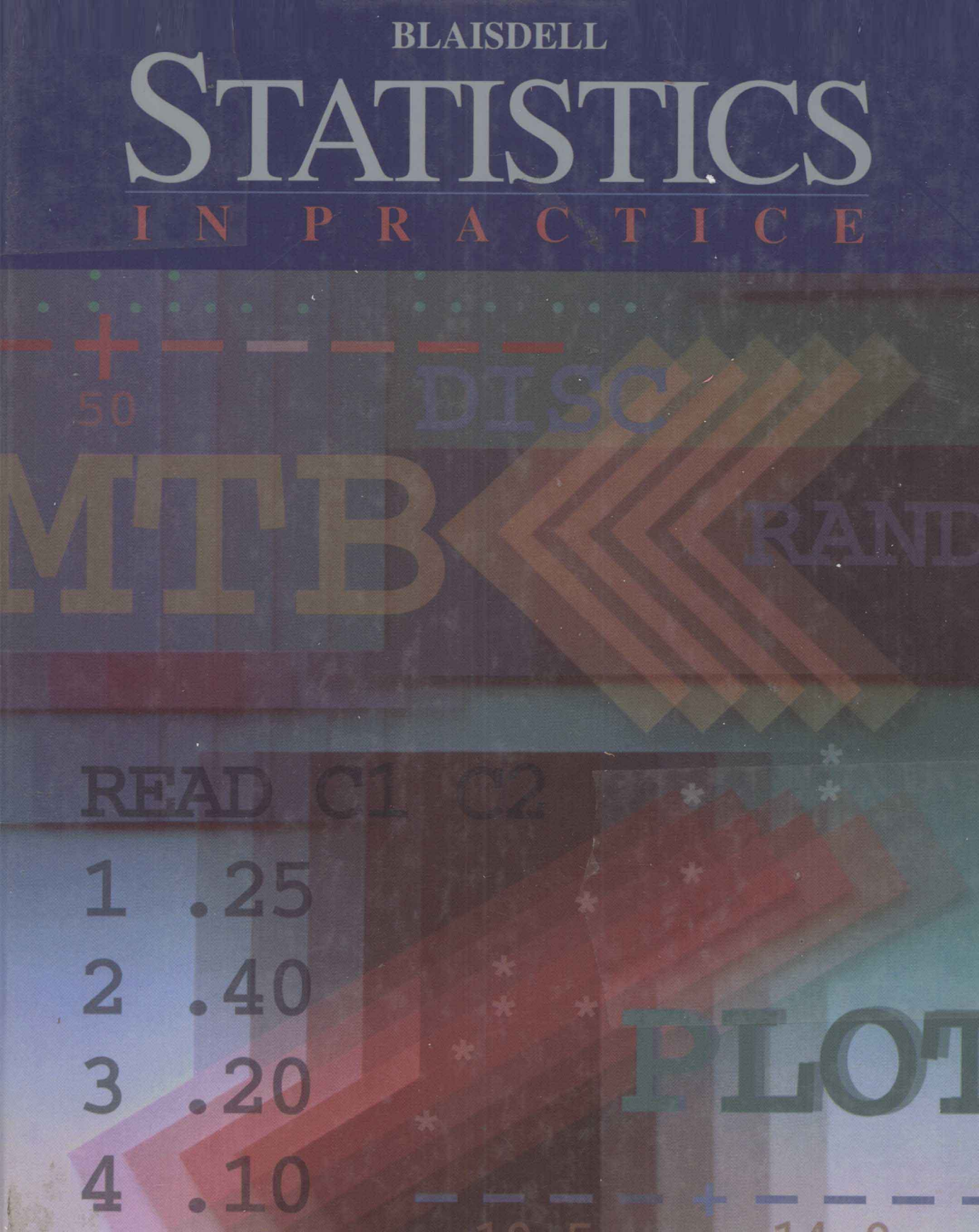
BLAISDELL

# STATISTICS

## IN PRACTICE



# STATISTICS IN PRACTICE

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To my loving Mother, Thelma

*With fondness, Alf and I recall*
*those many trips to and fro,*
*especially when you multiplied*
*by* n, *more or less.*

*Now the final journey home remains.*

# Preface

*"The time may not be very remote when it will be understood that for complete initiation as an efficient citizen of one of the great complex world states that are now developing, it is necessary to be able to compute, to think in averages and maxima and minima, as it is now to be able to read and to write."*

Though written more than 60 years ago, H. G. Wells' passage from *Mankind in the Making* seems particularly relevant in today's electronic age of global communication. Understanding the uses of statistics and its role in assimilating information contained in reports, scientific journals, political coverage, or even the daily newspaper is a necessary part of modern education. I have attempted to bring my training as a statistician and my years of teaching experience to the shaping of a clear and concisely written text. In addition, there is always the difficulty of persuading students, many of whom have been conditioned into math anxiety, that they might actually enjoy statistics, that statistical concepts are worth learning, and that statistics derives from real problems in the real world. My goal has been to provide a presentation that is pedagogically and mathematically sound, yet sufficiently gentle to minimize math anxiety.

## Content Features

- To make data as vivid as possible, traditional methods of summarizing data are blended in Chapter 2 with more recently developed **data analysis techniques** such as dotplots, stem-and-leaf displays, 5-number summaries, and boxplots.
- **Regression analysis,** frequently used in many disciplines, can be introduced much earlier than it usually is in the traditional course. Chapter 3, therefore, is a concise introduction to the descriptive aspects of correlation and regression. It is written so that an instructor can vary its placement within the course syllabus. Furthermore, if the instructor wishes, this coverage can be complemented later

with a detailed discussion in Chapter 14 of inferential methods in regression analysis.

- Included in Chapter 4, which introduces probability, is a **concise section on elementary counting techniques.** Students often find this topic difficult because they tend to approach each problem as either "a permutation or a combination." I believe a greater understanding can be achieved by de-emphasizing permutation formulas and stressing the versatility of the multiplication rule.
- The critical topics of **confidence intervals** and **hypothesis testing** merit separate chapters. They are introduced in Chapters 9 and 10, respectively, and in Chapter 11 they are jointly used to discuss two-sample inferences.
- ***P*-values** are prominent in the research literature of virtually all disciplines. Consequently, after the introduction of hypothesis testing in Chapter 10, the reader is frequently exposed to the use of *P*-values throughout the remainder of the book. This is done, however, only after the student has had adequate opportunity to comprehend the basic concepts of hypothesis testing and rejection regions.

## Exercises and Examples

- There is an abundant quantity of **interesting exercises** (1,633) and illustrations based on real-life situations and cited sources from a wide spectrum of disciplines. They are stated concisely, without burying the reader in verbiage.
- The **exercises** have been **carefully selected** and constructed to ensure that they meaningfully contribute to the learning process and enhance an appreciation of how statistics intermingles with our daily lives. The order of presentation progresses from mastering the basics to practical applications. Data used in previous exercise sets are always reproduced when used in subsequent applications. To serve the needs of instructors, odd-numbered problems are frequently paired with even-numbered problems. Answers are given in the book for all review exercises and for all odd-numbered end-of-section exercises.
- **Worked examples** are set up so that students can "walk through" them step by step. This approach helps the student understand the rationale of each statistical procedure. **Procedure boxes** that recap in a step-by-step manner what students should understand about a given process are liberally provided.

## Pedagogical Features

- Each chapter opens with a preview, "Looking Ahead." The opening photograph and accompanying caption set the theme for the chapter and give the students a foretaste of what they will explore in the pages that follow.
- To enhance the book's appearance and reader friendliness, liberal use is made of photos, marginal notes of interest, newspaper and magazine excerpts, and historical highlights of prominent mathematicians and statisticians.

- To help students master and retain the concepts in each chapter, the end-of-chapter material includes a summary, "Looking Back," a "Key Words" list, a "MINITAB Commands" list, and "Review Exercises," a set of comprehensive problems.
- Important formulas, definitions, procedures, tips, and computer commands are highlighted so that the reader can give them priority on first reading and, later, during review.
- A removable, detailed formula card and separate tables card have been bound into the book for possible use during examinations.
- For a ready reference, the normal, chi-square, and $t$ tables are reproduced on the inside covers.

## Use of MINITAB

This book is unique in its abundant use of the statistical computer package MINITAB. Instead of being used as a mere appendage to each chapter, MINITAB is woven throughout the text, with each command explained when it is first used in an application. This integration emphasizes the computer's role as a practical tool for relieving much of the drudgery associated with data sets, allowing the user more time to focus on other aspects of the analysis such as selecting a proper procedure, describing and interpreting data, and displaying the results. MINITAB's use also enhances the comprehension of many statistical concepts and techniques presented in a first course.

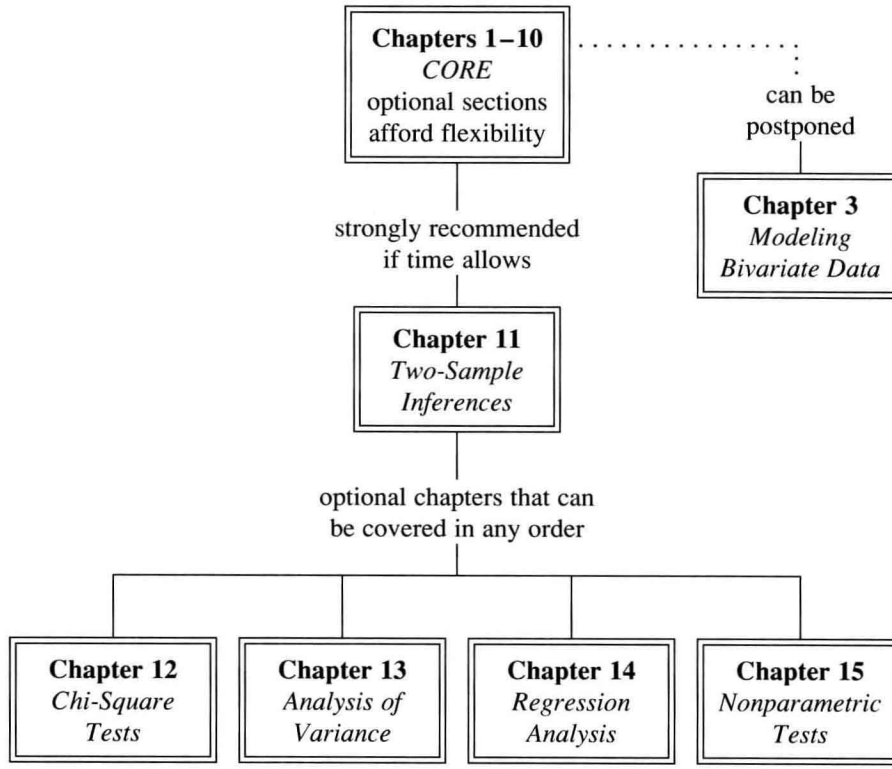
Although there are many statistical software packages currently available, I chose MINITAB because of its wide acceptance in educational instruction and its extensive use around the world in business and government. It is currently used at more than 2,000 colleges and universities and by 70% of Fortune 500 companies. Of equal importance, MINITAB can be learned quickly and easily, providing students with a powerful data analysis system that can be used in other courses and in their professional careers.

Because not all students have access to MINITAB, I have incorporated it into the text in a manner that affords an instructor considerable flexibility concerning its usage in the course. An instructor can choose any of the following options, each of which has been used by the author during the class-testing of this book.

- **Active Computer Usage.** Sufficient MINITAB instruction is provided so that students can write their own commands for statistical analyses. The book contains a total of 240 MINITAB assignments. They are flagged with the symbol Ⓜ and are placed at the end of an exercise set. MINITAB coverage is so extensive that the usual MINITAB supplement manual is unnecessary.
- **Passive Computer Usage.** Students can be instructed to examine only the output of the MINITAB exhibits and to just look over (or ignore) the commands used to generate the results.
- **No Computer Usage.** An instructor may prefer to have the class skip entirely the MINITAB exhibits. Implementation of this option is facilitated by the fact that all MINITAB output is prominently highlighted.

## Flexibility in Topical Coverage

The book is designed so that an instructor has a great deal of flexibility in topical coverage. The diagram below displays several possibilities.




Chapters 1 through 10 form the core of the text, and Chapter 11 is strongly recommended if time allows. For instructors who want to spend less time covering these chapters, optional sections 6.4, The Hypergeometric Probability Distribution; 6.5, The Poisson Probability Distribution; and 11.3, Small-Sample Inferences for Two Means: Independent Samples and Unequal Variances, can be excluded. Additional time can be gained by also excluding sections 9.7, Chi-Square Probability Distributions; 9.8, Confidence Interval for a Variance; 10.5, Hypothesis Test for a Variance; 11.6, $F$ Probability Distributions, and 11.7, Inferences for Two Variances.

## Supplements

The following supplements have been prepared to enhance the use of this book. They are available, free of charge, to instructors who adopt the text.

- **Student Solutions Manual.** This supplement was prepared by Ronald L. Shubert of Elizabethtown College and is available to students for purchase. It con-

tains detailed solutions for all review exercises and all odd-numbered, end-of-section exercises.

- **Instructor's Manual.** Also prepared by Ronald L. Shubert, this manual contains detailed solutions to all exercises, and a sample course syllabus with helpful suggestions.
- **ExaMaster™ Computerized Test Bank.** Available for IBM-compatible and Macintosh computers, this test bank contains more than 1,200 questions, each written especially for this text. A virtually unlimited number of tests can be custom designed by an instructor. Tests can contain a mixture of multiple-choice and free-response questions sorted by several different categories. An instructor can also add and edit questions, and grading keys can be generated. Full documentation accompanies the test bank.
- **Printed Test Bank.** A printed version of the Computerized Test Bank is also available. This supplement was prepared by Amy F. Relyea of Miami University of Ohio.
- **Professor's Grade Book.** Computer software for managing student records accompanies the Computerized Test Bank.
- **Data Disk.** A computer diskette is available containing the data sets for 384 exercises, including all data sets for the MINITAB problems. The data sets are stored as ASCII files, and they may be freely duplicated for student use at adopting institutions. The data disk will be distributed to instructors free of charge upon adoption.

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I am grateful to Minitab, Inc. for providing a copy of the latest release of MINITAB available at the time of this writing—Release 8.2 for the MS-DOS standard version. Information about MINITAB can be obtained by contacting

Minitab, Inc.
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E.A.B.
Lebanon, Pennsylvania
November, 1992

# Index of Applications

# Contents