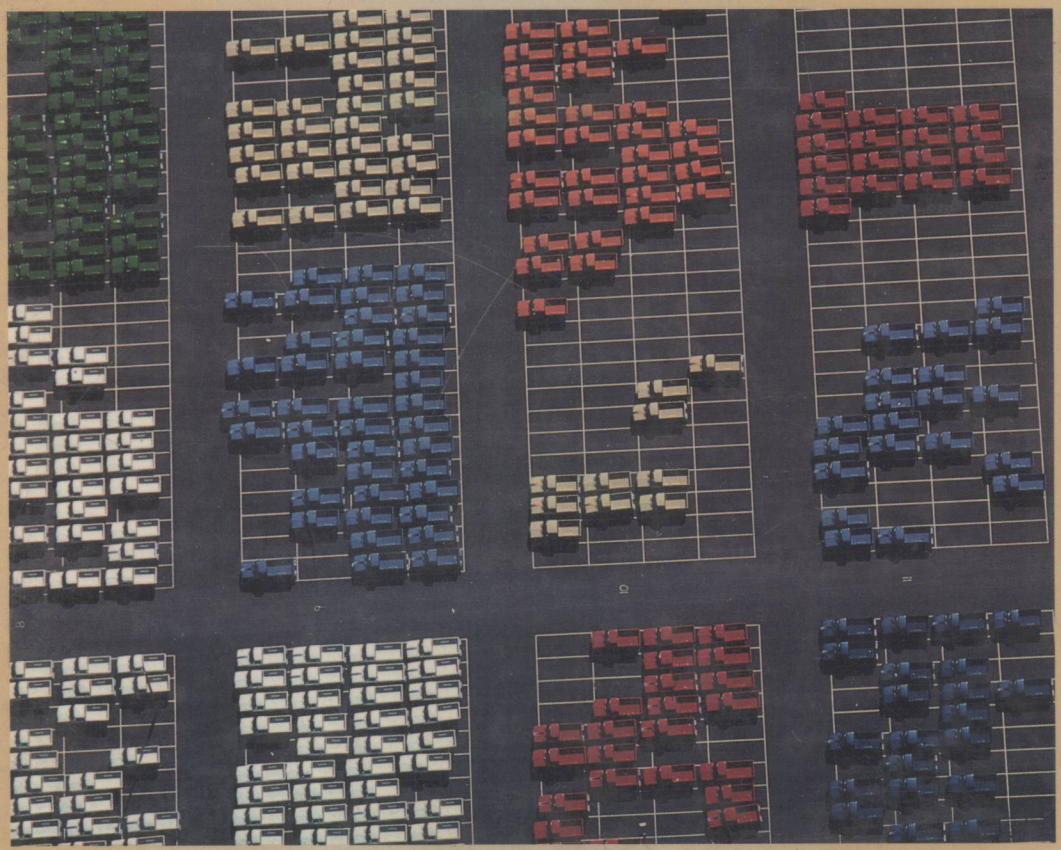
STATISTICS

FOR MANAGEMENT AND ECONOMICS

A Systematic Approach

Gerald Keller Brian Warrack Henry Bartel



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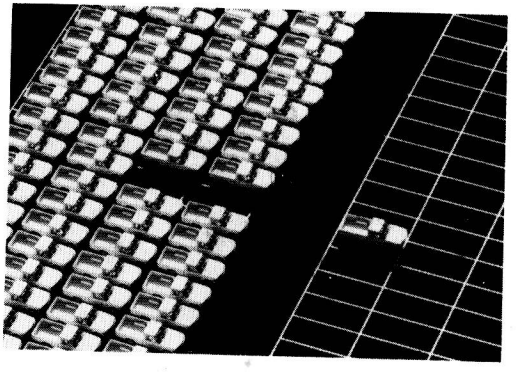

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WADSWORTH PUBLISHING COMPANY
BELMONT, CALIFORNIA
A DIVISION OF WADSWORTH, INC.

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Printed in the United States of America 49

1 2 3 4 5 6 7 8 9 10—92 91 90 89 88

Library of Congress Cataloging-in-Publication Data

Keller, Gerald.
Statistics for management and economics : a systematic approach / Gerald Keller, Brian Warrack, Henry Bartel.
p. cm.
Includes index.
ISBN 0-534-08622-5
1. Management—Statistical methods. 2. Economics—Statistical methods. I. Warrack, Brian. II. Bartel, Henry. III. Title.
HD30.215.K45 1988 87-19845
658.4'033—dc19 CIP

A Guide to the Statistical Techniques

SCALES	PROBLEM OBJECTIVES: *Description of a Single Population*	PROBLEM OBJECTIVES: *Comparison of Two Populations*
Nominal (Qualitative)	z-test and estimator of p Sections **8.3** and **8.4** χ^2-test of the multinomial experiment Section **13.2**	z-test and estimator of $(p_1 - p_2)$ Section **10.2**
Ordinal (Ranks)		Wilcoxon rank sum test for independent samples Section **14.2** Wilcoxon signed rank sum test for matched pairs Section **14.3**
Interval (Quantitative)	z-test and estimator of μ Sections **7.3** and **7.5** t-test and estimator of μ Section **7.6** χ^2-test and estimator of σ^2 Section **7.7**	z-test and estimator of $(\mu_1 - \mu_2)$ Section **9.2** t-test and estimator of $(\mu_1 - \mu_2)$ Section **9.3** t-test and estimator of μ_D Section **9.4** F-test and estimator of σ_1^2/σ_2^2 Section **9.5**

	Comparison of Two or More Populations	*Analysis of the Relationship Between Two Variables*	*Analysis of the Relationship Among Two or More Variables*
	χ^2-test of a contingency table Section **13.3**	χ^2-test of a contingency table Section **13.3**	
	Kruskal-Wallis test for the completely randomized design Section **14.4** Friedman test for the randomized block design Section **14.5**	Spearman rank correlation Section **15.10**	
	ANOVA: completely randomized design Sections **12.2** and **12.3** ANOVA: randomized block design Section **12.4**	Simple linear regression and correlation Sections **15.2**–**15.9**	Multiple regression Chapters **16** and **17**

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STATISTICS

FOR MANAGEMENT AND ECONOMICS

DEDICATION

Gita, Barbara, Jeffery, and Jonathan
G. K.

Veronica and Cynthia
B. W.

Margaret, Tanya, and Annatasha
H. B.

PREFACE

Statistics is a required course in various programs of study, including business and economics, in almost all universities. While the material covered, the level of difficulty, and the approach vary enormously, most have one aspect in common: the course is typically the most unpopular in the academic program.

Some of the most common reasons for this unpopularity are:

1. Statistics is mathematically based. Unfortunately, many students have come to fear and despise mathematics. Hence, any subject too closely related to mathematics must also be feared and hated.
2. Statistics is not perceived as being relevant to careers in business and economics. Few students aspire to be statisticians. Rather, they intend to become accountants, financial analysts, marketing managers, and corporate vice-presidents and presidents. They cannot or will not see how statistics can be useful to these professions.
3. Statistics appears to be a confused mass of different techniques, with little or no organization in the presentation of material. The typical statistics course and textbook may cover as many as forty different techniques, and it is difficult to determine the circumstances under which each should be applied.

One of the functions of this textbook is to persuade you that these comments are really unfounded. If we can convince you, we believe that you'll have no more difficulty with statistics than with any other course in your university or college program. Our approach follows some general guidelines, outlined here.

The mathematics is kept to a minimum, with very few derivations of formulas. Instead, we develop each technique in a rational, intuitive way. Moreover, we intend to explain all but the most complex concepts fully. In this way, you'll realize that the foundations for statistical techniques are quite logical.

We assume that you've had a course in algebra and that you can perform the basic arithmetic operations. No more is required! With these arithmetic skills, you will be able to do all the necessary calculations. Although the calculations can be somewhat time-consuming, we regard this aspect of problem solving as fairly unimportant. We emphasize understanding how the technique works, when to apply it, and how to interpret the results. The actual calculations, although necessary, are not featured preeminently in this text.

In most of the examples and exercises, we stress the context in which the problem is placed. We discuss why the technique is applied and how the result of the technique helps managers and economists make decisions. Where possible, we use actual studies and data reported in journals, magazines, and newspapers.

Each technique is placed in a systematic framework. Instead of viewing statistics as an incomprehensible jungle, you will see that each technique fits into a particular position. More than any other statistics textbook, this one emphasizes when each technique is to be used and what assumptions are necessary for its application.

All of these guidelines are reinforced in the exercises appearing throughout the chapters. These are pitched at several levels of difficulty:

1. At the end of many sections, we present exercises under the heading *Learning the Technique.* They are provided to help you learn the arithmetic required in using the statistical method.
2. *Understanding the Concepts* exercises follow. These stress when and why the technique is used and how the results assist in the decision-making process.
3. *Supplementary Exercises* appear at the end of most chapters. Because they cover all the topics presented in that chapter, they provide practice in identifying which of the techniques encountered in that chapter should be employed. They also tend to be more realistic (and for this reason are considered somewhat more difficult) than the other two types of exercises.
4. Review chapters, too, are designed to help you recognize the appropriate methods to use. There are two such chapters: Chapter 11, which appears midway through our discussion of statistical inference, and Chapter 18, which appears at the completion of that same discussion. Because the exercises in these two chapters are not directly affiliated with the chapters in which the solution methods were presented, they are more realistic. When a statistical problem arises in real life, no one is around to tell you which statistical technique to use.
5. Minicases are scattered throughout the book, with a greater concentration appearing in Chapters 11 and 18. Often, these are larger problems, almost all of which report actual studies and/or present actual data. The sources of the minicases are journals, magazines, and consulting projects in which we or our colleagues have participated.
6. Cases with raw data appear in Chapters 11, 15, 16, and 18. Whereas the minicases usually present summarized data (in the form of frequency distributions or statistics), the cases provide a relatively large mass of raw data. In general, the cases should be solved by computer. (The data are available on diskette for those who have access to a microcomputer and a statistical application package; contact Wadsworth for details.)

We've attempted to make the minicases and cases as realistic as possible. Most require the use of several techniques. As is the case with many real-life statistical applications, we do not direct you to perform any specific technique. You will have to decide for yourself which statistical methods to use. For the most part, you will have to perform the same techniques that the original author of the article or project had to perform to complete the task at hand.

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We're optimistic that our efforts will be successful in helping you understand how, when, and why statistics is used. We hope that our use of realistic problems from various functional areas will heighten your interest in this subject.

This text is suitable for a one- or two-semester course in a business or economics program. It can be used at both undergraduate and graduate levels. Although various sections can be omitted, we strongly urge instructors to attempt to complete most of Part One (descriptive measures and probability) and almost all of Part Two (statistical inference). Like a house under construction, the structure of the systematic approach is strongest if almost all of the various components are in place. At our university, we offer the material covered in Parts One and Three (applications) in a single one-semester course (39 hours) and Part Two in a second course. We're confident, however, that instructors can find a suitable combination of topics for their program needs.

To assist professors, we provide an *Instructor's Resource Book*—which includes a wide variety of teaching aids and a test bank—and a *Solutions Manual.* The test questions are available from the publisher on two types of computerized test banks: (1) Micro-Pac Genie, which allows the instructor to generate, edit, and author tests with full graphics capability on IBM and compatibles and (2) Wadsworth's Teletesting Service for those without access to a microcomputer. Also available to instructors who adopt our text are *Data Sets*, which include raw data from each of the text's eight cases so students don't have to waste time inputting data. The sets are available on diskette for use with Minitab or on tape for use with mainframes.

For students, we have written a *Study Guide* that contains overviews of each chapter in the text, examples illustrating specific techniques, and exercises and solutions to provide practice in using the systematic approach. For use with the *Study Guide*, we offer software that enables students to practice using appropriate statistical techniques by working through thirty-five problems from each of the two review chapters, Chapters 11 and 18.

This book was developed from several courses that we've taught in business and economics programs in a total of ten universities over a combined forty years of teaching. We are most grateful to our colleagues, our teaching assistants, and especially our students, whose helpful suggestions, comments, and criticism have benefited this text. In particular, we note the contributions of Len Fertuck, University of Toronto; Hamid Noori and Ganesh Vaidyanathan, Wilfrid Laurier University; and Alan Marshall and Laurie Phipps, York University. We thank Andy Berczi, Wilfrid Laurier University, who started the project and provided guidance along the way. We also acknowledge the excellent work of our word processor, Elsie Grogan.

The following reviewers also provided valuable suggestions and comments: Bruce Bowerman, Miami University; Henry Crouch, Pittsburg State University; Tim Daciuk, Ryerson Polytechnic Institute; Paul Eaton, Northern Illinois University; David Eldredge, Murray State University; Myron Golin, Widener University; Robert C. Hannum, University of Denver; Iris B. Ibrahim, Clemson University; Alan Neebe, University of North Carolina at Chapel Hill; Dennis Oberhelman, University of South Carolina; Nancy V. Phillips, University of Texas at Austin; Farhad Raiszadeh, University of Tennessee at Chattanooga; Andrew Russakoff, St. John's University; Mike Ryan, University of South Carolina; Michael Sklar, Emory University; Craig Slinkman, University of Texas at Arlington; Jae H. Song, St. Cloud State University; William Stein, Texas A & M University; Will Terpening, Gonzaga University; James E. Willis, Louisiana State University; and Marvin Wolfmeyer, Winona State University.

Finally, to anyone who has read this preface, we wish you success in your studies in statistics.

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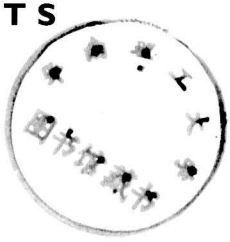

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