

ESSENTIALS OF BUSINESS STATISTICS

A SYSTEMATIC APPROACH



KELLER / WARRACK

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A SYSTEMATIC APPROACH

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G. K.

To the memory of my mother, Marnie Warrack
B. W.

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A GUIDE TO THE STATISTICAL TECHNIQUES

		PROBLEM OBJECTIVES	
		DESCRIPTION OF A SINGLE POPULATION	COMPARISON OF TWO POPULATIONS
TYPE OF DATA	QUANTITATIVE	z-test and estimator of μ Sections 8.3 and 10.3 t-test and estimator of μ Sections 8.4 and 10.5	z-test and estimator of $\mu_1 - \mu_2$ Sections 9.2 and 11.2 t-test and estimator of $\mu_1 - \mu_2$ Sections 9.3 and 11.2 Wilcoxon rank sum test Section 18.3
	QUALITATIVE	z-test and estimator of p Sections 8.5 and 10.6 χ^2 -test of a multinomial experiment Section 14.2	z-test and estimator of $p_1 - p_2$ Sections 9.4 and 11.3
	RANKED		Wilcoxon rank sum test Section 18.3

	COMPARISON OF TWO OR MORE POPULATIONS	ANALYSIS OF THE RELATIONSHIP BETWEEN TWO VARIABLES	ANALYSIS OF THE RELATIONSHIP AMONG TWO OR MORE VARIABLES
	Analysis of variance Chapter 13 Kruskal–Wallis test Section 18.4	Simple linear regression and correlation Chapter 15	Multiple regression Chapter 16
	χ^2 -test of a contingency table Section 14.3	χ^2 -test of a contingency table Section 14.3	
	Kruskal–Wallis test Section 18.4		

P R E F A C E

It's been three years since our first book *Statistics for Management and Economics: A Systematic Approach* was published. During the writing of that book and in the ensuing years, we received comments and suggestions from statistics professors across the United States and Canada. It is evident that our approach to teaching statistics has received wide acceptance. But at the same time there is clearly a need for another kind of business statistics text.

A substantial number of business statistics instructors want a book that covers a core of statistical techniques but does not present all of the methods provided by the larger books. Most professors who teach 20 to 30 methods do not want to use a book that provides 50 or more techniques. They feel that a large book needlessly intimidates students. As one reviewer facetiously commented, "Students are afraid of books that weigh more than they do." Moreover, larger books tend to be written for the mathematically more sophisticated student. Professors who teach less mathematically inclined students prefer a friendlier, less formal approach.

One of the criticisms of shorter books is that they tend to be cookbooks that delete any discussion of concepts and principles. They also tend to provide unrealistic examples and exercises. In our discussions we found that all professors want to motivate their students by showing them real-life practical applications of statistics.

Our objective in writing this book was to provide a shorter book that covered the essential techniques and contained many of the features of our larger book. In the final analysis, we wanted to create a book that professors and students would find interesting and that would motivate students and convince them that statistics can be as useful as any other course in their program. We attempt to fulfill our goal in several ways.

ESSENTIAL CORE OF TOPICS

If you examine the table of contents, you will see that we have covered most or all topics that are considered essential. We have excluded subjects that are not vital to the development of a statistically aware business student. For example, calculation of the probability of a type II error, inference about variance, and inference about a matched pairs or blocked experiment have been omitted. Our presentation of probability (Chapter 4) focuses on concepts and procedures that are critical to the understanding of how probability is used in statistical inference; we avoid a wide-ranging discussion of probability.

FLEXIBLE COVERAGE

Even though we have limited our presentation to essential subjects, we recognize that some instructors would prefer to delete certain of these or to discuss them in a different way. We have written the book to facilitate flexibility. For example, we introduce estimation and hypothesis testing in separate chapters. Instructors then have the option of not teaching one of them or of teaching them in a different order.

SYSTEMATIC APPROACH

The systematic approach, introduced in our first statistics book, teaches students how to recognize which statistical technique to use. We believe that this skill is the most important one to develop, and yet it is the one students have the greatest difficulties in mastering. When each technique is introduced, we show how statisticians identify when that method is to be used. When we demonstrate examples, we begin the solution by reviewing how we know that the method to be used is the correct one to apply. One of the major benefits of our approach is that it allows professors to de-emphasize mathematical manipulation. Consequently, students can spend more time setting up the procedure properly and interpreting the statistical results and less time grinding out the arithmetic.

CASES

There are 26 cases scattered throughout the book. These have been adapted from actual studies published in journals and magazines. Students are expected to analyze the cases and draw conclusions in the same way the original authors did. These cases are neither summaries of what some statistician did to solve a problem nor glorified exercises; they give students the opportunity to see for themselves how statistical problem solving works.

COMPUTER OUTPUT AND INSTRUCTIONS

For most of the worked examples, we provide Minitab software output. This exposes students to how statistics is actually applied in the real world. We also provide Minitab instructions in the appendixes of many chapters. In addition, we have made available a student version of Microstat II—a commercial statistics software package. This comes with a manual keyed to the textbook.

REVIEW CHAPTERS

There are two review chapters to help students practice identifying the correct techniques. Chapter 12 appears midway through our discussion of statistical inference, and Chapter 19 reviews all the statistical methods covered. Each provides exercises and cases that require the use of several different statistical procedures and thus provide practice in the technique identification skills that are required on statistics exams and ultimately in any real-life application of statistics.

EXERCISES

There are approximately 750 exercises of varying levels of difficulty in this book. At the end of most sections, we supply exercises under the heading *Learning the Techniques*, which help students learn the arithmetic involved in a specific procedure. *Applying the Techniques* exercises then stress when and why the technique is used and how the results assist in the decision-making process. *Supplementary Exercises* appear at the end of each chapter. Because they cover all the topics presented in that chapter, they give students 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.

We're optimistic that our approach will be successful in helping students understand how, when, and why statistics is used. We hope that the realistic examples, exercises, and cases we present will make the subject more interesting and will convince students that statistics can play a vital role in managerial decision making.

This text is suitable for a one- or two-semester course in a business program. Although various sections can be omitted, we strongly urge instructors to attempt to complete most of the statistical inference part of the book. Like a house under construction, the structure of the systematic approach is stronger when most of the various components are in place. Nonetheless, the book has been designed so that it is relatively easy to omit chapters.

To assist professors, we provide an *Instructor's Resource Book*, which includes the following:

1. Suggestions about how to teach statistics using the systematic approach.
2. Transparency masters keyed to the teaching suggestions.
3. Teaching notes for each case, detailing goals of the case, assignment questions, analysis and solution, and teaching strategy.
4. Test bank containing about 450 problems and answers.
5. A guide to setting up exams that can be marked by computer (with possible part marks) and calculation-free exams.

A *Solutions Manual* that furnishes detailed solutions for all of the textbook's exercises is also available. These solutions were produced by the authors and independently double-checked by teaching assistants.

For students, we have written a *Study Guide* that contains overviews of each chapter in the text, examples illustrating specific techniques, and exercises and their solutions. The guide attempts to anticipate specific student problems and answer what we believe are the most commonly asked questions.

This book was developed from several courses that we've taught in business and economics programs in a total of six universities over a combined 35 years of teaching. We are most grateful to our students, whose helpful suggestions, comments, and criticisms have benefited this text. We also acknowledge the excellent work of our word processor, Elsie Grogan.

Finally, we would like to thank the following reviewers: Rich Behr, Broome Community College; Harry C. Benham, University of Oklahoma; Steven E. Eriksen, Babson College; Jacqueline F. Hoell, Virginia Polytechnic and State University; William P. Lovell, Cayuga Community College; Mary Maples, Oklahoma City Community College; Tom Noser, Western Kentucky University; Khalid Pathan, Lewis University; Harrison Reinken, Phoenix College; Susan Simmons, Sam Houston State University; Charles E. Tychsen, North Virginia Community College.

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