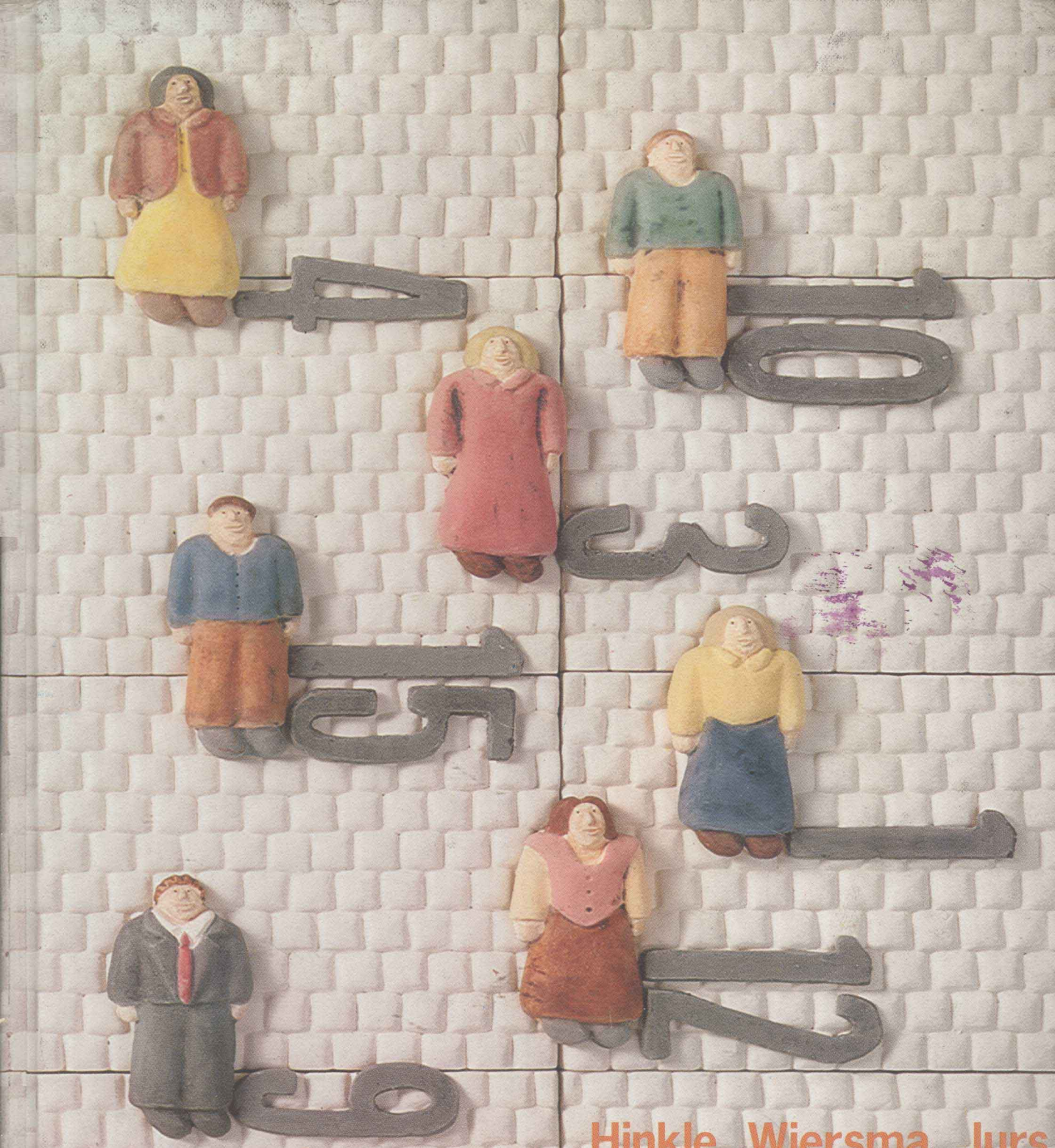

Hinkle Wiersma Jurs

BASIC BEHAVIORAL STATISTICS

Basic Behavioral Statistics

Dennis E. Hinkle
Virginia Polytechnic Institute and State University

William Wiersma
The University of Toledo

Stephen G. Jurs
The University of Toledo

Houghton Mifflin Company Boston
Dallas Geneva, Illinois Hopewell, New Jersey Palo Alto London

To

Mary, Chas, and Anya

and

Joan, Lisa, and Susan

and

Sara, Peter, and Andrew

Ceramic art on cover and chapter openers by Kenneth Goldstrom.

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Library of Congress Catalog Card Number: 81-81700

ISBN: 0-395-31729-0

Printed in the U.S.A.

Foreword to the Student

By Sheila Tobias
author of *Overcoming Math Anxiety* (Houghton Mifflin, 1980)

For some very unusual people mathematics is a gift. For the rest of us it is a collection of learnable (and easily forgettable) skills. Hence it may be wise, before you undertake to learn the material covered in this text, to do some systematic review of the algebra and precalculus courses you may have taken, along with a group of supportive and like-minded friends. Such re-exposure will remind you of mathematical notation and of some of the basic algebra you once knew. And it may help you "hit the ground running" when you start statistics.

A more problematical aspect of mathematics, somewhat harder to deal with, is the built-in prejudice some of us bring to mathematics and math-related fields of study. We call this phenomenon "math anxiety" or "math avoidance," and in numerous intervention programs around the country, students are being urged—before they confront their required statistics course—to undertake some "math anxiety reduction." Such a process involves self-examination of your own, personal math autobiography, some self-monitoring of the ways you may be defeating yourself when doing mathematics, and some study of mathematics in a tension-free and pressure-free environment.

Another technique that is used for reducing math anxiety is assertiveness training. Some of us feel embarrassed when we don't "get" a mathematical idea the first time it is presented, and consequently we don't ask questions in class. Assertiveness training teaches students how to ask their instructors for the help they need. Sometimes the text—even one as carefully prepared as this one—may not answer a question floating around in your mind. Note such questions and ask for clarification. If nec-

essary, write your questions down and give them to your instructor. Being cumulative, your statistics course will build continuously on everything that has gone before. A missed concept or a misunderstanding is like a dropped stitch; it is all the harder to correct later on.

A third helpful technique is to work with other people. Your instructor may not permit you to take group tests (though some teachers are beginning to allow this in order to reduce tension and competitiveness among students), but group study is often worthwhile. Explaining concepts to one another enhances and deepens your own learning, and the group experience relieves some of the uncertainty of doing mathematics in isolation.

Above all, don't be demoralized by your mistakes. In a session held for math-anxious adults, a graduate student in mathematics once agreed to answer general questions from the group. An intrepid woman ventured this question: "How do you feel when you make a mistake?" After a short pause, the graduate student answered, "I find my mistakes interesting and my confusions even more so." The group gasped. They had come to believe that mistakes were like blemishes, emblems of their stupidity. The graduate student had pointed out, correctly, that mistakes are like windows into our minds.

Examine your mistakes. Are they the result of careless error—something you wouldn't do again—or do they indicate a missing skill? Did you mislearn an operation that worked for awhile on simpler data but will not work on the new material? Is the problem in the mathematics? In your comprehension of the verbal information presented? In the notation? (You will be learning more new notation in your statistics course than you learned in your algebra courses in high school. Some of this notation will be different from and contradictory to what you learned before.) Or is the problem in visualizing the operation when it is expressed on a graph?

Obviously, the better you analyze your errors (alone or with the help of your tutor or instructor), the less likely it is that you will make them in the future.

Finally, be flexible. Even mathematicians may modify a problem they are working on to get a better handle on it. They substitute smaller numbers or replace a long series with a shorter one, just to get an idea of the parameters of the problem and to test their methods. Guessing is O.K., so long as you find a good way to test your hunches. (Sometimes the way you test your hunch will give you a good clue to the formula you are seeking.) And use your intuition. Math-anxious people trust their intuition far less than successful learners of math and statistics.

This textbook has been skillfully prepared and carefully reviewed by many experienced teachers of statistics, with the aim of making the presentation as clear as possible. But this does not mean you will learn everything you need to know the first time around. "Reading" mathematics or statistics is very different from reading social science or general nonfiction. Read with a paper and a pencil; each statement is made once and you must master it before going on. Imagine examples, imagine counter-examples. Note any questions that arise and, if these are not answered by the time you are finished studying, give them to your instructor. Try to slow down your reading speed. Think of reading statistics as rather like "reading" a crossword puzzle. You don't just look at the cues for Down and Across; you work them out. And the same

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is true for this textbook. Don't just glance at the words; work out the ideas and apply them.

If you have anxiety to deal with, try to make yourself relax. Writing down your "self-defeating self-talk" is one way to relax. Try to get more time to complete your tests if your instructor will allow it. And you may want to consult other books on math anxiety.

Consider ways to make your first course in statistics easier for you. You might audit the course for one semester before taking it for credit. This will give you an idea of the scope of the material and some advance warning about what the more difficult areas will be. You might even discover that the subject of statistics is both fascinating and empowering: The opportunity to take control of data, to find patterns in ostensibly unrelated phenomena, and to deal critically with other people's research will give you thinking strengths that no other course can offer.

Preface

This book was written primarily as a text for a one-term or semester course in statistics. However, it can serve as a supplement for related courses with a quantitative orientation, such as courses in measurement and research methodology. It is an introductory text and is designed to teach concepts and procedures that are fundamental for further study in statistics. The book can be used for either undergraduate or graduate courses found in behavioral sciences curricula such as psychology, education, and sociology.

Conceptual Approach The approach of the text is conceptual and nonmathematical in nature. Any study of statistics must include some consideration of formulas and computation, but we have included formulas only when necessary and then with an emphasis on understanding the formula, not a "cookbook" use of it. We have selected the simplest version of formulas in most cases, and we do not confuse the student with three or four equivalent formulas. Basic concepts of statistical reasoning and the underlying assumptions are presented. For undergraduate students and beginning graduate students (especially those who may take additional statistics courses) such concepts are necessary, even though they require only a limited mathematical background. Computation is illustrated through the examples that are introduced to develop understanding of the concepts.

Learning and Teaching Aids The book contains several features designed to enhance its use as a teaching tool and a learning device. Statements summarizing the

important points being made are displayed prominently throughout the chapters. Key concepts listed at the end of each chapter help the reader review the major concepts introduced in the chapter. Exercises are included for each chapter, and solutions to the exercises are provided in an appendix. Thus students can receive immediate feedback about their solutions. For students who use an electronic calculator to work problems, the key strokes for selected exercises have been included at the end of each chapter in a section identified by a calculator symbol, as on page 21. The use of pocket calculators in statistical analysis is described in Appendix A.

A *Student Workbook* is available and can be used effectively as a supplement to the text. It includes definitions of key concepts, exercises to reinforce these concepts, and additional exercises for further review.

The first chapter offers an optional review of elementary mathematics for those students with a very limited mathematics background. This review covers the basic operations of addition, subtraction, multiplication, and division, along with the real number system and elementary algebra. Notation is explained, and the Σ operator, so important in statistics, is introduced. But essentially, no mathematical background beyond elementary algebra is required for using the text effectively.

Coverage The book includes both descriptive and inferential statistics, the latter through analysis of variance. The basic descriptive statistics are presented in Chapters 2 through 7; included are graphs, measures of location, measures of central tendency, measures of variability, standard scores, correlation, and regression. The learning process is enhanced through the use of realistic examples and exercises. It should be noted that the concept of regression is considered in the descriptive sense—that is, in terms of the development of the regression equation, the use of this equation in the prediction process, and the definition of the standard error of prediction.

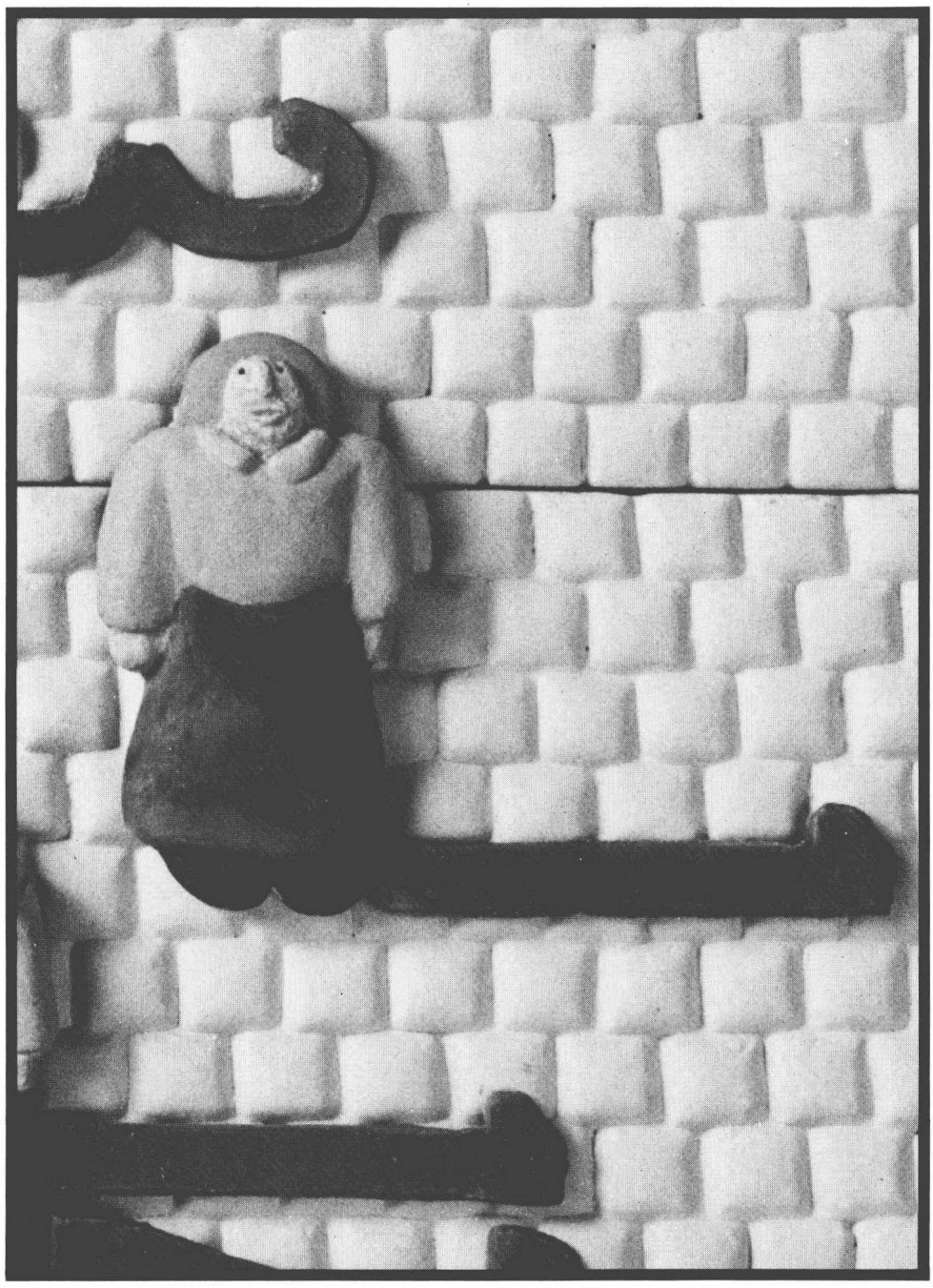
Inferential statistics are introduced via a discussion of the concept of probability and its relationship to sampling and sampling distributions. These basic concepts are then used in developing the logic underlying hypothesis testing and parameter estimation. Hypothesis testing and estimation are discussed for the one-sample case for the mean in Chapters 9 and 10 and then expanded to the two-sample case in Chapter 11. One-sample and two-sample cases for other parameters are considered in Chapter 12.

Chapter 13 is devoted to one-way analysis of variance (ANOVA). Conceptual development of the partitioning of the sum of squares and *post hoc* multiple comparison procedures receive special consideration. Repeated measures analysis of variance is also included. Two-factor analysis of variance is treated in Chapter 14 as the logical extension of one-way ANOVA. Selected nonparametric statistics are presented in Chapter 15; these procedures are the analogues to the procedures discussed in Chapters 9 through 13.

Acknowledgments We are grateful to the Literary Executor of the late Sir Ronald A. Fisher, F.R.S., to Dr. Frank Yates, F.R.S., and to Longman Group Ltd., London for permission to reprint Tables III, IV, VII, and XXIII from their book *Statistical Tables for Biological, Agricultural and Medical Research* (6th edition, 1974).

We would like to acknowledge several people who have contributed to this effort. First of all we would like to thank the reviewers who gave us most constructive criticisms as well as suggestions that have enhanced the manuscript: William A. Frederickson, Central State University; John Harsh, University of Southern Mississippi; Donald V. Huard, Phoenix College; Charles R. Kessler, Los Angeles Pierce College; and Alice L. Palubinskas, Tufts University. Special thanks goes to J. R. Cox for his review of the manuscript and to L. E. Ewing for his assistance in developing the exercises and their solutions. Our most special acknowledgment is to our families, to whom we dedicate the book.

Dennis E. Hinkle
William Wiersma
Stephen G. Jurs



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