
BASIC | **SECOND** **STATISTICS** | **EDITION** **FOR SOCIAL** **RESEARCH**



DEAN J. CHAMPION

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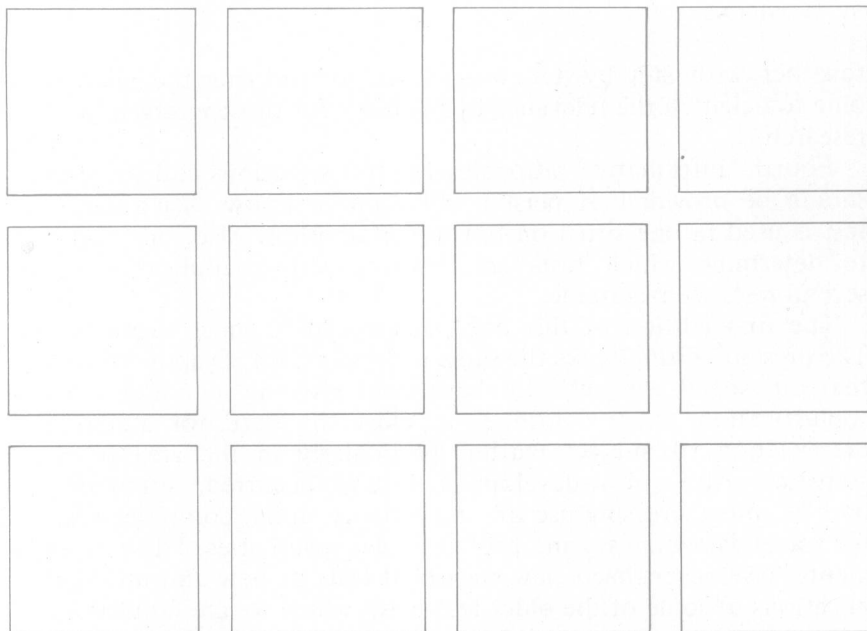
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Preface

A statistics book can be a valuable reference source for both the social researcher and the more-than-casual student of social phenomena. The value of the book will depend upon a number of things. First, the book should be fairly broad in its coverage of statistical tests and techniques. This by no means implies that the text must be encyclopedic in scope. Rather, it is important that the most frequently used tests be included.

Second, the text should be reasonably simple. Formulas and symbolic expressions should be rendered in simple forms to permit the widest possible usage for a variety of readers with different levels of statistical sophistication.

Third, examples should be used that reflect proper applications of the tests discussed. The more realistic the examples, the better. The frequent use of tabular presentations accompanying the examples,

together with step-by-step procedures for utilizing the tests, combine to heighten the relevance of the book for those engaged in social research.

Fourth, informative rationales for test selections and preferences should be provided. A person will want to know *why* a particular test is used in one situation but not in another. Also, one may wish to determine which tests are best for certain applications when several tests seem suitable.

The first edition of this book attempted to meet these criteria. The present edition seeks the same objectives; for, in spite of the fact that our social science fields have been growing in popularity and sophistication, there continues to exist the need for a simplified presentation of subject matter, particularly in the area of social statistics. Also, new developments have occurred, stimulated in part by our increasing use of, and reliance upon, computer systems for social data analyses and problem-solving activities. These developments have often been new statistical tests or new and unusual applications of some of the older tests with which we are familiar.

Improvements that have been incorporated into this edition include more-extensive discussions of statistical tests, and their assumptions, weaknesses, and strengths relative to one another. Also, greater stress has been placed on the interpretation of statistical test results in conjunction with one's research.

Another positive feature is the expanded exercise sections at the ends of chapters, which will provide students with a greater opportunity to work problems in preparation for statistics examinations and to increase their ability to work through statistical formulas with confidence.

A more-detailed discussion of the logic of hypothesis testing in social research is included to illustrate more clearly the interplay between statistics and research methodology. It is hoped that this will provide students with a more informed perspective concerning the exact role of statistics in social problem-solving endeavors.

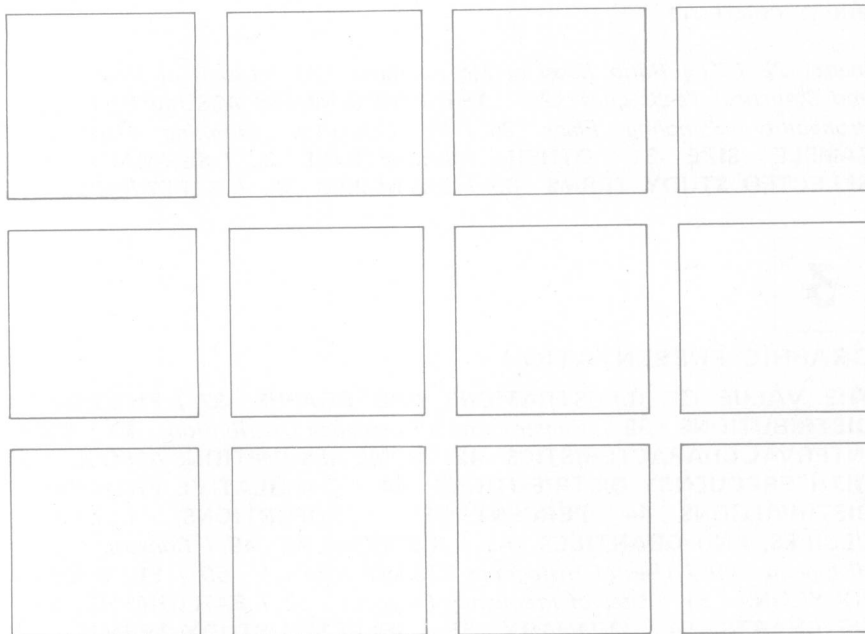
For persons with more professional research interests, this book continues to function as a potential sourcebook and guide. The statistical tables in the appendix are accompanied by step-by-step instructions for using them and interpreting observed values meaningfully. This is also a new feature of the present edition.

It should be noted that statistics are not ends themselves but rather means toward ends. In the traditional view of the research process as a chain of events leading from the definition of a researchable problem to a potential working solution for it, statistics are only one link in the chain. Also, statistics are *never* the most important link, contrary to the thinking of some researchers who try

to prove everything with numbers. Statistical tests and measures continue to function *purely as aids* rather than as substitutes for sound theorizing and good thinking. They serve primarily a *supporting role* in our quest for establishing facts about things of interest to us. This theme will be repeated at appropriate places in the book as a reminder to the reader that there are equally and more important activities in the process of social research beside the quantitative manipulation of data.

I am 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, and V from their book *Statistical Tables for Biological, Agricultural and Medical Research* (6th edition, 1974).

D. J. C.
Knoxville, Tennessee



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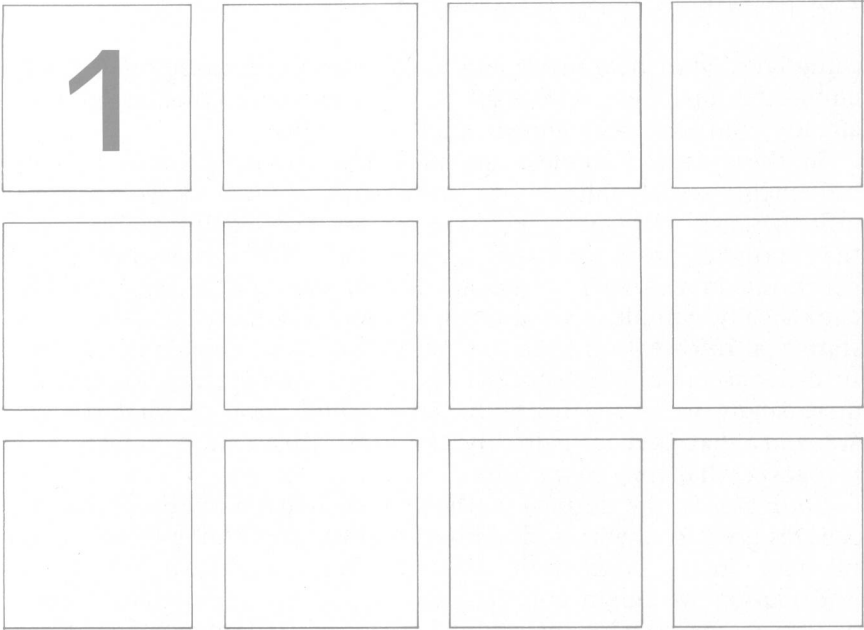
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An Introduction to Social Statistics

The Food and Drug Administration of the United States frequently acts to limit the distribution and sale of particular products to the general public. The FDA recommendations influence our economy in significant ways, and there are numerous implications of their decisions for our personal health, public policies, and general quality of life. FDA reports and recommendations almost always contain supportive information in the form of statistical findings. Statistical results of one scientific investigation or another are responsible for much FDA decision-making action.

In the political arena, city, state, and federal elections are prefaced by claims and counterclaims by political opponents. An incumbent mayor might state that during the previous 4 years, the city's crime rate decreased by 12 percent. The impression that the mayor is responsible for the reduction might well be challenged by an opponent, who will cite statistics to show that crime in the city actually increased by 20 percent. A dispute follows, in which both

candidates' statistical information is closely scrutinized by campaign committee members. The result is often greater confusion among an already confused and somewhat gullible public.

In these two examples, statistics have performed a key role in influencing social policies and consumer's product alternatives, and influencing public voting patterns in political elections. The fact is that statistics are a vital part of our daily lives. In a world that is becoming increasingly technical, mechanical, and socially and psychologically complex, we are turning more and more to statistics and statistical information in our planning and decision-making activities. In order to cope more successfully with contemporary society, it is increasingly necessary for us to have a solid grasp of what statistics are and what they can do. By the same token, it is important to recognize what they *cannot* do.

Statistics can be defined as the general body of methods and procedures used to assemble, describe, and infer something from numerical data. In the context of this book, *numerical data* refer to any information we might collect about people and their characteristics (e.g., race, sex, religion, attitudinal traits and patterns, social class).

Data collected by the FDA might include figures showing the incidence of cancerous tissue among persons consuming products containing suspect chemicals or substances. Data collected by politicians might reflect the number of burglaries, robberies, or rapes in a given city over a designated period of time, or perhaps a city's financial indebtedness.

The examination of these data by persons skilled in data analysis and interpretation will yield statistical information or statistical results that can be presented to others for their consideration and/or action. All of us are consumers of statistical information of one sort or another.¹ Some of us are also generators of statistical information, by doing research or conducting scientific investigations. It makes sense to develop some degree of familiarity with a subject that affects us in so many ways.

This book has been prepared to meet certain needs of persons desiring to learn what statistics are and how they can be used in a variety of ways for decision-making purposes. The intended audience is the student of social science and the beginning social researcher.

The primary assumptions made about your background as a reader are that (1) you can add, subtract, multiply, and divide; and (2) you want to learn about and understand a variety of statistical procedures that will be useful to you in your professional reading and research

¹ A monthly publication familiar to many of us, *The Reader's Digest*, requires a limited amount of statistical literacy if the reader is to derive full value from some of the articles.

work. A table of squares and square roots is available for your use in Table A.1, Appendix A.

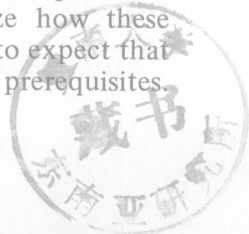
Some of the things this book attempts to do are

1. To familiarize the student with the role statistics plays in the overall social research picture.
2. To present an array of descriptive procedures for portraying statistical information in graphic form (this will not be comprehensive, although some of the more popular or representative graphic techniques will be described and discussed).
3. To give the reader a variety of tests and procedures that can be useful in data analysis and subsequent hypothesis-testing and decision-making activity.
4. To provide real examples of how these tests can be applied, their major weaknesses and strengths, and crucial assumptions underlying their legitimate application.
5. To create an awareness of qualitative differences in collectible data that will influence, if not determine, the choice of statistical test or procedure a researcher might use in a given instance.
6. To provide the reader with a set of easy-to-use tables to aid in statistical interpretations.
7. To present problems to be solved, to encourage a degree of statistical independence and confidence (answers to all mathematical exercises are found in Appendix B).
8. To give the reader a basic foundation for pursuing more elaborate and advanced statistical methods later.

Among the things this book will *not* do are

1. To present and discuss the theoretical derivation of statistical formulas.
2. To present procedures requiring more than simple arithmetic skills.

It is important to note here that not everyone agrees about how much statistical sophistication one should acquire before attempting to engage in data analysis and interpretation and statistical decision making. Some persons feel that a sound, in-depth understanding of the *theory* underlying statistical tests and their application is vital before embarking on a course of social research. Others feel that it is primarily necessary to have a working familiarity with various tests and procedures, to know how to apply them properly, and perhaps most important, to know when not to apply them. Needless to say, those stressing a theoretical understanding of statistics expose students to complex statistical formulas and emphasize how these formulas are mathematically derived. It is not unusual to expect that students will have elementary and advanced calculus as prerequisites.



Those stressing *application* are sometimes said to have a “cook-book” orientation. Given the fact that many social science students are attracted to social science because they believe it to be less technical and mathematical than subjects such as chemistry or physics, it is not unusual to find entering students in social science programs who have severely limited statistics and mathematics background.

This book is directed to students with limited mathematical experience. It has been intentionally simplified in order to maximize the reader’s understanding of what is being done and why. For instance, if 15 different mathematical formulas exist for computing standard deviation (a measure of variability discussed in Chapter 5), the simplest one has been selected to present here.

Also, simplicity has been incorporated into this book’s *notation system*, the symbols that stand for various procedures and measures. Unnecessary or superfluous subscripts and other notation have been deleted wherever possible. For instance, if we wanted to write a symbolic expression for summing an array of 10 test scores for a sociology class, we could write this expression as

$$\sum_{i=1}^{N=10} X_i.$$

The subscript i refers to any particular score, such as the first score, the second score, and so on. Under the summation sign, \sum , is found “ $i = 1$.” This instructs you to start summing the scores beginning with the first score, X_1 . Above the summation sign is found “ $N = 10$,” which instructs you to sum all 10 scores (i.e., $X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7 + X_8 + X_9 + X_{10}$). In certain instances a researcher will want to sum the last five scores only, or the first five scores only, or the middle six scores, or some other arrangement. But most of the time in social research work, an investigator will want to sum all the scores, so this notation that instructs us to sum all scores (N) beginning with the first score ($i = 1$) may be conveniently deleted. Although generally used to provide the full, formal symbolic expression, in this text we regard this notation as assumed or understood, and write the expression “sum all of the scores” simply as

$$\sum X_i.$$

This modest change vastly alters our initial impression of the formula. The simpler form makes the notation significantly less “threatening” to students with limited statistics backgrounds. Few persons will disagree that many beginning students are frightened away from statistics courses because of the appearance of certain formulas and the complexity associated with statistical procedures.

Notation systems vary from book to book. It may come as a sur-

prise to some readers to learn that there is no single notation system common to all statistics books. The system used in any book is that preferred by the author, who believes that it expresses statistical information in what he or she regards as a clear and usable format. It is necessary only that the author clearly define every symbol used, and that procedure will be followed in this book.

Finally, it should be understood that although the external appearance of a particular formula may be different from that encountered in other books, the results will always be identical regardless of the form in which the formula has been cast. This is why it is possible for a researcher to select a more familiar or easy-to-use formula for a given test or procedure with no harm to the final outcome.

□ SOME OBJECTS OF INQUIRY IN SOCIAL RESEARCH

Earlier it was noted that social scientists are interested in the collection and analysis of data or information expressed in a quantified form. Psychological and/or social information is frequently collected through interviewing, through the administration of questionnaires, or through observation. This information is transformed into numerical quantities in order to simplify the tabulation and subsequent statistical analysis of the data. The process whereby personal and social information is transformed into numerical values is called *coding*.

Various bits and pieces of information are assigned numerical values. For instance, we might assign a 1 to the category "male" and a 2 to the category "female." A 1 is then said to *stand for* "male" and a 2 is *to stand for* "female." Coding, the assignment of numbers to data collected, makes it possible for us to feed large quantities of data into computer systems and obtain printouts of the information within a matter of seconds. Coding not only saves the researcher a lot of time and energy, but it also makes possible the application of a wide variety of statistical tests and procedures which help to answer questions about the numerical data that have been collected.

Indeed, there are computer programs specifically designed to electronically analyze data that researchers have collected in ways that are consistent with social scientific principles.² Many of the tests discussed in later chapters are an integral part of these computer programs which are at the social investigator's disposal.

² One of the more popular programs or packages is the SPSS, or Statistical Package for the Social Sciences. See Norman H. Nie, C. H. Hull, J. G. Jenkins, K. Steinbrenner, and D. Bent, *Statistical Package for the Social Sciences*, 2nd ed. (New York: McGraw-Hill Book Company, 1975), for a comprehensive description of this program.