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BOOK REVIEWS

SAMUEL S. WILKS. *Mathematical Statistics.* New York: John Wiley and Sons, Inc., 1962. Pp. xvi + 644. $15.00.

This book is an outgrowth of *Mathematical Statistics*, which was lithoprinted by Princeton University Press in 1943. There are some who have used this earlier version extensively. I have found it so useful during the years, especially in presenting material on multivariate analysis, that I had my copy bound with a hard cover. During the years, too, Professor Wilks has been developing and testing the material in his courses at Princeton.

A major content addition to the 1943 version is the inclusion of material on order statistics and nonparametric statistical inference which resulted from the author's work as Fulbright research scholar at Cambridge University in 1951. The incorporation of this and other material has led to a volume of about 600 pages of text and exercises. Another 19 pages are used in presenting a bibliography of some 423 titles (with page reference to the text) which is a very valuable feature of the book. Most of the books and articles to which reference is made deal with developments of the past quarter century and, in fact, nearly one-third of them (138) appeared in the decade 1952–1961 prior to the publication of the book.

The emphasis is on mathematical statistics rather than statistics. The objective can perhaps best be learned from a quotation from the Preface.

> No attempt has been made here to write a comprehensive treatment of the main results in this body of literature. Instead, I have made a selection of basic material in mathematical statistics in accordance with my own preferences and prejudices, with inclinations toward trying to make a unified and systematic presentation of classical results of mathematical statistics, together with some of the more important contemporary results, in a framework of modern probability theory, without going into too many ramifications.

Again,

> Some readers will wonder why more discussion was not interwoven between the mathematical results in the book and the statistical methodology which rests upon these results. Discussion of this kind has been kept deliberately at a minimal level. . . . In a fairly comprehensive book on mathematical statistics such as this it is my conviction that it would be most unwise to attempt to deal with both aspects of each topic with equal emphasis. A careful presentation of basic mathematical statistics and the underlying mathematical theory of a wide variety of topics in statistics, with just enough discussion and examples to clarify the basic concepts, such as that attempted here, is a much more feasible undertaking.

The typical reader of *Psychometrika* will probably not wish to use this book as a text but he may wish to use it for reference. For this purpose he should know the general nature of the contents.

The first chapters are on probability. As to the nature of the treatment of the material on this subject, Professor Wilks says, "Modern mathematical statistics depends heavily on the theory of probability. An attempt has been made therefore to set this entire treatment onto an adequate foundation in modern probability theory without actually constructing the foundation."

The chapter headings usually give good indication of the material covered. They are: 1. Preliminaries; 2. Distribution Functions; 3. Mean Values and Moments of Random Variables; 4. Sequences of Random Variables; 5. Characteristic Functions and Generating Functions; 6. Some Special Discrete Distributions; 7. Some Special Continuous Distributions; 8. Sampling Theory; 9. Asymptotic Sampling Theory for Large Samples; 10. Linear Statistical Estimation; 11. Nonparametric Statistical Estimation; 12. Parametric Statistical Estimation; 13. Testing Parametric Statistical Hypotheses; 14. Testing Nonparametric Statistical Hypotheses; 15. Sequential Statistical Analysis; 16. Statistical Decision Functions; 17. Time Series; 18. Multivariate Statistical Theory.

Each chapter concludes with a list of problems, many of which are essentially a continuation of the discussion of the text with pertinent comments and references. The problems themselves are theoretical in nature and do not provide, as in many texts, numerical illustrations or applications of the theory.

The objective of writing a book on mathematical statistics, at the introductory or intermediate mathematical level, which is comprehensive enough to serve as a standard work for the many subdivisions of the subject covered is a most worthy one and yet it is doubtful if any one man (or even two) can possibly condense, organize, and transmit all the accumulated knowledge and insight of the many individual workers into a treatise which is perfect. Critics of the book point out certain errors in the development of the theory and illustrations of inadequate insight or knowledge appearing in the first edition. Responses will undoubtedly be made to specific valid criticisms in later versions, but we can never expect any one man to make the best presentation of theory and knowledge in each one of the subfields of an area as broad as mathematical statistics. However, I doubt that a committee, composed of the men best qualified in the respective subfields, could do a better job in assembling the material into a unified presentation. Both theoretical and applied statisticians should be grateful to Professor Wilks for his willingness to undertake a task of this magnitude and for the resulting book.

University of Michigan PAUL S. DWYER

Howard Raiffa and Robert Schlaifer. *Applied Statistical Decision Theory.* Boston: Harvard Business School, 1961. Pp. xxviii + 356. $9.50.

In recent years a theory of statistics has taken root in which the personal opinions of the individuals who face statistical problems, as measured in terms of "personal probabilities," play a central role. This personalistic Bayesian theory is an outgrowth of the theories that have been popular during the recent decades of rapid statistical expansion, though in attaching probabilities to all uncertainties it is in seeming conflict with them. The conflict is, in principle, only apparent. Yet we partisans of the new theory anticipate radical changes in statistical practice as misunderstandings and confusion peripherally associated with the older theories are cleared away.

This book is one of the very few books that represent the personalistic Bayesian viewpoint, so anyone who has a serious interest in that viewpoint—whether friendly, neutral, or hostile—will want to study it. Many insights and facts in the book are not to be found elsewhere. The authors are able pioneers in their field and they write with verve and care. Really advanced mathematics is avoided, but the subject is such that perhaps no one will find the book easy, and many will find it quite difficult if rewarding.

Though the book is oriented toward application of Bayesian statistics, not toward a polemical justification, skeptics may find most of their criticisms answered here.

Applications are discussed in a very general spirit, but there is special emphasis on problems to be anticipated more in business than in science. To put it more technically, the keynote of the book is decision theory, or the economics of action in the face of uncertainty, in terms of specific loss functions, rather than statistical inference, the modification of opinion by data. In the authors' view, and mine, these are two harmonious ways of looking at the same thing. The emphasis on decision may dilute the book for scientific readers, though it also may lead them to ponder the important analogy between a laboratory and a firm.

Part III of the book, "Distribution theory," which is almost 150 pages long, is in effect a big technical appendix with a very high density of useful formulas and their derivations. This part contributes to making the book the nearest thing we yet have to a handbook, or manual, of Bayesian statistics, but Bayesian statistics has far to go before any handbook making a more than momentary claim to relative completeness will be possible.

The authors thought it useless to attempt an index, which somewhat impeded my first reading of the book and subsequent use of it. The notation is logical and consistent but, for me, dazzlingly elaborate. Misprints seem to be rare. A substantial one caught my eye—the second surd in the Wilson-Hilferty formula on page 223 should be a cube root. The physical make-up of the book is good, which is important in a work of such mechanical complexity.

The University of Michigan LEONARD J. SAVAGE