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Reviews

KARL HINDERER, *Foundations of Non-Stationary Dynamic Programming with Discrete Time Parameter*, Springer-Verlag, New York, N. Y., 1970, 160 pages, \$4.40 (paper)

EVER SINCE the appearance of BELLMAN's pioneering book in 1957, considerable attention has been focused on dynamic programming. Hundreds of papers have been published and several books. However, it was evident that there were some significant gaps in the theoretical structure of dynamic programming. Unfortunately, some of the early researchers seemed to be more interested in selling the technique and extending its applications than in firming up a rigorous theoretical basis. In fact, some of us remember only too well certain snide remarks about the Bourbaki mathematicians.

It was perhaps with the article by BLACKWELL in the 1962 *Annals of Mathematical Statistics* that a solid rigorous basis for dynamic programming was begun. Through the years a variety of other papers by Blackwell, DYNKIN, and others have furthered the mathematical foundations of dynamic programming. Today there is a need to pull all these results together and this book by HINDERER does just that.

This book is rigorous, set-theoretic analysis of dynamic programming, suitable for a one-semester course in a mathematics department. It is divided into two main parts. The first treats models with countable state space (an arbitrary action space), whereas in the second part models are investigated in which the state space and the action space are Borel subsets of complete separable metric spaces. All features of the optimization problem are developed in the first part, thus making it possible to concentrate in the second part on the measure-theoretic aspects of dynamic programming. Although technical students without a background in measure theory will be able to understand all proofs of the first part and then in the second part can stick to the statements of the theorems, a grounding in measure theory would make this a more viable book.

This book is published in the "Lecture Notes in Operations Research and Mathematical Series" of the Springer-Verlag Publishing Company. Thus it has been printed by the photo offset process of a typewritten page, as are all volumes in this series. There exist several errors, mostly typographical, in this book, but errata are available from the author. Including everything there are 160 compact pages.

In a way, this book reminds one of that similarly published milestone in mathematical statistics by S. S. WILKS, which for several years served as the only rigorous text for statistics. Like the monograph by Wilks, this book by Hinderer seems destined to serve an equally important role in the area of dynamic programming.

This book on dynamic programming could serve nicely as a text for a course in

dynamic programming taught in a mathematics department and, in fact, such a course would be a welcome addition to the graduate curriculum of an operations-research program.

P. H. RANDOLPH
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**B. W. LINDGREN, *Elements of Decision Theory*, Macmillan,
New York, N.Y., 1971, 292 pages, \$8.95**

ELEMENTS OF *Decision Theory* was written as a text for a course in elementary decision theory. Most of the material contained in this book has already appeared in an earlier text by the same author, *Statistical Theory*, but the emphasis here is quite different. *Statistical Theory*, as its name indicates, took a rigorous approach, concerning itself with statistics as an axiomatic, mathematically complete discipline. Although written at a college level, Borel fields and measurability were introduced as needed, and mathematical complexities beyond the scope of the book were alluded to frequently. In order to achieve this goal the book opened with a careful examination of the concepts of sample space, dependence, random variables, expectation generating functions, limit theorems, and families of distributions including Bernoulli, Poisson, normal, chi-squared, and exponential distributions. Only at this point did the author feel he had developed a firm enough basis to introduce statistical inference from a decision-theoretic viewpoint. Chapter 4 discussed classical decision theory and included such topics as convex sets, utility, the minimax principle, Bayes' solutions, dominance and admissibility, and decision making with and without data. Chapter 5 takes a decision theoretic approach to parameter estimation and Chapter 6 does the same for hypothesis testing. The remainder of the text was devoted to advanced topics in statistics such as multivariate analysis, nonparametrics statistics, regression, and analysis of variance.

In the present text the author is a lot more bold but at the same time a lot less ambitious. This change of course can be traced to the author's apparent desire to attract the less mathematically sophisticated student to a broad, applications-oriented area of study that can be attacked with a minimum of formal training in mathematics.

The first chapter, which describes convex sets, is preceded by a discussion of discrete random variables and their expectations. The treatment of utility in Chapter 2, which presents detailed methods of calculating utility values, is a lot more extensive than that found in the earlier text. Chapters 3 and 4, which deal with methods of decision making with and without data available, follow the same format and are not greatly altered from Chapter 4 of *Statistical Theory*. The author has taken care to introduce appropriate probabilistic concepts such as conditional probability and Bayes' theorem as they become necessary. Chapter 5 presents estimation and hypothesis testing from a decision-oriented point of view, eliminating some of the more esoteric aspects of these subjects such as consistency, efficiency, uniformly-most-powerful tests, and the Neymann-Pearson lemma. Chapter 6 applies estimation and hypothesis-testing techniques to the normal distribution while chapter 7 does the same for the Bernoulli model. Chapter 8 introduces game

theory, which presupposes a malevolent, conniving opponent, in contrast to decision theory where nature is pictured as being fair and indiscriminating, although unpredictable. The chapter concludes with a brief introduction to linear programming viewed as a means of solving games. The final chapter of the book introduces sequential testing procedures.

The question that arises is exactly whom this book is intended for. For future mathematical statisticians, the author's *Statistical Theory* is more appropriate. Nonmathematicians, on the other hand, will appreciate it, but might be confused by the title, which implies a familiarity with basic probability and statistics. Perhaps a more suitable name would have been "Principles of Probability and Statistics (in the Context of Decision Theory)", similar to the title of D. V. LINDLEY's well-known text, "Introduction to Probability and Statistics from a Bayesian Viewpoint." An outstanding quality of this book is the urgency it imparts as regards the applicability of the material it contains. Even for applied statisticians, stress is laid on the right facets of statistics, although the book would have to be supplemented in the following areas:

(1) Distribution theory. Certain elementary continuous distribution such as the chi-squared and exponential, are not covered.

(2) Parameter estimation. More examples taken over a broader range of distributions are required.

(3) Earlier introduction and greater emphasis on the significance of certain probabilistic concepts such as variance and higher-order moments.

With these additions, the book would be well fitted for a year's introductory course in statistics for applied statisticians and social scientists. Perhaps this will be PROFESSOR LINDGREN's next project.

ABRAHAM ENGELBERG
Polytechnic Institute of Brooklyn

Books Received

D. J. BARTHOLOMEW AND B. R. MORRIS, *Aspects of Manpower Planning*, American Elsevier Publishing Company, New York, N. Y., 1971, 130 pages, \$7.50.

P. BITTER, D. GRAEWE, H. GROSS, H. HILLEBRAND, H. OHLERT, AND D. SCHMIDT, *Technische Zuverlässigkeit*, Springer-Verlag, New York, N. Y., 1971, 227 pages, DM 39.- (paper).

MARVIN BURT AND LOUIS BLAIR, *Options for Improving the Care of Neglected and Dependent Children*, The Urban Institute, Washington, D.C., 1971, 136 pages, \$2.75 (paper).

JOHN S. CHIPMAN, LEONID HURWICZ, MARCEL K. RICHTER, AND HUGO F. SONNENSCHNEIN, *Preferences, Utility, and Demand*, Harcourt, Brace and Jovanovich, New York, N. Y., 1971, 510 pages, \$13.50.

COMMITTEE ON TELECOMMUNICATIONS, *Communications Technology for Urban Improvement*, National Academy of Engineering, Washington, D.C., 1971, 218 pages, \$3.00 (paper).

A. N. FELDZAMEN, *The Intelligent Man's Easy Guide to Computers*, David McKay, New York, N. Y., 273 pages, \$7.95.

- JOHN R. GRIFFITH, LEWIS E. WEEKS, AND ROBERT A. DEVRIES, *A Reappraisal of the McPherson Experiment in Progressive Patient Care*, School of Public Health, University of Michigan, Ann Arbor, Mich., 1971, 69 pages (paper).
- FRED W. FORBES AND PAUL DERGARABEDIAN (editors), *Technology Utilization Ideas for the 70's and Beyond*, American Astronautical Society, Tarzana, Cal., 1971, 315 pages.
- ULRICH HOFFMANN AND HANNS HOFMANN, *Einführung in die Optimierung*, Verlag Chemie, Weinheim, West Germany, 1971, 260 pages, DM 48.- (paper).
- RONALD A. HOWARD, *Dynamic Probabilistic Systems, Volume II: Semi-Markov and Decision Processes*, John Wiley & Sons, New York, N. Y., 1971, 543 pages, \$19.95.
- MICHAEL D. INTRILIGATOR, *Frontiers of Quantitative Economics*, North Holland Publishing Co., Amsterdam, The Netherlands, 1971, 400 pages, \$26.25.
- L. A. JOYS, *Comments on the Engset and Erlang Formulae for Telephone Traffic Losses*, Research Establishment, Norwegian Telephone Administration, Bergen, Norway, 1971, 127 pages (paper).
- M. G. KENDALL(editor), *Cost-Benefit Analysis*, American Elsevier Publishing Co., New York, N. Y., 1971, 328 pages, \$16.50.
- SERGE-CHRISTOPHE KOLM, *La Valeur Publique*, Dunod, Paris, France, 1970, 232 pages, 48 French francs (paper).
- , *Prix Publics Optimaux*, Dunod, Paris, France, 1970, 180 pages, 48 French francs (paper).
- , *La Théorie des Contraintes de Valeur*, Dunod, Paris, France, 1971, 196 pages, 48 French francs (paper).
- , *Le Service des Masses*, Dunod, Paris, France, 1971, 476 pages, 140 French francs.
- WAYNE LEE, *Decision Theory and Human Behavior*, John Wiley & Sons, New York, N. Y., 1971, 352 pages, \$13.95.
- P. McMULLEN AND G. C. SHEPHARD, *Convex Polytopes and the Upper Bound Conjecture*, Cambridge University Press, Cambridge, England, 1971, 184 pages, \$4.95 (paper).
- R. J. REDDING, *Intrinsic Safety—The Safe Use of Electronics in Hazardous Locations*, McGraw-Hill, New York, N. Y., 1971, 180 pages, \$12.50.
- ROBERT SCHLAIFER, *Computer Programs for Elementary Decision Analysis*, Harvard University Press, Cambridge, Mass., 1971, 346 pages, \$12.00.
- GAIL THORNLEY (editor), *Critical Path Analysis in Practice*, Tavistock publications, Barnes & Noble, New York, N. Y., 1971, 151 pages, \$6.75 (\$3.25 in paper).
- JACQUES WANTY AND ISI HALBERTHAL, *La Stratégie d'Enterprise à Long Term*, Dunod, Paris, France, 1971, 250 pages, 48 French francs (paper).
- C. F. WOODHOUSE (editor), *Progress in Soviet Science: Game Theory*, U.S. Army Foreign Science and Technology Center, Charlottesville, Va., 1971, 98 pages (paper).

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