



Management Science

Publication details, including instructions for authors and subscription information:
<http://pubsonline.informs.org>

Book Reviews

To cite this article:

(1970) Book Reviews. Management Science 16(5):402-406. <https://doi.org/10.1287/mnsc.16.5.402>

Full terms and conditions of use: <https://pubsonline.informs.org/Publications/Librarians-Portal/PubsOnLine-Terms-and-Conditions>

This article may be used only for the purposes of research, teaching, and/or private study. Commercial use or systematic downloading (by robots or other automatic processes) is prohibited without explicit Publisher approval, unless otherwise noted. For more information, contact permissions@informs.org.

The Publisher does not warrant or guarantee the article's accuracy, completeness, merchantability, fitness for a particular purpose, or non-infringement. Descriptions of, or references to, products or publications, or inclusion of an advertisement in this article, neither constitutes nor implies a guarantee, endorsement, or support of claims made of that product, publication, or service.

© 1970 INFORMS

Please scroll down for article—it is on subsequent pages



With 12,500 members from nearly 90 countries, INFORMS is the largest international association of operations research (O.R.) and analytics professionals and students. INFORMS provides unique networking and learning opportunities for individual professionals, and organizations of all types and sizes, to better understand and use O.R. and analytics tools and methods to transform strategic visions and achieve better outcomes. For more information on INFORMS, its publications, membership, or meetings visit <http://www.informs.org>

Book Reviews

editor, David W. Miller

Book Reviews Section, Graduate School of Business, 514 Uris Hall, Columbia University, New York, New York 10027

In response to the interest expressed by many members of TIMS, we shall list working papers by title and author at the end of the Book Reviews Section. Any interested author of a working paper should send a copy of it to the Book Reviews editor. Any working paper which is received by the editor will be listed without comment. It is hoped that this will provide better communication of the kind of work which is in progress and will permit direct contact among various persons who may be pursuing similar directions in their research.

PATIL, GANAPATI P., AND SHARADCHANDRA W. JOSHI, *A Dictionary and Bibliography of Discrete Distributions*. New York: Hafner Publishing Co., 1968, 268 pp., \$23.95.

This is an extremely timely and useful addition to the literature of applied probability theory. Most of us have to deal frequently with discrete probability distributions. A remarkably large number of named discrete distributions, each with one or more plausible explanatory mechanisms, is available to help in discovering the genesis of a given empirical distribution. Unfortunately, the literature is extraordinarily widely scattered and one distribution may be discussed in articles in biology, ecology, bacteriology, electrical engineering, and still other fields. Because of this, many of these distributions have been independently "discovered" several times—the workers in one field being unaware of the derivations from the same model in other disciplines. The need for a guide to the literature dealing with these distributions is, therefore, acute and we must all be in the debt of Professor Patil and Mr. Joshi for providing us with this book.

There are three chapters. Chapter 1 is "A Dictionary of Discrete Distributions and Their Inter-relations." After a few pages on notation there is an alphabetical index of the 111 distributions covered in the dictionary. For each of these distributions the dictionary then offers a brief description which typically includes the genesis of the distribution, the explicit density function, the generating function, and the mean and variance. In addition, a goodly number of the inter-relations of the given distribution with others are indicated.

Chapter 2 gives the bibliography. There are 144 pages and 2904 bibliographic entries. In addition to the obvious bibliographical information included, reviews of the publication cited are given whenever there was a review in one of the standard review journals. Further, whenever a publication is cited as a reference in another publication, then the latter is cited as a user of the former. This inclusion of the "users" of each entry, where appropriate, is a most valuable feature of this bibliography. Finally, a great many of the entries are classified in three ways: by distribu-

tion, by statistical inference, and by fields of application. For purposes of this classification the authors have taken 44 specific distributions (e.g., compound Poisson), 22 kinds of statistical inference, and 8 fields of application. Of course, each of the three categories includes a "miscellaneous" category. Thus, to give an example, a famous article by Fisher, Corbet, and Williams has the classification LS:mb-pe-gf:BM. Translated, this means that the article discusses the logarithmic series distribution; that it deals with model building, point estimation, and goodness of fit; and that it considers applications in biology and medicine. These classifications are very helpful and I have already saved some hours of search in the literature by using them.

Chapter 3 is "A Classification According to Distributions and Inference." This gives a cross-classification of the bibliographical entries by the 22 kinds of statistical inference as applied to each of the 44 classes of distributions. Thus, suppose one is interested in the moments of the logarithmic series distribution. Reference to this chapter shows three articles dealing with this subject, at least in part. Of course, one may find that the articles discuss cumulants or factorial moments and one is interested in, say, absolute moments but the general usefulness of this cross-classification is clear. It should be noted that one of the classes under "statistical inference" is model building, which includes all derivations of discrete distributions under suitable assumptions. The general importance of this particular classification to management scientists is obvious and Chapter 3 provides means for quickly discovering, for example, six articles which offer models leading to the logarithmic series distribution.

The outstanding merits of this book ought to be clear from the description above. Still, I think some things could have been included which would have enhanced its usefulness. I suspect that many users of this book will not be experts in the relevant areas of probability theory. Therefore, it would have been helpful if some important general information had been included. For example, many of these distributions are mixed or generalized distributions. Surely it would have been appropriate to include brief discussions of these processes for generating distributions rather than the one-line definitions given presently. Some of the general mathematical relationships which exist between the various kinds of generating functions of the mixing distribution and the resulting mixed distribution, for example, could have been given. Many of these distributions have very complicated density functions and it is sometimes easier to calculate the distribution by deducing some recursive relations between the probabilities. A brief discussion of this question might have been worthy of inclusion. Again, one of the major motivations for attempting to use these distributions in practice is the fact that a given empirical distribution is highly skewed. It would surely have been helpful if measures of skewness had been given for the various distributions. Indeed, the first four moments of each distribution might have been the objective to be given rather than just the first two. Finally, it would have been helpful if existing tabulations of distributions had been noted.

However, I want to emphasize that the comments of the preceding paragraph are intended to be suggestions for possible improvements rather than criticisms. The book is enormously useful as it is. Most quantitative analysts will want it for inclusion in their working library.

SEAL, HILARY L., *Stochastic Theory of a Risk Business*. New York: John Wiley & Sons, Inc., 1969, 210 pp., \$14.95.

When an expert undertakes to organize and summarize everything that has been done in a well-defined problem area, the result is likely to be an important book.

Professor Seal has done exactly this for the stochastic theory of risk business and this excellent book is the outcome of his efforts. In his preface the author states that he attempted "to survey all the literature relating to the mathematical foundations of risk taking as a business." In this book he summarizes what he found with clarity and despatch.

In a short introductory chapter the author tells us that by risk businesses he means such activities as a gambling casino, an employer who has guaranteed to pay his employees' medical expenses out of a trust fund set up for that purpose, a fire insurance company, or a life insurance company which issues only short-term policies. Almost all of his examples, however, are drawn from the insurance business because most of the mathematical theory has been developed in the insurance context.

Chapter 2 is devoted to "The Distribution of Aggregate Claims." Various approaches have been tried in the attempt to describe adequately the claim distribution. One approach is to try and relate the observed claim outgo for a year to the total amount insured for the year. Pearson Types I, III, and IV, and the lognormal distribution have been used to fit the empirical data. Another approach attempts to classify the claims into appropriate categories and then to "relate each group of claims to the corresponding exposure." This has been used particularly in life insurance, where the age of the insured is the major basis for classification. A third approach uses generalized distributions: assume that the probability distribution of size of claim is independent of the probability distribution of number of claims. The Poisson and negative binomial distributions have been often used for the distribution of number of claims. Mixed Poisson distributions have also been used and the question of contagion or accident proneness is a critical one. For the distribution of size of claim the lognormal, Gompertz, Pareto, and mixed exponential distributions have been used. There is a fairly lengthy summary of the efforts which have been made to deduce the explicit probability density function of total claims, given the two separate distributions of number of claims and size of claim.

Chapter 2 covers the outgo and Chapters 3 and 4 deal with income. Professor Seal distinguishes between the net premium which is intended to cover, for all contract holders, the mean outgo and the risk loading or "house cut." Chapter 3, "Calculation of 'Fair' Net Premiums," is devoted to the former. This involves such topics as the classification of risks, experience rating of a whole portfolio by payment of dividends, experience rating of individual contract holders, the reclassification of individual contract holders into "good" and "bad" risks, and experience rating by credibility indices.

Chapter 4, "The Probability of Ruin of a Risk Business," begins the discussion of the size of the risk loadings. Obviously, the risk reserve of the business is depleted by claims paid and increased by the risk-loaded premiums received. Therefore, the size of the risk loading is the major determinant in avoiding ruin. Professor Seal begins by developing the probability of ultimate ruin with equal sums at risk. After a discussion of the discrete-time case (random walk), he determines the probability of ruin before time t and deduces some asymptotic values for the moments of the time to ruin. There is a section on annuity or pension funds and a development of some of the results by direct solution of the renewal equation. This chapter requires somewhat more advanced mathematics but as the author notes in his preface: "However, those who find this theory hard going may console themselves with the thought that until the last 10 years the results could only be derived by even more difficult and circuitous methods."

Chapter 5 is on "Premium Loading and Reinsurance." Clearly, an alternative to increasing the risk loadings is to change the probability distribution of the aggregate

outgo. This can be done either by rejecting large individual risks or by reinsuring part of the portfolio. The three usual kinds of reinsurance contract are quota reinsurance (a fixed proportion of every individual sum insured is reinsured), excess-loss reinsurance (all amounts insured in excess of some predetermined amount are reinsured), and stop-loss reinsurance (any aggregate claims in excess of a "priority" amount are paid by the reinsurer). Sections on the mathematical theory of each of these are included in this chapter.

Chapter 6 is on "Utility Theory and Its Application to Reinsurance and Profit Prospects." The questions of the effect of the utility index of a risk business (or of the company directors) on optimal reinsurance policies are considered. In particular, the question of reciprocal reinsurance treaties is discussed. There are two appendices: one is on renewal processes and the other is a very good summary of procedures for the numerical inversion of Laplace transforms.

The book is very well organized and the exposition is clear, although quite fast moving and succinctly stated. It is not intended as a text and there are no problems. Most management scientists have to deal at one time or another with some of the questions discussed by Professor Seal and an increasing number are directly involved with some of the problems of risk businesses. Such persons will surely want to read this excellent book.

WHITE, D. J., *Dynamic Programming*. San Francisco: Holden-Day, Inc., 1969, 181 pp., \$10.50.

This is a skillful exposition of dynamic programming. The importance of the subject surely justifies various books dealing with it and several quite good ones have recently appeared. However, Professor White's presentation does not suffer from comparison with any other book dealing with dynamic programming. The whole subject has a Protean diversity and this permits a considerable variety of expository approaches. Which one is preferred is probably mainly a question of taste so I will simply state that I find Professor White's approach more illuminating than the others with which I am familiar.

After an interesting short introductory chapter, Chapter 2 is on "The Optimal Path Problem." The author tells us that his reason for devoting an entire chapter to this problem is that it typifies in many ways "the whole D.P. area, both conceptually and computationally." He demonstrates this by illustrating, in the context of this problem, the functional equation approach, the principle of optimality, the three main computational algorithms, backward and forward formulations, and other things as well.

Chapter 3 is on "The Nature of Dynamic Programming." In addition to stating the basic characteristics of D.P. problems this chapter is intended to help in understanding how to formulate problems in D.P. form. After introducing sequentially controlled systems, there are definitions and discussions of some key concepts: state, decision, transformation, stage, measure of performance (path values), and policy. The crucial functional equations are developed, three postulates needed for the application of D.P. are presented, and D.P. is applied to classical optimization problems.

The remaining three chapters deal respectively with systems of levels 0, 1, and 2 (deterministic, stochastic, and adaptive). Chapter 4, "Deterministic Processes," covers allocation and assortment problems, long-term planning problems such as optimal equipment replacement policies, multi-stage production processes such as a multi-stand rolling mill, and sequencing problems. There is an interesting section on the advantages

of D.P. as compared to the calculus of variations and to the use of Pontryagin's maximum principle.

Chapter 5 is on "Stochastic Processes." There is a discussion of Howard's algorithm for finite discrete Markov processes. Professor White concludes, to my surprise, "One can therefore see that the connection between D.P. and Howard's results is very tenuous." There is a section on processes involving choice of the decision interval. One example of this is the old problem of sampling the output of a continuous production process (without feedback). There are discussions of stochastic constraints; approximations using expectations, with the author telling us that numerical experimentation "has shown sensational reductions in computational time using this method to generate an initial policy"; and control processes with probabilistic duration—the essential feature being that the process terminates when some specified event occurs. There is a very interesting section on D.P. and investment analysis in which the author surely makes his point that "D.P. can be used to analyse some of the conceptual difficulties arising in investment problems."

Chapter 6 is on "Adaptive Processes." These are cases where "the parameters themselves are subject to stochastic laws and can be modified as information is acquired from stage to stage." Such a problem is "a mixed learning and optimising type problem." There is a section contrasting the use of D.P. with the statistical decision function approach and another section which discusses the usefulness of sufficient statistics in reducing dimensionality. The examples are interesting ones: large batch sampling, an adaptive version of the economic lot-size problem, a pricing problem, a capacity expansion problem, and a search problem.

There are six appendices, one for each chapter, in which some of the relevant proofs are given. This book was not intended as a text and there are no problems. However, the exposition is very clear, the examples are well chosen, and the mathematics is not excessive. Anyone who wants to learn something about D.P. will find this book a good one for his purposes. And most persons who already know and use D.P. will find it well worth reading.

All unsigned reviews are written by the Book Reviews editor.