Operations Research

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

The Analyst's Bookshelf

To cite this article:
(1966) The Analyst's Bookshelf. Operations Research 14(2):351-357. https://doi.org/10.1287/opre.14.2.351

The Analyst's Bookshelf

Reviews

ANGEL VEGAS, JOSÉ M. FERNÁNDEZ PIRLA, SIXTO RIOS, JOAQUIN TORRENS-IBERN and others, *Reuniones Nacionales sobre Investigacion Operativa*, Instituto Nacional de Racionalizacion de Trabajo (Departamento de Organizacion Cientifica), Serrano, 150 Madrid (6), Spain, 1965, 510 pages, 250 pesetas (paper)

THIS impressive and well-printed collection of 33 papers on operations-research techniques and their application to specific military, social, and industrial problems of interest to the Spanish nation, is the proceedings of a December 1962 symposium sponsored by a National Institute dedicated to the application to the Spanish economy of work rationalization techniques of all kinds, from the early efficiency engineering efforts of Taylor to the most recent applications of PERT. The volume, or separate preprints, were distributed to the participants before the meeting. Presumably the papers, some of which are quite long and detailed, were presented orally in abridged form, and then laid open to discussion. Those parts of the discussion which are appended to each paper in this volume are of as high quality as the papers, and are distinctly worth having. The symposium must be considered to have been a great success.

Although the reviewer has been in communication with a few eminent Spanish-speaking operations analysts, especially in South America, his principal reaction to the volume under review has been one of surprise at his own relative unawareness of the large number of well-informed, ingenious, and resourceful operations-research practitioners who appear to flourish in Spain; and the breadth of the opportunities they are already realizing to make contributions to industry and government. Although a few of the papers in this volume are of a general explanatory nature only (invariably distinguished by great clarity), and a rather small group are no more than applications of statistics or of computer programming, the great majority qualify as operations research in terms, for example, of the definition implied by the terms of the ORSA Lanchester Prize award. Many of the papers could well be published in this JOURNAL, to which some would bring novel treatments of refreshingly unfamiliar problems.

Practically all of the standard techniques are represented, including various methods of simulation. It is in the applications that novelty is sometimes found. Thus, one of the six papers on military applications deals with promotion in rank; one of the public administration problems is concerned with the proper method of redistributing equitably ownership by a single individual of many small parcels of various types of land so that larger more economic units result, without loss or gain in the value of the holdings by any individual. More familiar applications are to be found in quality control and economical testing, railway operation, coal-mining, administration, queuing theory in manufacturing, inventory control, cost-minimi-

zation, order quantities, warehouse and other distribution problems, telephone traffic analysis and optimization, and marketing. The problems for the most part are real. Actual work has been done, and decisions influenced.

Most of the papers are characterized by unusual clarity of exposition. The reviewer was pleased by an exhortation by the host that operations-research efforts should be directed toward the alleviation of real situations rather than at exercising pointless mental agility. Perhaps others besides the reviewer will be interested in learning (p. 336) that the most extensive table of random numbers available is one based on the Spanish national lottery.

JACINTO STEINHARDT
Georgetown University

LEONARD KLEINROCK, *Communication Nets: Stochastic Message Flow and Delay*, McGraw-Hill Book Company, New York, N.Y., 1964, 221 pages, $12.50

KLEINROCK classifies flow problems into four kinds: (1) steady flow through a single channel, (2) stochastic flow through a single channel, (3) steady flow through a connected network of channels, and (4) stochastic flow through a connected network of channels. He characterizes the first kind of problem as trivial, the second kind as the principal subject of traditional queuing theory, and the third kind as the concern of network flow theory and certain work in mathematical programming. The fourth kind, distinguished by the relatively meager attention it has so far received, is the subject of his monograph.

The reason for the meager attention becomes clear when Kleinrock begins his formal analysis. To keep the problem tractable and within mathematical bounds, he makes a series of assumptions, all within the context of a store-and-forward communication net:

1. Noiseless channels and perfectly reliable nodes and channels.
2. Negligible cross-office delays.
3. Restriction to message traffic.
4. Single destination for each message, with no defections.
5. Infinite storage capacity at each node.
6. Full reception of message before retransmission.
7. Poisson arrival statistics.
8. Exponentially distributed message lengths.
9. Stationarity and independence in 7 and 8.

Even this list of simplifications does not quite succeed in taming the tiger. The final and loudest crack of the whip is another independence assumption, this one inside the net; it has the effect of assigning a new randomly-drawn length to each message every time the message changes nodes in the net. This assumption permits the problem to be partitioned, and allows each channel to be considered separately.

Kleinrock describes the general problem treated as a constrained optimization problem; that is, the minimization of average message delay with respect to the channel capacity assignment, the routing procedure, the priority discipline, and

the network topology, subject to the constraint of a fixed total channel capacity assigned to the net. Among the results of the investigation is a formula for the optimum channel capacity assignment and another for the corresponding average message delay implied by this assignment. Reasons are given for the desirability of concentrating traffic into a small number of high-capacity channels. The degree of concentration of traffic and the average length of the path of a message are both important factors in determining average delay.

Kleinrock supplemented his analytical work by experimental simulations on the TX-2 computer at Lincoln Laboratory. His experiences on the computer left him positively disposed, and he termed it an "indispensable tool in this investigation." The simulations provided a test of the internal independence assumption, a check on the analytical results, and a vehicle for relaxing the assumptions required by the mathematics. They also served to suggest and guide further analytical work. The computer's value in the study is explained partly by the fact that the TX-2 is operated by the user himself, sitting at a console with excellent graphical display facilities available. A simulation can be interrupted on-line at any time, results studied, decisions made, parameters changed, and the simulation continued. These features are now becoming available on time-shared computer systems.

Speaking of time sharing, in a chapter on priority procedures, Kleinrock treats analytically the round-robin algorithm that is used in the scheduling of a number of time-shared systems; but, unfortunately, his model is not detailed enough to offer practical guidance to system designers. In particular, he assumes an infinite number of consoles, and he postulates request lengths that are discrete multiples of the quantum size. He also neglects the overhead caused by segmenting requests, and this can be very considerable.

That the monograph is based on an MIT doctoral thesis, as stated in the preface, will be clear to anyone accustomed to the format of these theses: Introduction, Summary of Results, . . . , Conclusions, Suggestions for Further Investigation. The format is actually not an unpleasant one, however, except perhaps for its tendency to encourage a level of redundancy somewhat in excess of that necessary for efficient transmission of information.

MARTIN GREENBERGER
Massachusetts Institute of Technology

IRWIN GUTTMAN and SAMUEL S. WILKS, *Introductory Engineering Statistics*, John Wiley & Sons, Inc., New York, N.Y., 1965, 356 pages, $7.95

THE LATE beloved PROFESSOR SAM WILKS (who was a primary originator of the OPERATIONS RESEARCH SOCIETY OF AMERICA) collaborated with another excellent statistician, PROFESSOR GUTTMAN, to produce this elementary textbook for engineers. It might best be described as the classical introductory course, beginning with elementary probability, discrete distributions, the concept of sampling, and the normal distribution, and then going into estimation problems and statistical tests based on sampling distributions derived from the normal distribution. The later chapters deal with order statistics, nonparametric tests, regression analysis, and analysis of variance. Two of the sixteen chapters give the

book its engineering turn: one on acceptance sampling and one on control charts. Also, an attempt has been made throughout the book to give an engineering flavor to many of its 240 problems. The book is arranged so that it may be used for a one- or a two-semester course.

The treatment is elementary, although the knowledge of first-year calculus is presumed. Simple derivations are included in the text and more complicated ones put in an appendix; worked-out numerical examples appear throughout the book; and well selected problems both drill and expand the text material. The book reaches through regression with two independent variates, analysis of variance for a two-way replicated experiment, analysis of variance for Latin squares, rank and run tests, the F test, simple sequential ratio tests, and distribution-free tolerance limits. The book is brief—the density of equations is high—and accuracy, rigor, and carefulness of phraseology distinguish it.

Many schools of engineering will regard this as one of the best texts available. These are the schools which believe that the most valuable training in a subject comes from digging into it in depth and developing a proficiency in some of its methods and techniques. With this kind of solid introduction, the student is well prepared to cope with the next level of material should the occasion later arise for him to do so either in or out of college.

Another school of thought with respect to engineering education will not care for the book at all. This school argues that engineers have time for only one statistics course and therefore that depth must be sacrificed for breadth—otherwise the students will have no grasp of the many ramifications of statistics in engineering, and hence will be unable to recognize those occasions that will arise later in their careers when they must, in truth, master a particular statistical technique. Advocates of this philosophy would seek a textbook that introduced the students to the basic ideas of probability and statistics and then proceeded forthwith to introduce safety factors for structures in the face of variability in the strength of materials and cost or weight limitations, reliability of complex mechanisms, communication in the face of noise and the fundamental concepts of information theory, spectral analysis, simple Markov and Gaussian processes, queuing processes and stochastic programming, and perhaps even statistical and quantum mechanics and indeterminacy.

A third kind of book might be patterned somewhat after PROFESSOR SNEDECOR's gem for the biological sciences. It would (1) concentrate wholly on significant engineering problems and go into a few of them in some depth with more and more sophisticated analyses, and (2) devote a substantial portion of the course to careful explication of the assumptions behind the analyses, the occasions in engineering when they are nearly satisfied and when they are not, and the pitfalls one must avoid in applying the techniques—in short, the impact of the engineering facts of life on conventional statistical methods.

If I had been trying to write an introductory engineering statistics text I would probably have attempted all three approaches at once and struggled to a hodgepodge nobody would have. On the other hand, Guttman and Wilks selected a limited objective that they reached easily and unscathed.

ALEX M. MOOD
Department of Health, Education and Welfare

GIUSEPPE M. FERRERO DI ROCCAFERRERA, *Operations Research Models for Business and Industry*, South-Western Publishing Co., Cincinnati, Ohio, 1964, 1122 pages, $18.00

THIS large volume is intended primarily for managers and potential managers, who, the author believes, should know something about operations-research models. It is contended that managers can use OR models without being highly trained in mathematics or statistics in much the same way as one can drive an automobile without understanding the functioning of its engine. Certainly, many OR practitioners would welcome increased understanding of operations research by their managers, since the acceptance and use of their models depend upon the managers' evaluations. It is doubtful whether many busy managers will find time to read this large book, but the potential managers now in business schools *can* be required to study it, and then they should know something about OR models. However, the mastery of this book alone will not enable any manager to construct, select, or test OR models without the assistance of a competent OR practitioner who is sufficiently well trained in mathematics and statistics.

The volume is composed of eight parts: *Introduction*, *Curve Fitting and Forecasting*, *Elements of Mathematics*, *Mathematical Models*, *Linear Programming* (three parts), and *Queuing Theory*. There are also extensive tables and illustrative notes. The treatment of the subject matter is largely descriptive, with many numerical examples worked in great detail. There is also some theoretical background for some of the models.

The introduction (33 pages) gives a capsule account of the development of scientific management and the use of operations research in the firm. Operations research is described as a tool that enables the decision maker to be more objective in choosing a course of action, and the significance of OR models is made fairly clear. The background and antecedents of operations research are given, but with some inaccuracies; for example, reference to the early military applications is neglected, and the term *operations research* is erroneously ascribed to McCLOSKEY AND TREFETHEN. The author refers, quite properly, to the desired collaboration between the responsible man in operations research and managers who are seeking solutions to particular problems. Yet he states that a manager responsible for the administration of a firm ordinarily performs his duties in a staff position, and, throughout the book, continually refers to the manager collecting and analyzing data, and selecting and solving OR models. It is not correct to assume that the manager will personally carry out specialist staff work such as OR, or that the OR practitioner or group will directly manage the firm.

The section on curve fitting and forecasting (156 pages) contains an elementary treatment of business statistics, covering time trends, regression analysis, histograms, and some theoretical distributions, but neglecting sampling and expected value, which are also important to OR. Applications of the models and methods presented are generally given, but little basic understanding is made available to the reader.

The section on elements of mathematics (168 pages) covers determinants, vectors, matrix analysis, and set theory. The treatment here is primarily numerical with geometric displays, and, as such, is quite satisfactory. However, it is not

shown to be related to the theme of the book, and no business examples are given.

The section on mathematical models (34 pages) covers input-output analysis and inventory models. The chapter on input-output analysis shows how business results depend upon an interlocking economic structure. Certainly, the welfare of a single firm depends upon its economic climate, but the manager will need to know much more than the contents of this small chapter. There is no attempt to show how OR can be helpful in input-output or other economic analysis. The chapter on inventory models shows the effects of inventory policy on business results, but it is too short and very elementary, especially for this most prolific area of operations research.

The section of three parts on linear programming (507 pages) is the principal work of the book and it tends to be very inclusive. However, it is much too long for the subjects covered. Most of the length is caused by the worked examples for many slightly different models presented without much generalization. The subjects include the transportation model (205 pages), the simplex method, revised simplex, duality, dynamic linear programming, and degeneracy. There is another review of vectors and matrix algebra, and a slight mention of dynamic programming, which seems to be confused with dynamic (stagewise) linear programming. The treatment is very uneven, including excessive numerical work on the one hand, and unnecessary theory (such as the epsilon method for degeneracy) on the other.

The section on queuing theory (113 pages) includes examples of queuing, development of differential equations for Poisson arrivals and exponential service, a statement of queuing formulas (mostly without derivation) for several queuing systems, a number of numerical examples, and an exposition of the Monte Carlo procedure for solving queuing problems. The presentation is straightforward and satisfactory for the level of this book.

There is no treatment of OR models dealing with replacement, maintenance, sequencing, routing, networks, game theory, or competitive strategies, almost no treatment of dynamic programming models, and insufficient treatment of inventory models.

This volume impresses one as a collection of somewhat disconnected books giving different emphasis to each of the subjects covered, and, in spite of its size, not adequately covering the entire field of OR models. Of course, the business student will learn something about OR models from the study of this book, and it is possible that more teaching experience will lead to improved revisions of it. The objectives remain worthy, but, so far, the old standby introductory books on OR should not be considered to be displaced by this book.

GIFFORD H. SYMONDS

CLAUDE BERGE and A. GHOUILA-HOURI, *Programming, Games, and Transportation Networks*, John Wiley and Sons, New York, N.Y., 1965, 270 pages, $8.75

THIS BOOK is an English translation by MAXINE MERRINGTON AND C. RAMANUJACHARYULU of the book *Programmes, jeux, et réseaux de transport* by the same authors published in 1962 and reviewed in this journal, **11**(1963), page 286. This new version appears to be a very close translation.

Subsequent reflection on our earlier comments leads to one revised opinion: We regret mentioning a bifurcated book. Better to speak of two treatments of the same subject from different viewpoints. Mastery of this kind of diversity is one of the best ways really to understand a topic, and presentation of the first and third items in the title in such a double manner makes this an unusually fine book.

It is fair to warn the reader whose prime interest is games that this is not the book for him. There is but one relevant chapter that covers only the rudiments of finite, matrix games. It is there because its treatment appends nicely to the main business of the book rather than of its intrinsic interest.

RUFUS ISAACS
Center for Naval Analyses

N. PAUL LOOMBA, *Linear Programming: An Introductory Analysis*, McGraw-Hill Book Co., New York. N.Y., 1964, 300 pages, $7.95

THE PURPOSE of this introductory text is to describe, analyze and explain the basic elements of linear programming to the beginning student. The reader's mathematical background is stipulated to be a course in high-school algebra. The author adopts what he terms an 'integrated approach' to explaining LP, i.e., using the same LP problem throughout, he describes how to solve linear programming problems by the graphical method, systematic trial-and-error methods, the vector method, and the simplex method. An economic interpretation is also offered. The hope here is to bring the reader along in easy stages and indicate how the mechanics and economic interpretations relate to each other.

The chapters are *Linear Programming and Management*, *The Graphical Method*, *Systematic Trial-and-Error Method*, *Matrices and Vectors*, *The Vector Method*, *The Simplex Method*, *The Dual*, *Degeneracy*, *The Transportation Model*, *The Assignment Model*; there are five appendices that cover linearity, linear inequalities, and linear equations. A set of problems and a short bibliography are included.

Because it lacks any mathematical vigor, this book would not be recommended for the general operations-research community. A beginning student, however, would find it useful in gaining some insight into the nature of linear programming and its scope.

SAUL I. GASS
IBM Corporation

Books Received

ROBERT N. ANTHONY, *Planning and Control Systems: A Framework for Analysis*, Division of Research, Graduate School of Business Administration, Harvard University, Boston, Massachusetts, 1965, 192 pages, $4.00.

CLAUDE BERGE AND A. GHOUILA-HOURI, *Programming, Games, and Transportation Networks*, John Wiley & Sons, New York, N. Y., 1965, 270 pages, $8.75. An English translation by MAXINE MERRINGTON AND C. RAMANUJACHARYULU of a book published in French in 1962 and reviewed in this JOURNAL by HAROLD ISAACS, **11** (1963), page 286.

EDWARD C. BRYANT, *Statistical Analysis, Second Edition*, McGraw-Hill Book Co., New York, N. Y., 1966, 331 pages, $7.95.