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The Analyst's Bookshelf

Hugh J. Miser, Editor

Reviews

ALAN S. MANNE and HARRY M. MARKOWITZ (editors), *Studies in Process Analysis: Economy-Wide Production Capabilities*, John Wiley and Sons, New York, N. Y., 1963, 427 pages, $14.00

THIS book is Cowles Foundation Monograph 18, and it contains the proceedings of a conference sponsored by the Foundation that took place at Yale University in April of 1961.

The term *process analysis*, as it is used in this book, was chosen to identify studies that approach the analysis of industrial capability through models reflecting the structure of the productive processes. However, not all such models are classified as process analysis, since conventional requirements calculations of critical resources and input-output analyses, for example, are ruled out on the basis that they do not permit consideration of alternate inputs per unit of output. Though not required by definition, the principal tool of process analysis, as indicated by the case histories in this volume, is linear (or slightly nonlinear) programming. In view of the unusual interest and outstanding accomplishments of this volume, the complete contents are listed below, with brief abstracts accompanying most of the chapter listings.

Part I: Scope and Method of Process Analysis

This part contains three chapters, all by the editors: *Introduction*, *Alternate Methods of Analysis*, and *Problems and Potentials of Process Analysis*.

Part II: Petroleum and Chemicals: Production, Transportation, and Plant Location

After a *Glossary of Technical Terms* compiled by MANNE, there follows Chapter 4, *A Linear Programming Model of the US Petroleum Refining Industry*, also by Manne, which presents a static nonspatial model of the US petroleum refining industry. Refinery products are aggregated into 14 distinct end items: refinery gases of various grades, naphtha, fuel oils, lubricating oils, and gasolines. These end items are produced from inputs and intermediate products subject to constraints on equipment capacity, raw-material availability, fuel specifications, etc. In all, this amounts to a problem in 205 variables subject to 105 constraints with 1500 nonzero coefficients. Calculations were carried out aimed at determining the extent to which an increase in the production of jet fuel would necessitate a decrease in the production of other output products; they were carried out twice, once with full 1953 productive capacity and once with capacity reduced to 47 per cent. Results are presented in the form of trade-off curves between jet fuel and the 1952–53 standard product mix. It turns out that, in the neighborhood of the historical

production mix, additional jet fuel could be substituted for other refinery products in a ratio of about six-tenths of a barrel of jet fuel to one barrel of the standard product mix without jet fuel. However, the production of jet fuel becomes increasingly expensive in terms of the standard product mix as more and more of the output capacity is converted.

Chapter 5, *A Spatial Model of US Petroleum Refining*, by THOMAS A. MARSHAK, presents an extension of the nonspatial model described in the previous chapter. In the interests of keeping it within bounds, the basic model was reduced by further aggregation from 105 to 39 rows. As a check, the calculations were then repeated. The trade-off curves turn out to be numerically similar to those in Chapter 4 except in the vicinity of the maximum substitution of jet fuel, where, as might be expected, since there are fewer constraints, the reduced model permits more efficient conversion. A spatial dimension comprising four regions (Pacific Coast, Gulf States, East, and Midwest), together with intraregional and interregional transport of various types, is then added to the reduced model, bringing its size up to 1656 columns and 195 rows. Two applications of this spatial model are then exhibited: the first is the maximization of the spatial product mix subject to 1952–53 refining and transportation capacity restraints (the resultant figure is close to that obtained historically), and the second is the computation of the maximum amount of spatial product mix attainable with two alternative reduced tanker availabilities. The chapter concludes with two appendixes: one discusses from a mathematical point of view the general problem of aggregation in linear programming models, and the other derives the coefficients of the intraregional transportation model.

Chapter 6, *Chemical Processes, Plant Location, and Scale*, by THOMAS VIETORISZ AND ALAN S. MANNE, although belonging to the same part of the book, treats a completely different problem: the location of synthetic fertilizer plants within the Latin American regional market. Specifically, the problem is to select sites and sizes of plants to supply fertilizer to 12 market regions, where the sites are constrained to be selected from five potential site locations. If desired, a plant may be partitioned into two stages, an ammonia production stage and a fertilizer production stage, which need not be located at the same site. Since a plant of each of the two types may either exist or not at each of the five potential sites, 10 variables are constrained to have zero-one solutions, and the problem is of the mixed integer-programming type. All of the 1024 locally optimal solutions were enumerated and plotted in order of increasing costs. It turns out that the minimum corresponds to a single integrated plant at one specific site, but that the cost function is very flat in the neighborhood of the minimum, indicating that many of the remaining 1023 solutions are almost as good.

Part III: Food and Agriculture

Chapter 7, *Spatial Programming Models to Specify Surplus Grain Producing Areas*, by EARL O. HEADY AND ALVIN C. EGBERT, presents five related models for determining the optimal allocation of wheat and feed-grain production among the various geographic regions of the United States. The first model determines how much of each of three crops (food wheat, feed wheat, and other feed grains) should be raised in each of 104 geographic regions in order to meet national demands and

minimize the total costs of production. The other models differ from it in the items included in the costs, the manner in which the restrictions on acreage are derived, the number of categories into which the grains are aggregated, and the inclusion of transportation costs and local demands. All models are solved numerically, and shaded maps showing the resultant patterns of production are presented. The authors feel that their results and extensions of them could provide firm bases for national policy formulation in withdrawing land from crop production.

Chapter 8, *Spatial Price Equilibrium and Process Analysis in the Food and Agricultural Sector*, by KARL A. FOX, considers models involving the relations among price, consumption, and production of each of a set of farm commodities in each of a number of different geographic regions. It first considers a previously published model involving a single commodity with predetermined regional supplies, and then a model involving two independent commodities and 10 geographic regions—60 variables (one each for price, consumption, and production of each commodity in each region) and 60 constraints in all. An example of the numerical solution of the latter model is given. Finally the author makes a case for the construction of a model with 20 commodities and 100 regions that would involve 6000 equations. In addition, 20 transportation models, each with 9,900 price-differential equations, would have to be solved separately.

Part IV: Metals and Metalworking

Chapter 9, *Process Analysis of the US Iron and Steel Industry*, by TIBOR FABIAN, describes a model of the US iron and steel industry and discusses its potential use as a general-purpose tool for management. The model is static, and represents the iron and steel industry as one completely integrated steel plant. The exact equations of which the model consists are not written out explicitly, the reader being referred instead to an article by the author in *Management Science*. However, all of the technological coefficients are given. There is no indication as to the extent to which the model has been applied numerically.

Five chapters by the editors follow, all of which deal with the metalworking industries: Chapter 10, *The Metalworking Industries;* Chapter 11, *Metalworking Requirements Analysis;* Chapter 12, *A Machine-Tool Substitution Analysis;* Chapter 13, *Future Metalworking Analysis;* and Chapter 14, *Statistical Appendix on Metalworking*.

Chapter 10, giving background information, serves as an introduction. It covers, among other topics, definitions and classifications of materials, operations, equipment, occupations, and products.

One of the limitations of requirements analysis as usually conducted is that it ignores indirect requirements—i.e., requirements of resources for intermediate rather than end products. Chapter 11 develops a mathematical method for estimating total requirements, both direct and indirect, on the basis of sales from one metalworking industry to another, and between each metalworking industry and each other industry. The chapter also discusses the application of historical usage records to the determination of direct requirements, and develops a mathematical method for evaluating total programs in terms of requirements estimates, however obtained.

Chapter 12 treats a modification of the classical assignment problem applied to the machine tool industry. Given the productivity of a number of different types of machines on each of a number of different tasks, given the unit operating costs and availabilities of the machines, and given also the option of purchasing additional machines at specified costs, what is the minimum-cost assignment of machines to tasks? The problem involves 115 machines, 142 tasks, and 1200 machine tasks, and gives rise to a linear programming problem of 257 equations in 1200 variables. The assembly of data, the numerical solution, and the interpretation of results are discussed.

Chapter 13 discusses briefly and qualitatively the potential applications of simulation techniques to the metal-processing industries while Chapter 14 gives extracts from extensive tables of data used in the analyses described in Chapters 11 and 12.

Chapter 15, *Alternative Approaches to Metalworking Process Analysis*, by THOMAS VIETORISZ, compares the Markowitz-Rowe metalworking models described in the last 5 chapters with alternative metalworking models used by the Soviet Machinery Industry Study of the University of North Carolina. Basically, the Markowitz-Rowe models deal with tasks performed by individual machine tools, while the University of North Carolina models deal with the capabilities of aggregates of tools called 'resource elements.' While lacking the specific detail of the Markowitz-Rowe models, the North Carolina models permit a more general type of substitution. The author of this chapter proposes a more generalized model yet, including as special cases both the Markowitz-Rowe models and the North Carolina models: Specifically, the generalized model would break out specialized, outsized, or otherwise scarce machinery, while aggregating other machines into resource elements. It would thus be particularly suited for identifying bottlenecks on scarce machinery and for the study of problems in the organization of aggregates of machine tools.

Part V: Programming of Economic Development

Chapter 16, *Key Sectors of the Mexican Economy, 1960–70*, by ALAN S. MANNE, summarizes the work of a Mexican study group in which the author participated in the summer of 1961; it was concerned with the construction and use of an aggregate planning model of the Mexican economy. Its work resulted in a linear programming model of 156 nonslack variables and 92 constraints, representing the static interactions among those sectors of the Mexican economy that were of primary interest to the sponsors—electricity, rail freight, heavy chemicals, paper, oil, steel, aluminum, copper, cement, and selected metal fabricated products, including capital equipment for these industries. Demands from excluded industries were introduced in the same manner as final demands. The model was applied to the problem of finding the minimum inflow rate of foreign loans and aid required by the sectors listed above in order to satisfy final demands and remain within available resources. The results of the calculation show that a small change in foreign loans and aid could make a large difference in Mexico's growth between 1960 and 1970.

Chapter 17, *Sector Studies in Economic Development Planning by Means of*

Process Analysis Models, by THOMAS VIETORISZ, discusses the practical problems that arise in attempting to apply process analysis in undeveloped countries.

The Appendix, *Basic Concepts of Activity Analysis*, by ALAN S. MANNE, defines an activity as a process for transforming inputs of goods and services into outputs, and an activity analysis as an analysis (subject to certain quantitiative conditions) in which the producing sector of the economy is described in terms of commodities and activities. The quantitative conditions are (1) the axiom of proportionality (an activity can be operated at any nonnegative fraction or multiple of its base level with all inputs and outputs varying proportionately), (2) the axiom of additivity (the collective output of two activities producing the same product is the sum of their separate outputs), and (3) the maxim of economic efficiency (whatever activity levels are selected, there exists no other set of activity levels that generates a greater net output of one commodity without reducing the net output of some other commodity).

In the light of this description of the book's contents, let us now consider the volume as a whole. Collectively, the papers cover a wide range of important, large-scale applications, many of which are carried through to the stage of producing practical numerical results. Some of them, such as the study of the US petroleum refining industry and the machine-tool substitution analysis, are worked out to a very fine-grained level of detail. All of the chapters are well written and carefully edited. Quantitative documentation is emphasized throughout, with numerical values of inputs and outputs given in most cases. Formulas and numerical inputs are carefully justified, and sources and references spelled out explicitly. The several new concepts and methodological developments presented in the context of the practical applications are also very worthwhile. All in all, the contribution of this volume to the analysis of industrial capabilities through quantitative mathematical models is enormous.

On the other hand, the exact meanings of the terms *process analysis* and *activity analysis* do not come through as clearly as one might like, although considerable effort is devoted to explaining them. [Incidentally, neither of these terms appears in the new (1965) McGraw-Hill *Dictionary of Modern Economics*.] It seems that an economic study may be classified as an activity analysis, a process analysis, or neither, depending upon which of several technical axioms and conditions is satisfied (such as proportionality, additivity, economic efficiency, or substitutability, all described above). For example, a nonlinear mathematical programming model dealing with unsubstitutable resources would fall in the 'neither' category. A generic term covering all quantitative economic models based upon the structure of the productive processes would perhaps have been a more useful contribution to lexicography than terms distinguishing among subsets of such models on the basis of their technical characteristics.

The present volume is in a sense a sequel to the well known 1951 Cowles Commission Monograph No. 13, *Activity Analysis of Production and Allocation*, reviewed in this JOURNAL 2 (1954), pp. 97–100. Both books are devoted to the analyses of economic problems by mathematical methods (whatever one wishes to call them) reflecting the structure of the economic process. A comparison of the contents of

the two volumes yields several observations: First, the earlier volume is concerned primarily with theory, while the later one deals more with applications; thus the subject appears to be emerging from a theoretical to a more practical state of development. Second, the considerable effort devoted to input-output models in the earlier volume is completely lacking in the later one; in fact, the subject of input-output analysis is ruled out by definition. Thus, if one may judge from the contents of the two books, the use of input-output models appears to be giving way in favor of linear programming models of greater generality.

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D. V. LINDLEY, *Introduction to Probability and Statistics from a Bayesian Viewpoint: Part 1, Probability, and Part 2, Inference*, Cambridge University Press, 32 East 57th Street, New York, N. Y. 10022, 1965, 271 and 306 pages, $6.00 and $6.50

THE GROWTH of the Bayesian revolution in statistics is limited more by the lack of suitable textbooks than by any other factor. These two books are among the first to appear that present the subject of statistics from a Bayesian point of view. Although they have their shortcomings, they are a welcome contribution to an undernourished field.

The first book, *Part I, Probability*, presents the mathematical theory of probability with emphasis on the type of interpretation necessary for Bayesian statistics. However, the Bayesian viewpoint appears explicitly only at the beginning of the book where the foundations are laid; the remaining parts could have been written as well by a classical statistician. This segregation is understandable, but pedagogically regrettable, because Bayesian concepts could have been successfully exploited throughout.

The first chapter introduces probability as both a frequency limit and an axiomatic consequence. The axiomatic structure is unusual in that all probabilities are treated as conditional; thus conditional probability itself appears as an axiom rather than a definition—a treatment that has conceptual advantages for the Bayesian. Great stress is correctly placed on the interpretation of probability as a degree of belief. Several interesting elementary examples from such fields as atomic physics and genetics illustrate typical applications. Inclusion of a discussion of the algebra of events would have improved the coverage of a comprehensive, conceptually sound, and lucid introduction to the theory of probability.

From this point on the book is a clear and competent treatment of the subjects usually found in probability texts. Chapter 2 discusses one-variable probability distributions: expectation, the Poisson process, moments, random walk, the normal distribution, and generating functions. Chapter 3 introduces many-variable probability distributions: multinomial, regression, correlation, change of variable, and limit theorems. Chapter 4 applies the results of the first three chapters to the study of stochastic processes: the immigration-emigration process, queuing, renewal theory, and Markov processes. Although all this material is logically presented, the presentation is almost entirely mathematical. For example, the discussion of change of variable does not use any graphical illustrations to make clear to the

student the nature of the difficulties that are sometimes encountered. Further, very few examples are worked out—the applications of each model are only indicated.

Over-all LINDLEY has accomplished what he set out to do, namely, to provide a probability text for the general applied mathematician rather than for the statistical specialist or the natural scientist. One very useful feature of the book is a large set of problems, mostly selected from examination papers of British universities. I believe that both teacher and student would enjoy an introductory probability course that used this book as a text.

The second book, *Part 2, Inference*, is an introduction to statistics. Because of the Bayesian revolution, any author of a text in this area faces a difficult choice. First, he can remain classical in outlook, draw on the large body of classical material available, and then hope that the spread of the Bayesian school will not make his work obsolete. Second, he can become Bayesian in viewpoint and be more in tune with the trend of events, but at the same time give up much of what now fills classical texts. You might say that the choice is between a fat trite book and a thin novel book. I cannot blame Lindley for the choice he has made; namely to eat his cake and have it too. Unfortunately, as a result the book appears more like a classical text designed to pay lip service to Bayesianism than as a direct Bayesian approach to statistics. This is even more regrettable because Lindley's research and published statements show him to have the potential of writing the first really Bayesian statistics book. The author's own statement in his introduction says it better than I can: "What I have done in this book is to develop a method which uses degrees of belief and Bayes's theorem, but which includes most of the important orthodox statistical ideas within it. My Bayesian friends contend that I have gone too far in this: they are probably right."

The four chapters of the book are devoted to inferences for normal distributions, inferences for several normal distributions, approximate methods (maximum likelihood, goodness of fit, contingency tables), and least squares. The treatment is in the same vein as much of Savage's work; that is, it emphasizes cases where the prior distribution is so diffuse that the posterior is governed only by the data. Although such cases do arise in practice, they are the very cases where Bayesian thinking is least necessary: both classical and Bayesian statisticians will behave in approximately the same way. The interesting time to compare statistical concepts is where the prior information and the data gathered must have roughly the same weight in forming an opinion. These cases arise perhaps more often in modern practice; they illustrate a type of problem that many people feel can be formally treated only in a Bayesian format. Therefore rather than providing a complete introduction to Bayesian statistics, this book supplies a Bayesian rationale for current classical statistical practices. The nature of the book is indicated by the fact that no prior distributions are required to solve any of the many interesting examples selected from the same sources as those in Part I. Such a book is valuable, but it is not the whole answer to the textbook problem for those wishing to teach statistics from the Bayesian viewpoint.

Professor Lindley has produced two interesting, competent, and highly readable books. The first provides a much needed Bayesian introduction to probability.

The second, in trying to be all things to all men, succeeds mainly in providing a Bayesian foundation for classical statistics. Both books are thoroughly enjoyable—they deserve a place on the analyst's bookshelf.

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EDGAR A. PESSEMIER, *Experimental Methods of Analyzing Demand for Branded Consumer Goods with Applications to Problems in Marketing Strategy*, Washington State University Press, Pullman, Washington, 1963, 175 pages, $6.00

ECONOMISTS since Adam Smith have concerned themselves with the question of the price of a commodity as a function of the elasticity of its demand. According to the classical school, at each price a certain amount is required by users, and another amount is offered by suppliers. The transaction price and amount are set at the intersection of the supply and demand curves. More recently, and especially during the last 50 years, economics theoreticians have recognized that conditions of perfect competition—explicit or implied—are not typical, and they have concerned themselves with other competitive forms. Even in these, however, the so called price-elasticity of demand remains an area of considerable interest to economists.

Producers themselves have shown a somewhat less avid interest in these findings than economists would have liked. Statistical parameters were lacking until the mathematical school of economists achieved eminence, and even the most soundly constructed theories have long remained of academic value only.

In this monograph PROFESSOR PESSEMIER advances the science of price elasticity a step further. He purposefully chooses 320 persons as experimental shoppers, and, in a carefully thoughtout series of experiments, subjects them to simulated shopping trips in which they are confronted with alternative choices of toilet soaps and toothpastes. Their decisions, including the interviewees' stated reasons, are carefully recorded as they are made during a range of price changes in each category. In analyzing the results, Professor Pessemier classifies his subjects by age, sex, and what he calls their socio-economic characteristics, the last not clearly defined. With the aid of standard statistical tools he derives parameters of brand preference, brand loyalty, and brand switching. His ultimate purpose is to develop models through the aid of matrices to indicate how experimental data of the type selected here can be used to appraise the strategy of price setting.

Throughout the study Professor Pessemier's pragmatism and plain, old-fashioned common sense are in ample evidence. His assumptions are explicit, and his mathematics and statistics never bemuse him. This reviewer cannot help wondering, however, whether market strategists will actually find this work directly useful. Unfortunately, the prices set for consumer goods are often beyond the control of the manufacturers themselves, especially in this age of discount selling and the loss of fair-trade-law protection. Prices at retail are determined by retailers rather than by manufacturers. They are often a function of supply, in terms of stocks on hand, and demand in terms of competitors' prices. Demand schedules may be determined more by specific advertising programs than by final

price. Professor Pessemier speaks of changing advertising outlays, but the dollar amounts of these outlays may be less influential than their form.

Students of price elasticity will find much worth in Professor Pessemier's study, and marketing strategists will learn from its models. It was for these readers, rather than operations researchers themselves, that the author undoubtedly undertook his work.

SEYMOUR T. R. ABT
The Hecht Co.

Books Received

CHRISTOPHER ANDREWES, *The Common Cold*, W. W. Norton & Co., New York, N. Y., 1965, 187 pages, $4.50.

V. E. BENEŠ, *Mathematical Theory of Connecting Networks and Telephone Traffic*, Academic Press, New York, N. Y., 1965, 333 pages, $12.00.

DOUGLAS L. BROOKS (editor), *The Environment and Man*, The Travelers Research Center, Inc., 250 Constitution Plaza, Hartford, Connecticut 06103, 1965, 72 pages, $1.50 (paper). A collection of seven papers from a seminar; the authors are J. HERBERT HOLLOMAN, LUTHER L. TERRY, JAMES P. DIXON, FREDERICK SARGENT II, JOHN DONNELLY, ALLEN V. KNEESE, and HELMUT E. LANDSBERG, and there is an introductory essay by the editor.

MURRAY D. BRYCE, *Policies and Methods for Industrial Development*, McGraw-Hill Book Co., New York, N. Y., 1965, 319 pages, $7.50.

ROBERT G. BUSACKER AND THOMAS L. SAATY, *Finite Graphs and Networks: An Introduction with Applications*, McGraw-Hill Book Co., New York, N. Y., 1965, 308 pages, $11.50.

HAROLD CHESTNUT, *Systems Engineering Tools*, John Wiley & Sons, New York, N. Y., 1965, 662 pages, $12.95.

CHARLES CHRISTENSON, *Strategic Aspects of Competitive Bidding for Corporate Securities*, Division of Research, Graduate School of Business Administration, Harvard University, Boston, Massachusetts, 1965, 128 pages, $6.00.

DATA PROCESSING MANAGEMENT ASSOCIATION, *Principles of Automatic Data Processing*, available from the Association, 505 Busse Highway, Park Ridge, Illinois, 1965, 93 pages, $1.25 (paper). A brief orientation for students and the general public.

FERDINANDO DI FENIZIO (editor), *Letture di Politica Monetaria e Finanziaria, Volumes I, II, and III*, Banca Popolare di Milano, Milan, Italy, 1965, 1350 pages, no price. A collection, in honor of the first centenary of the Banca Popolare di Milano, of 26 articles on monetary and financial policy; all are in Italian, those originally in other languages having been translated.

JAMES H. GREENE, *Production Control: Systems and Decisions*, Richard D. Irwin, Inc., Homewood, Illinois, 1965, 617 pages, $12.00.

P. E. HART, G. MILLS, AND J. K. WHITAKER (editors), *Econometric Analysis for National Economic Planning*, Butterworth & Co., 88 Kingsway, W. C. 2, London, England, 1964, 332 pages, $14.50. The proceedings of the Sixteenth Symposium of the Colston Research Society held in the University of Bristol, April 6–9, 1964; each of the 11 papers is followed by an account of the ensuing discussion.

ORRIS C. HERFINDAHL AND ALLEN V. KNEESE, *Quality of the Environment: An Economic Approach to Some Problems in Using Land, Water, and Air*, The Johns Hopkins Press, Baltimore, Maryland, 1965, 104 pages, $2.00 (paper). Results of a study conducted by Resources for the Future, Inc.

EDWIN HEWITT AND KARL STROMBERG, *Real and Abstract Analysis: A Modern Treatment of the Theory of Functions of a Real Variable*, Springer-Verlag, New York, Inc., 175 Fifth Avenue, New York, N. Y. 10010, 1965, 484 pages, $9.50.

CHARLES J. HITCH, *Decision-Making for Defense*, University of California Press, Berkeley, California, 1965, 90 pages, $2.95. Reviewed in the September–October 1965 issue, pp. 863–869.

MANFRED KOCHEN, *Some Problems in Information Science*, The Scarecrow Press, Inc., 257 Park Avenue South, New York, N. Y. 10010, 1965, 309 pages, $8.50. A set of related papers by various authors that emerged from a two-year study program under a research grant from the Air Force to the IBM Research Center; the book is reproduced from an unjustified typescript.

BEN-AMI LIPETZ, *The Measurement of Efficiency of Scientific Research*, Intermedia, Inc., Monument Circle, Carlisle, Mass. 01741, 1965, 278 pages, $7.00.

ROBERT E. MACHOL, in collaboration with WILSON P. TANNER, JR., AND SAMUEL N. ALEXANDER (editors), *System Engineering Handbook*, McGraw-Hill Book Co., New York, N. Y., 1965, 1085 pages, $29.50. There are 41 chapters, as follows: introduction (1 chapter), system environments (6), system components (14), system theory (9), system techniques (7), and useful mathematics associated with system engineering (4). The contributors include RICHARD BELLMAN, KENNETH E. BOULDING, A. CHARNES, W. W. COOPER, GEORGE B. DANTZIG, LESLIE C. EDIE, D. L. GERLOUGH, WALTER HELLY, RONALD A. HOWARD, PHILIP M. MORSE, and ROBERT M. THRALL, as well as many others.

RICHARD L. MEIER, *Developmental Planning*, McGraw-Hill Book Co., New York, N. Y., 1965, 438 pages, $10.00.

PAUL L. MEYER, *Introductory Probability and Statistical Applications*, Addison-Wesley, Reading, Massachusetts, 1965, 349 pages, $8.75.

NATIONAL SCIENCE FOUNDATION, *Federal Funds for Research, Development and Other Scientific Activities: Fiscal Years 1963, 1964, and 1965, Volume XIII*, NSF 65-13, Superintendant of Documents, US Government Printing Office, Washington, D. C. 20402, 1965, 258 pages, $1.25 (paper).

ERWIN RAISZ, *Principles of Cartography*, McGraw-Hill Book Co., New York, N. Y., 1962, 323 pages, $8.50.

A. V. SKOROKHOD, *Studies in the Theory of Random Processes*, Addison-Wesley Publishing Co., Reading, Massachusetts, 1965, 207 pages, $12.50. Translated from the Russian by Scripta Technica, Inc.

GEOFFREY VICKERS, *The Art of Judgment: A Study of Policy Making*, Basic Books, Inc., New York, N. Y., 1965, 242 pages, $5.00.

IRA G. WILSON AND MARTHANN E. WILSON, *Information, Computers, and System Design*, John Wiley and Sons, New York, N. Y., 1965, 361 pages, $12.50.

Notes

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