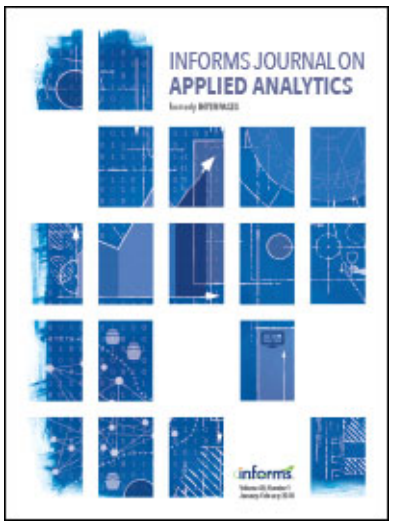

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Book Reviews

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Book Reviews

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AOKI, MASANAO, *Optimal Control and Systems Theory in Dynamic Economic Analysis,* North-Holland Pub. Co., 1975, 400 pp., $27.50.

Professor Aoki's stated objectives in writing this book were to ". . . assist economists, management scientists, and other scholars to utilize the concepts and tools of control and systems theory without the necessity of recourse to writings that are exclusively oriented towards engineers." There is unquestionably a need for a text or research monograph which lays out the intricacies and subtleties of the state variable version of control theory for nonengineering audiences. Control theory has found some application in economics with perhaps less than perfect information transfer. Given the need and given Professor Aoki's credentials as a scholar in control theory and economics, I approached this book with a high level of anticipation. I came away extremely disappointed by unfulfilled promise. He provides some fairly interesting examples of control theory at work in economics, but certainly does not substantially alleviate the need for recourse to the control theory literature.

The book is divided into three parts: State Space, Deterministic Economic Systems, and Stochastic Economic Systems. The first part is a brief overview of selected parts of linear systems theory, including both discrete and continuous time systems, with some additional material on bilinear systems and linear approximations for nonlinear systems. The relationships between state space and various transfer function representations of linear systems are shown. Similarly, nth order scalar differential and difference equation representations of linear systems are placed in state variable form. In turn, all the standard linear system representations are placed under the state space umbrella but precious little motivation or intuition guiding insight is provided along the way.

The strength of the section is without doubt the heavy emphasis placed on structural properties, e.g. controllability, observability and stability. The concepts are adequately illustrated with examples adapted from economic theory. Linear time invariant systems are emphasized and the developments are quite acceptable. Unfortunately however, Professor Aoki leaves these technical concepts to stand on their own merit and does not take advantage of the opportunity to discuss their importance in qualitatively understanding system behavior and assessing the adequacy (technical) of a system representation.

The latter two sections of the book consist of, for the most part, adaptations of papers which have appeared in the economics literature. They illustrate the use of linear systems in economic analysis, but the number and type of simplifying assumptions left this reader with an uneasy feeling about their real utility. It appears that much of the usefulness and insight might disappear with more realistic assumptions, but the economic community, not I, will have to address the substantive merit of the control theoretic approaches.

There are, in my opinion, several specific defects in the book which prevent it from meeting the stated objectives. First, the title is misleading. The systems theory is rather restricted and there is almost no optimal control. The only systems theory is that of time-invariant, finite dimensional, continuous state systems representable by difference or differential equations, probably not a serious fault in a book of this type. There is, however, virtually no discussion or illustration of optimal control and the associated methodologies as they are known to specialists in the area. Stabilization is the dominant question in the deterministic section and a linear systems theorist would probably label the examples modal control problems rather than optimal control. The quadratic regulator problem is introduced in terms of a quadratic welfare function and the Riccati equation suddenly appears after a brief whisper about dynamic programming. The results are always stated, never motivated or developed. The reader is left on his own to interpret the significance and gain insight into the problem structure.

The quadratic optimal control presentation is symptomatic of all of the optimization material presented. Each problem is considered in isolation without the development of, or even a hint of, a unifying structure or philosophy. I found it surprising that there was no mention of variational methods nor an illustration of the maximum principle of Poutryagis. This strategy of presentation might convince the reader that problem formulation and modelling are the important aspects of optimal control, a highly desirable result, but it leaves him ill prepared to go further in the literature. He would probably even have some difficulty identifying where to start his search for additional literature, particularly for sources on problem solution methodologies.

Another problem is the somewhat uneven level and style of presentation. A few results are developed in reasonable detail, others of comparable importance are simply presented without development. Guiding the development of intuition does not seem to be of any concern. For example, controllability, observability and stability are developed via linear algebraic methods, a very reasonable and insightful approach. State transition motives could have been developed in the same way, but were not. Instead Laplace and Z transforms are used with, in my opinion, some loss of continuity and insight.

A related difficulty is a tendency to jump, seemingly at random, back and forth between discrete and continuous time representations. It's useful to know that either type of system can be handled, but it would be very helpful to the reader to know why a particular representation was used for a given problem.

Even though the book falls short of its objectives, I think it serves a useful, if limited, purpose. An economist or management scientist might use it in conjunction with something like Padulo and Arbib's *System Theory* to gain insight into what this

type systems theory can and cannot do. Engineers and control theorists could certainly use Professor Aoki's book as an amusing introduction into the application of control theoretic methods in theoretical economics.

The book can be read by anyone with a modest level of mathematical sophistication. Some knowledge of linear algebra, differential equations and probability theory is probably sufficient to read the book and develop some facility with the terminology of control theory. To fully appreciate the material one probably has to be actively involved in control theory, or perhaps economics. This unfortunately precludes its use as a text, although it might be useable source material in a graduate seminar on control theory in economics.

REFERENCE

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BELL, COLIN E., *Quantitative Methods for Administration*, Richard D. Irwin, Inc., Homewood, Ill., 1977, 587 pp., $15.50.

Many people believe that Operations Research originated in Britain during the Second World War. Colin Bell shows conclusively in this book that OR's roots are in the blues ballads of the early 20th century United States. Each chapter is prefaced by a verse from some ballad. In the chapter introduction the author then shows how the essence of the concept discussed in the chapter can be found in the preceding ballad. For example, a discussion of blending problems points out that the spirit of the problem can be distilled from the preceding verse of "That Good Ole Mountain Dew."

Because the set of introductory OR books is so large, one is automatically tempted first to evaluate a new member of the set by comparing it with the "classics." The size of this latest addition is comparable to Hillier and Lieberman; however, its style and presentation have a distinct Wagnerian tenor. It avoids the use of calculus but it does use linear algebra and matrix notation. An appendix devoted to the latter is included. Symbolic notation is used extensively. The notation is well defined and explained, but students who nevertheless cannot adjust to short, precise symbol-littered statements might have trouble. The complete range of standard OR topics is covered. The presentation is concise, regularly light and witty, but conventional. The explanations are complete and carefully orchestrated. The bright, well-motivated student should enjoy the book; however, other students may find the low redundancy inherent in concise explanations and notations a real challenge.

Chapter 1 is the obligatory introduction to the concept of modeling. Chapters 2 through 14 devote 300 pages to a more thorough than typical survey of probability theory and statistics. Complete chapters are dedicated to each of: limit theorems, hypothesis testing, Normal tests, goodness of fit tests, nonparametric tests, least squares, decision trees, Markov chains and queuing models.

A chapter on simulation provides the transition from stochastic models to deterministic models. There follow four chapters and 125 pages on linear programming.

Three of these are the standard introduction to the simplex method, the transportation problem, and network problems, while one provides a good sampling of the kinds of practical problems to which LP might be applied.

The final two chapters lead the reader through Dynamic Programming and inventory models. The DP chapter covers both the deterministic and the stochastic models. The discussion of the latter includes a complete coverage of the policy iteration method of solution. The inventory chapter requires the reader to hang on tight because it covers all the standard models at a hectic pace. Economic Order Quantity models get two pages, Wagner/Whitin dynamic lot size models rate three pages complete with circles and arrows, and Newsboy–S, s models receive five pages.

Each chapter is supplemented by several dozen well-posed exercises. Answers to approximately 45% of them are provided at the back of the book. The problems and the text are peppered with little personal touches and witticisms that the student should find entertaining.

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BERLINSKI, DAVID, *On Systems Analysis: An Essay Concerning the Limitations of Some Mathematical Methods in the Social, Political, and Biological Sciences,* M.I.T. Press, Cambridge, MA, 1976, 186 pps., $15.00.

Berlinski, like Ida Hoos in *Systems Analysis in Public Policy: A Critique* (Univ. of Calif. Press, 1972), develops the thesis that systems analysis is bunk. The two books, like their authors, are quite different. Whereas Hoos is a social scientist and concerned with the failures in implementing systems analysis, Berlinski is a Professor of Philosophy with a solid foundation in mathematics (particularly differential equations) who is concerned with the failures in the underlying theory. The scope of the book is well defined by the subtitle, "An Essay Concerning the Limitations of Some Mathematical Methods in the Social, Political, and Biological Sciences." The mathematical methods referred to are general systems theory, dynamical systems, and mathematical systems theory.

This book is a devastating polemic. Being a polemic, it is filled with witty and pithy remarks, many of them rapier sharp. But when you get beyond the gratuitous and the clever, there remains a hard core of truth that must be listened to. Before discussing Berlinski's substance, let me quote a few of his choicer remarks:

"Friends . . . have sometimes asked why I spend so much time denouncing as worthless theories that *are* worthless. To this question I have no reasonable answer save the one that H. L. Mencken gave: for the same reason that men go to zoos."

On General Systems Theory: "The idea that very particular empirical principles can somehow be eked out of overwhelmingly general definitions betrays an almost Oriental passion for the union of opposites."

On artificial intelligence: "A great deal of work undertaken in artificial intelligence rests on a fundamental error. From the fact that programs can be written to

simulate any human computation, it hardly follows that human beings employ such programs themselves, any more than human beings use the rules of transformational grammar to utter correct sentences, or a falling projectile computes an integral in order to arrive at the minimum distance it must travel."

On cybernetics and information theory: "Both subjects are shaped about real theories, but their application has taken place in the paraplegic disciplines–sociology, psychology, political science, and management science–a sure sign of debility."

On *Urban Dynamics:* "*Urban Dynamics* carries the ordinary systems–analytic hunger for the general to a point of baroque splendor ...."

In critiquing *Urban Dynamics:* "... the hypothesis that managerial unwillingness to stay within a city is almost a linear function of rising tax rates–an assumption that makes the movement of managers toward the suburbs and higher per capita taxes hard to explain."

On *Limits to Growth* and *World Dynamics:* "They are gloomy and fashionable documents . . . the notation largely in the cumbersome DYNAMO style, a Stalinist mass of tightly bunched capital letters."

On numerical approximation: "Stability is quintessentially a qualitative concept of the sort that may not be obvious from a simulation run no matter how elaborate."

On social science: "Models drawn from the engineering disciplines have always had a certain fascination for the social scientist, though this fascination has been directed toward techniques that the mathematician looks upon with paternal embarrassment."

On economics: "In the face of nonlinearities, the prevailing tactic among economists, at least, has been to linearize whenever possible, and where not, to linearize anyway."

Berlinski's book consists of three interconnected chapters in which he takes on his devils in turn. In the first, *General Systems Theory,* he jousts with von Bertanlaffy, Laszlo, and Forrester's *Urban Dynamics.* In the second, *Dynamical Systems,* he continues to take on Forrester and adds Meadows in discussing the limitations of deterministic differential equation models for social systems. In his final essay, *Mathematical Systems Theory,* he excoriates Easton and others who model political systems as feedback loops and discusses the use of automata theory in biology.

In essence, Berlinski feels that simple stable linear models are being used to represent nonlinear, discontinuous, stochastic unstable situations. The tractability of of the linear models makes them attractive. The analyst assumes that because the models behave in a certain way, the world does also. Berlinski performs transformations on Forrester's world model equations to show that these equations are really linear and that the multipliers are given "administratively" from graphs rather than from "compelling theoretical assumptions". He holds out much more hope for the catastrophe theory of Thom which takes discontinuity and divergence into account since these are a mark of political and economic life. He also believes that the use of stochastic differential equations would be more appropriate than Forrester's deterministic differential equations.

A recurrent theme is that whereas the engineer is faced with a design problem

for obtaining a desirable or optimal behavior of a system that he or other engineers have built, the social scientist and the biologist are faced with an inductive problem in trying to understand a system that exists and that may have been built for some mysterious purpose. Thus, while certain designed social systems (such as the Federal Reserve in a corporate hierarchy) can benefit from being modeled in terms of optimal control theory, he questions whether most social or political or biological systems really satisfy the underlying assumptions of this theory.

Only when it comes to the use of automata theory in modeling the bacterial cell does Berlinski see a triumph of the theory; however, even here he feels the success has been limited.

It would be easy to dismiss this book as a wild attack by an enfant terrible. It is not. It is a tour de force, a serious criticism, and a thoughtful scholarly work. It is an important work that should be read and heeded by management scientists concerned with the philosophical basis of what they do.

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DEAN, JOEL, *Statistical Cost Estimation,* Indiana University Press, 499 pp., $20.00.

For those interested in the empirical study of cost behavior this book offers historical perspective along with some very important insights regarding the practical determination of cost functions. The book conveys these ideas through the detailed discussion of nine case studies, six of which were conducted during the 1930's and 1940's. Although seven of these studies were previously published, they have been out of print until now. The other two cases were published for the first time.

The book is organized into four parts with an introduction for each of these parts. Each introduction is a well organized discussion of the premises to be tested by the case studies, the economic theory involved, the practical considerations of preparing the test and the limitations of the results.

Part One, which constitutes 60% of the book, contains four cases dealing with the statistical determination of the economic relation between output and production costs in the short run. The short run is based on the idea that certain inputs such as buildings and machinery are fixed and cannot be changed. The last of the four cases in this part suggests that selling costs are an integral portion of the cost required to realize an output. Therefore, this case is analyzed within the same theoretical cost-output relationship applied in the previous three cases.

Part Two utilizes two case studies to examine the practical difficulties of statistically determining the economic relationship between plant size and cost for the long run. The statistical studies in this part attempt to empirically identify the envelope curve of long run costs proposed by conventional economic theory. Approximately 12% of this book is devoted to this discussion.

Part Three deals with the problem of assessing the geographic structure of labor costs. In this part, a single case study is presented. Four theories about the effect of geographic location on labor costs are tested by statistical methods. The means for

developing nationwide salary schedules are presented and general conclusions are drawn. Only 4% of the book is allocated to Part Three.

Part Four deals with the problem of inflation and its effect on the reporting of profits. Again, two statistical case studies are presented to reveal "the way costs and real profits should be measured when inflation causes changes in costs that invalidate the profit measurements of conventional accountancy". The important difference between "economic" earnings and "accounted" earnings is discussed. These issues are certainly timely in the present-day business environment. About 15% of the book is required for this part while the remaining 9% provides notes and references.

There are two significant features of this book. First, the material that introduces each of the four parts provides an organized, rational approach to the very difficult task of empirically developing general economic relationships. Alternative methods of analysis are set forth, their practicality is examined and the reasoning which supports the method chosen is made clear. This introductory material would make excellent reading for anyone interested in the real problems of cost estimation.

The second important feature of this book is the detailed case studies presented. Not only do they provide a historical perspective indicating early statistical estimation techniques but they provide a general format useful in any empirical study. Problems that generally exist when seeking trade-offs within economic systems are successfully handled in these cases. Therefore, these studies can provide a framework for thinking that is useful in all mathematical modelling.

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GREENBERGER, MARTIN, MATHEW A. CRENSON and BRIAN L. CRISSEY, *Models in the Policy Process,* Russell Sage Foundation, New York, 1976, 376 pp., $15.00.

The subtitle of this book, *Public Decision Making in the Computer Era,* is more relevant indication of its contents than is the title. The reader who hopes to find detailed descriptions of various quantitative models used in, or proposed for use in various public enterprises will be disappointed. Nonetheless, the book contains a great deal of worthwhile information on the interactions among modelers, decision-making entities, and public policy makers.

Of particular interest is the portion of the book devoted to a discussion of the impact of the New York City-RAND Institute on the decision-making processes of the New York City government. The initiation of new programs in any level of government is a difficult process, even if the new program is carried out by existing organizations and personnel. One may well imagine the nature of the politico-social interactions that occur when a highly nontraditional organization is set up to initiate new programs that also have to rely upon new personnel. Further difficulties ensue from divided authority which seems to be a fundamental characteristic of the democratic polity. The reaction of Congress to the Energy Plan of the Carter Administration is a good example of the problems faced by one part of the decision-making structure in

trying to implement modeling recommendations through another powerful part of the decision-making entity.

Many other interesting modeling activities are discussed. The World Model of the Club of Rome is an effort, carried out by Jay W. Forrester and his associates at M.I.T., that has received a great deal of public awareness. Whatever criticisms one may wish to enunciate about the inner workings of the World Model, one cannot help but admire the audacity required to elaborate such a model.

Within the limits of its scope, this book is interesting and informative.

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LEWIS, T. G. AND J. W. DOERR, *Minicomputers: Structure & Programming,* Hayden Book Company, Inc., 1976, 282 pp.

The book is designed to be a text "appropriate for a minicomputer laboratory course .... emphasizing hands-on use, fundamental computer concepts, ... and problems peculiar to small machines." There are three major sections subdivided into eleven chapters. .The first section is concerned with the nitty gritty of computer operations: number systems; conversion techniques; information representations; and the mechanics of arithmetic operations.

The second section deals with the basics of minicomputing: machine organization and functions; peripherals; instruction sets; and input/output. The PDP-11 structure is used as a basis for development and discussion.

The third section deals with software engineering: system software; programming techniques and examples; and micro programming.

The reader (student) as a minimum should have had an introductory course in a higher level language (Fortran, Basic, PL/1). The book does not (and the authors do not intend to) lead the reader through minicomputing in the way that a programmed text might. In this sense, the book is not integrated. It should be used (as the authors intend) as a text and reference for a *hands on* course in minicomputing. It is filled with the little technical problems and solutions that are necessary for an assembly language programmer's basic bag of tricks. It should make a good reference manual for the student as he progresses beyond the scope of a first course in minicomputing.

The book lacks a general broad overview of the potential uses and applications of minicomputers. As a consequence, this must be provided by the instructor. However, this deficit can be counted as an advantage. With the state of the art in the small (mini- and micro-) computer area moving so fast, any attempt at providing a broad overview would be outdated very quickly. The authors do provide a historical perspective on the development of some of the basic principles of computer structure and design.

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POMPER, CLAUDE, *International Investment Planning: An Integrated Approach*, Amsterdam, North-Holland Publishing Co., 1976, 204 pp., $26.95.

This book, which appears as Volume 22 in the North-Holland series, *Studies in Mathematical and Managerial Economics*, stems from the author's D.B.A. thesis at Harvard Business School. According to the publisher, it "provides a completely new approach to one of the problems fundamental to multinational enterprises: how to plan the development of a worldwide network of manufacturing facilities in order to serve markets in different countries in an optimal way." The model is claimed as an "original, sophisticated, and yet workable" approach to determining "when to build new facilities, where to locate them, what size to make them and what technology to use, what markets to supply from each facility, what transfer prices to associate with such shipments, and how to structure the payment of royalties and management fees."

This reviewer regards these claims as rather overstated. After the author simplifies the problem definition by excluding such complications as multiple products, production-market interrelationships, competitive reactions, and financial decisions, his model actually is strikingly similar to others developed some ten years ago just across the Charles River [1], [2]. Even the application of such dynamic, multi-location models in multinational companies dates back to this period [4]. Amazingly, the author seems totally unaware of these studies and subsequent related work.

Originality, therefore, can be claimed only for a pair of extensions to this type of model. The first is the inclusion of a limited degree of uncertainty through the familiar concept of an uncertainty tree, where the number of paths in the tree, or "scenarios," is limited to perhaps 10 or 20 "by constraints of computational feasibility." The second is the introduction of an elaborate accounting structure of transfer prices, fees, and royalties designed to shift profits to countries with favorable tax structures. One wonders here what the ultimate outcome will be as companies are met with counterstrategies by countries who by now are well aware of the nature of this game.

The book is divided into two parts. The first, oriented toward a managerial audience, uses a decision-tree approach to explain the basic dynamic programming model and presents a case study of a company with operations in six countries. The analysis includes three decision periods and six demand scenarios. Selection of facility size is severely restricted, with a single alternate size allowed in just two of the countries. The results show improvement over the plan proposed by the company, and that the best strategy is insensitive to demand uncertainty. (From the evidence given, however, this "case study" would not appear to meet the criteria for publication in *Interfaces*.)

The second part of the book, oriented toward management scientists, presents details of the dynamic programming model and also a multistage stochastic integer programming formulation for large problems. The author proposes solving the integer programming formulation with Benders decomposition, but leaves this approach untested. (A survey of recent Lanchester Prize winners from the same publisher would have revealed that this approach has already been applied to this type of problem [3].)

Transfer prices between countries, and royalty and fee rates, are restricted in the model by prespecified upper and lower limits. Based on a simple comparison of tax and incentive effects, each is set at either the upper or lower limit. The simplicity of this strategy may be deceptive, however. A more penetrating analysis [5] points out that it may not be optimal if transfer prices must be the same for all shipments entering (or leaving) a given country, or, due to asymmetric tax structures, if losses are incurred in a country.

The author's exposition occasionally lapses. The definitions of royalties as proportional to sales, and fees as proportional to invested capital, are never made completely clear; in fact, on p. 135 fees are erroneously related to sales revenue. Specification of the lower limits for transfer prices is also careless: the text on pp. 140 and 144 indicates the lower bound as the *lowest* of two bounds, but the formula on p. 144 uses the *maximum* of the two bounds.

The values assigned to terminal year capacities in such a model are very important due to the short planning horizon. The author uses the present value of seven (p. 101) or ten (p. 150) years of final year cash flow as the terminal valuation for each capacity configuration. Differences in remaining service lives at the horizon for capacity established at different times are ignored. The annualized cost calculation in Kendrick's model [1] would appear to be a superior approach.

The last chapter discusses an interactive computer system for the dynamic programming mode. Although programs are described, no listings or even flowcharts are provided and no information about the availability of the programs is given. One wonders about the purpose of such a chapter.

This study might have had some pedagogical value if distributed as a case for classroom discussion. Unfortunately, in this length and at this price, it has limited appeal.

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THEIL, HENRI, *Theory and Measurement of Consumer Demand Vols.* 1 *and* 2. North-Holland Publishing Company, 1976, 335 pps., $14.00 paperback; $19.50 hardback.

This pair of books is extremely difficult to review. On the one hand, I found both books to be tedious reading that I wouldn't recommend to my worst enemy, and certainly not to the readership of *Interfaces*. On the other hand, neither I, my

worst enemy, nor the overwhelming majority of our readership are intensely interested in the theory and measurement of consumer demand. However, persons having such an intense interest simply cannot afford to ignore the material in these two volumes, if they are not already familiar with the material through one medium or another. That is, the books present consumer demand à la Theil, his students and colleagues, and most persons already working in the area will be familiar with much, if not most of the material. But these volumes bring all of this material together in summary form, and as such are an absolute must for scholars with a compulsion to turn their talents towards the estimation of consumer demand. To the extent that reading the books is a laborious exercise, the same sort of effort is required as in reading a good and concise, but excrutiatingly comprehensive doctoral dissertation. Indeed, as part of Chapters 5 and 6, Volume 1 reproduces, presumably in summary form, at least two doctoral dissertations, and Chapter 7 of Volume 2 extends a third. More specifically, Volume 1 contains an awful lot of mathematical manipulation, little of which is motivated, none of which is especially difficult or interesting, and almost all of which is presented in a cut-and-dried fashion that makes virtually no attempt to lure the reader into subsequent sections. The mathematical machinations persist through most of Volume 2, although here new concepts are almost immediately motivated and illustrated within the context of the demand for (four) meats in the American meat basket, as well as a Dutch 14-commodity basket. My own preferences are such that this more extensive use of the "meshing of theory with application" approach retained my interest to a greater extent that did the earlier, "theory-first, applications-later" strategy of Volume 1. In either case, *all* of the theoretical developments are given practical application and empirical exposition. This is mathematics and theory for the ultimate sake of empiricism, and the game is worth the candle.

In Volume 1, Theil develops the basics of neoclassical (Marshallian) Utility theory, in order to lay the foundation for subsequent discussion of the so-called Rotterdam Model (a demand equation). The parameters of the Rotterdam Model are estimated for four commodity groups—from annual data for both The Netherlands and Great Britian—as well as for 14 commodity groups for The Netherlands. Beyond the results themselves, there are many interesting aspects to the estimation, and concepts related thereto. Again, none of these concepts and techniques are new: most have their origins, either in Theil's earlier work, or that of his students and colleagues. Nevertheless, it is exceptionally useful to have these ideas and methods brought together and applied in a single volume.

Volume 2 picks up where Volume 1 left off. This volume, which is much the larger in size and the smaller in theory, contained numerous extensions of the earlier basic ideas with which I personally could not even claim to have a passing acquaintance. The main focus throughout this volume is on "conditional demand equations." These are concerned with the behavior of demand *within* a group of commodities, given the behavior of demand for the group as a whole; for example, the demand for pork in the United States, given the demand for meat in the United States. Again, using the American meat basket and/or the Dutch 14-commodities basket, various summary measures are derived and their changes over time are measured, given institutional perspective, and placed in historical context. The relationship between these

measures and the basket as a whole, as well as between and within commodity groups, is subsequently explored.

Both volumes will be indispensable references to students and researchers that are either willing to wade their way through the books from start to finish, or that know what they are looking for in the first place, and are merely seeking a refresher. That is, one cannot open either book to a particular page, topic, or concept, and hope to understand what is going on, without having previously read or been familiar with virtually all of the material preceding that particular section. Notwithstanding the latter property or the focus on the Rotterdam Model, both volumes, then, are necessary additions to the library of any economist involved in demand estimation. Others would have fewer occasions to take the books off the shelf. It is also true, however, that, to the extent that I am familiar with them, the original sources do not suffer by comparison.

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WILKES, F. M., *Capital Budgeting Techniques,* John Wiley & Sons, 1977, 424 pp.

This book is a comprehensive and interesting treatment of capital budgeting theory. The presentation is to a large extent based on mathematical programming approaches. The first several chapters provide the background for the remainder of the text and include the traditional engineering economic considerations in capital budgeting. The presentation of this material, although concise, goes beyond typical treatments and introduces and illustrates the use of various types of sensitivity analyses in project evaluations. Also included is a timely section on the effects of inflation on capital budgeting decisions.

The remainder of the book is oriented around mathematical programming approaches to the formulation and solutions of capital budgeting problems. This includes linear and integer programming approaches, including the use of transportation and transshipment models for distribution, plant location, and short term cash management problems. The interdependencies between discounted cash flow and project scheduling are developed through critical path based methods. Stochastic programming approaches are included in a chapter dealing with nonlinear programming. A chapter on portfolio theory includes a presentation of Markowitz's model and Sharpe's single index model as well as a discussion of the problems encountered in implementing such models. The text also describes the essence of several large scale financial planning models.

Overall, the text presents a comprehensive, integrated, and up to date treatment of the quantitative aspects of capital budgeting. Throughout the text, the coverage of complex material is made in an elegantly simple and comprehensible manner. A good set of references on each subject area is also included. The text, however, does not contain any exercises. For this reason it would appear best used as a reference or supplemental text. It is this use that leads to the only major criticism. The text de-

velops, at an elementary level, most of the well-known mathematical programming solution techniques. Most readers will probably already be familiar with such methods and their omission, rather than detracting from the text, would have enhanced the overall presentation of capital budgeting theory.

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ANNOUNCEMENT

NATO SYSTEMS SCIENCE PRIZES

1 Prize of 100,000 Belgian francs
2 Prizes of 50,000 Belgian francs

Under the aegis of the NATO Science Committee, the Special Programme Panel on Systems Science has established annual prizes for outstanding publications in systems science which have appeared in the preceding three year period. The fourth set of prizes will be announced towards the end of 1978 for papers published between 1st January, 1975 and 31st December, 1977, inclusive.

The prizes will be awarded for up to three publications (papers, monographs, books) which best exemplify the application of systems science to the investigation of important social, economic and/or technological problems. The publications should not only indicate to decision makers the relevance of Systems Science but should also report on practical work that has been followed through by successful implementation and should be written in a form and language that is intelligible to managers as well as scientists.

Publications must be in English or French and written by nationals of NATO member countries. Eligible publications must be proposed to the Special Programme Panel on Systems Science by editors or editorial boards of journals or by professional/scientific societies, before June 30th, 1978. Ten copies of the publication should also be sent, together with the letter of nomination, by the specified date.

Forward nominations to: Scientific Affairs Division (Systems Science), NATO, 1110 Brussels, Belgium.