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The Analyst's Bookshelf

Reviews

ROBERT S. GARFINKEL and GEORGE L. NEMHAUSER, *Integer Programming*, John Wiley and Sons, New York, N.Y., 1972, 427 pages, \$18.95.

THIS IS an unusually good text. The coverage of qualitatively significant developments in integer programming is both economical and adequately comprehensive. It is clear that the authors have distilled the basic papers and have achieved a coherent synthesis of each of the several conceptual subdivisions of integer programming. The result is a practical balance between the pedagogical goal of succinct presentation of fundamental ideas and fidelity to the spirit and scope of the original papers.

The text is appropriate to an introductory course for advanced undergraduates or graduate students with a prior understanding of linear programming. A chapter of the text is devoted to linear programming, but the (explicit) purpose of the chapter is to establish notational conventions and some particular results used later in the text; it is not designed to develop an initial understanding of linear programming.

Applications and formulations are discussed in the introductory chapter. Subject to a brevity restriction, this is a thoughtful and useful sampling of the scope of integer programming applications. The treatment of applications is not comprehensive and the authors make no pretense of pursuing that objective. The bibliographic notes for Chapter 1 provide a good summary and ample guidance for those interested in further work on formulation and applications.

Chapters are devoted to each of the following topics: Integer Programming and Graphs, Enumeration Methods, Cutting Plane Methods, The Knapsack Problem, Integer Programming over Cones, The Set Covering and Partitioning Problems, Approximate Methods, Integer Nonlinear Programming, and Computational Experience. Each chapter is followed by a section of notes that identify the source material and give a brief historical summary of salient developments.

Within the chapters there is liberal and effective interstitial use of examples. Exercises follow each chapter. They are rarely trivial, and this book achieves better than normal success in integrating the explicit formal presentation of the text with the implicit insights imbedded in the exercises. Computational exercises, for example, are usually well selected to induce computational practice with methods where computational experience is a virtual necessity to appreciation of the motives and hazards of algorithm design.

While my overall judgment of this text is strongly favorable, this should not suggest a faultless book. Two chapters deal with GOMORY's conversion of the general integer program to a relaxed problem solved by dynamic programming over the elements of a finite abelian group. I regard this treatment as an heroic and generally effective attempt to simplify a critically important and relatively inaccessible part of the integer programming literature. This is achieved at the expense of very terse development of the related group theory (and that elicited anguish from some of my graduate students with strong backgrounds in group theory). My response

to the book was usually more approving in areas where I had thinner background, and more critical in areas where I was better informed—but the criticism was on secondary and subjective issues, and was related more to conceptual orientation and style than to accuracy, correctness, and comprehensiveness of the treatment. This confirms my belief that the text is effective in its primary role as an introductory treatment for the student or the operations-research practitioner.

A text is a medium of communication between the instructor and the student. As such it must bear stress and criticism if it is really used. Thus, having taught a semester course from the text, I would criticize some developments—for example, I would prefer a simpler and/or more fully explicit proof of Theorem 10 in Chapter 3—and I would regard the rarity rather than the existence of such criticism as the significant factor in judging the book. I found this book lucid enough to invite critical challenge and strong enough to withstand it. It is a truly useful and valuable text and reference.

R. D. YOUNG
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JOSEPH P. MARTINO, *Technological Forecasting for Decision Making*,
American Elsevier Publishing Co., New York, N.Y., 1972,
750 pages, \$30.00.

THIS COMPREHENSIVE, well documented 'how to' book sets forth the diverse methodologies and common pitfalls of the maturing art of technological forecasting circa the late 1960's. In orderly fashion, the reader is taken from the techniques of Delphi, trend extrapolation, et. al., through a variety of decision-making contexts in an attempt to answer "Why technological forecasting—does it make a worthwhile difference in effective decision-making?" DR. MARTINO, a member of both ORSA and MORS, has guided technological forecasting endeavors for the United States Air Force for many years, and effectively demonstrates the utility of technological forecasting across the R&D/product development spectrum in both the public and private sectors.

Two flaws mar what would be an otherwise first-rate presentation of the *current* state-of-the-art of technological forecasting and of its promising *future* in decision applications. The first was implied above: this book, although published in 1972 and distributed in 1973, is already somewhat out of date for those who wish to learn about the field as it exists today. The most recent references relate to research published in 1970 that, for the most part, was performed in the late 1960's. This book is not the place to look for technological forecasting pushing at its frontier. And, as any young field must do if it is to remain vital, technological forecasting is vigorously pushing at its expanding boundaries these days.

But technological forecasting is not the type of field for which lack of knowledge of current research neutralizes much of the potential usefulness of a book such as the one under discussion. A second and perhaps more serious implication of the temporal gap is the peripheral role given to the embryonic field of technology assessment; indeed, technology assessment appears to be encompassing technological forecasting.

An analogy with the current limits to growth debate is helpful to understand this point. The FORRESTER/MEADOWS world-dynamical model projections of economic and demographic crashes due to either resource depletion or environmental

disasters depend on the omission of many real-world adjustment and feedback mechanisms (e.g., prices and technological substitutions). The reality of these cybernetic mechanisms seems to preclude the inevitability of physical constraints, given the existence of *viable* technological alternatives by which economic growth, albeit at a decelerating rate, can be sustained in the long run.

Technology assessment addresses the question of which technological alternatives are deemed viable, or socially appropriate, in the context of the best possible comprehensive assessment of the primary and secondary impacts (both adverse and beneficial) of those alternatives. The results of bare technological forecasts often reflect the exponential character of technological developments that in the future may be deemed socially inappropriate. Hence technology assessment is to technological forecasting what the internalization of economic externalities is to the rather dismal science of classical economics: it places socio-political constraints, themselves changing and requiring estimation (cf., changing values and life-styles), on otherwise unleashed technologies. As technology assessment begins to play a more explicit role in technical decision-making, technological forecasting will be seen to be only one component of the assessment process by which the social management of technology unfolds.

Martino appears to underestimate the importance and future prospects of technology assessment in only spending nine pages discussing the subject in his chapter on forecasting in government. He provides limited acknowledgment of the increasingly widespread fact that the 'can do' technological imperative is giving way to 'should we do?' One of his final remarks concerns the future of technological forecasting:

Effective technological forecasting then is certain to be adopted on a large scale. The impact of this adoption will be to make the decision process more responsive to the needs imposed by forthcoming change; to reduce the dislocations caused by change both to individuals and to society as a whole, and to improve society's ability to avoid undesirable change.

One would hope that the next edition of this fine book updates the state-of-the-art of technological forecasting and elaborates the important centrality of technology assessment from the perspective of the constituent role played by technological forecasting in the social management of technology.

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Books Received

JAMES J. ADRIAN, *Quantitative Methods in Construction Management*, American Elsevier, New York, N.Y., 1973, 491 pages, \$20.00.

WALLACE N. ATHERTON, *Theory of Union Bargaining Goals*, Princeton University Press, Princeton, N.J., 1973, 168 pages, \$9.50.

AUSTIN BLAQUIERE, editor, *Topics in Differential Games*, North Holland/American Elsevier, New York, N.Y., 1973, 450 pages, \$25.50.

DENNIS GENSCH, *Advertising Planning: Mathematical Models in Advertising Media Planning*, American Elsevier, New York, N.Y., 1973, 176 pages, \$12.50.

RICHARD L. HEROUX AND WILLIAM A. WALLACE, *Financial Analysis and the New*

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- KENTARO YANO AND SHIGERU ISHIHARA, *Tangent and Cotangent Bundles—Differential Geometry*, Marcel Dekker, New York, N.Y., 1973, 423 pages, \$24.50.

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