

cases, and, in general, are described only very briefly. The text concludes with a chapter on "Better Approximations".

Many tables, relating to Slater coefficients, mean radii, screening numbers and reduced radial wave functions, are found in the text and in Appendix 2. For the bibliography up to 1947, the author refers to *Reports on Progress in Physics*, v. 11, 1946-47, p. 141-143, and completes the list to October 1956 in Appendices 1 and 3.

Numerical procedures, most of them recommended by the author's experience in hand and machine calculations, are described in detail, giving step-by-step instructions and numerical examples. The reviewer would have liked to have seen some comments on the numerical stability of methods using finite differences approximations to differential equations. Numerical stability is obvious in the Numerov and Fox-Goodwin process, but this is not so in Hartree's method of paragraph 4.6 (page 72), although the application is correct. Familiarity with numerical stability prevents the physicist from blindly refining the methods given in the text and will save costly "numerical experimentation".

In general, the book would gain by stating briefly the mathematical reasons why certain procedures are recommended (it would be mostly in the light of numerical stability!), as, for example, for the separation of integration of the radial wave equation into an outward and inward integration (§5.2). The physical reasons are stated adequately.

It seems that many equations were renumbered before the manuscript went to the printer. Cross references to equations are quite often unreliable. Otherwise, the number of misprints for a book of this kind is rather low.

ERWIN BAREISS

Argonne National Laboratory
Lemont, Illinois

67[W, X].—ROBERT O. FERGUSON & LAUREN F. SARGENT, *Linear Programming*, McGraw-Hill Book Co., New York 1958, xiv + 342 p., 24 cm. Price \$10.00.

With increasing frequency the professional mathematician, especially if he is working in applied mathematics, finds himself approached by friends or colleagues who lack advanced mathematical training but want to know more about the latest techniques, such as linear programming. In the course of the past year, several books on linear programming have appeared to which such inquirers might be referred.

This book should probably be regarded as the best of the group. It is addressed primarily to "people engaged in management activities at all levels in the firm and students of management. . . ." Its major virtues include a simple expository style without condescension, a wealth of illustrative examples, and a somewhat broader coverage of the subject than other works currently available. As a result of these qualities, it should prove suitable for individual study by management personnel with substantial practical experience in industry. It should, however, have its greatest value as a textbook for classroom instruction (on the job or off) of groups in which some or all participants lack the mathematical prerequisites which would permit use of a more advanced text, such as the well-known volume by Gass (from the same publishing house, interestingly enough).

The three sections into which the book is divided are entitled Introduction,

Methods, and Application, while two technical appendices treat the mathematical foundations of the Simplex Algorithm, and its relationships to the modi method, respectively. The second section presents the transportation method, the modi method, the simplex method, all of which are exact, and two approximation methods: the index method and the authors' own ratio-analysis method. Applications illustrated in detail in the third section include a product-mix problem, a production smoothing problem, and a problem in optimal assignment of orders to plants, where production costs as well as distribution costs affect the decision. Emphasis in this section is on obtaining and utilizing a maximal amount of information of value to management from the linear programming solution. Other applications, it may be added, are illustrated in presenting the computational methods in the second section. Further, two technical appendices treat the mathematical foundations of the Simplex Algorithm and its relationships to the modi method, respectively.

The professional mathematician should probably be warned that, while he may safely recommend this book to non-mathematicians, he should not attempt to read it himself, unless he is willing to take the risk of apoplexy. As evidence for this conclusion, one may cite a number of quite apoplectic reviews in which this book and others like it have been severely castigated (by mathematicians) for a low level of scholarship, lack of rigor, and similar mortal sins. To some, this attitude may seem unfair. Texts on business statistics, to take an analogy at random, are not usually criticized for omitting discussion of Borel sets, Stieltjes integrals, and the Cramer-Rao inequality. One might expect that there would be a place for a comparable treatment of linear programming without reference to theorems on matrix inversion or convex polyhedral cones.

For good or for ill, linear programming is being dished up for the common folk, and this book represents probably the most workmanlike presentation currently available. As might be expected, the book is weakest where it is most technical. The attempt, on page 50, to explain degeneracy explains nothing. Experience indicates that a better treatment of this concept is possible without resorting to advanced mathematics. Similarly, on page 5 and again on page 77, the difference between linear programming and the solution of simultaneous equations is explained in terms of the non-optimizing character of the latter, but the authors do not go on to explain, as they easily might have done, the reasons for this difference. Also, one of the examples (p. 119 ff.) used to illustrate the simplex method contains one redundant equation (because it is inherently a transportation problem) but the text makes no mention of this fact. As is all too often the case in technical works, the index is far from complete. For example, under "degeneracy" there is no reference to page 50, which has the only non-technical discussion of the topic (such as it is).

All these omissions could easily be remedied, and the many good qualities of the book warrant the hope that a future edition will see such improvements made.

THOMAS A. GOLDMAN

Corporation for Economic and Industrial Research
Arlington, Virginia