

10[65–01].—JOHN LL. MORRIS, *Computational Methods in Elementary Numerical Analysis*, Wiley, New York, 1983, xii + 410 pp., 23½ cm. Price: \$41.95 hardcover, \$19.95 paperback.

There is very little to recommend in this book. It is yet another run-of-the-mill book on elementary numerical analysis, covering the standard topics and containing the usual quota of typographical errors and imprecise statements.

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11[90C05, 90C35].—VASEK CHVÁTAL, *Linear Programming*, Freeman, New York, 1983, xiii + 478 pp., 23 cm. Price: \$49.50 hardcover, \$24.95 paperback.

This book is a very useful addition to the literature on linear programming and network flows. The emphasis throughout is on efficient implementation of the algorithms discussed; much of this computational material is presented for the first time in a textbook suitable for advanced undergraduate and graduate students.

The first ten chapters present the basic theory, using the simplex algorithm as the foundation. Thus the simplex algorithm is first presented on numerical examples, extended to handle any linear programming problem in standard form, and then used to prove the duality theorem. A worthwhile chapter considers the speed of the simplex method. At this point the revised simplex method is introduced, based on a chapter on Gaussian elimination and matrices. Because of the early introduction of Gaussian elimination and notions of sparsity, a valuable discussion of the product factorization of the basis and of the frequency of refactorizations can be presented at a very early stage, and the reader learns the importance of these computational aspects before tackling such topics as the dual simplex method. With the revised simplex method in hand, efficient algorithms for problems with bounded and free variables are presented. This allows the author to derive a general duality theory and prove results on the solvability of linear equations and inequalities. The first part concludes with a discussion of sensitivity analysis, for which the dual simplex method is introduced. Now the reader can appreciate the reasons for the revised form of the dual simplex method, and this is extended to cover problems with bounded variables. This part of the book presents a very modern and computationally-oriented presentation of the basic theory of linear programming. Surprisingly, there is no discussion here of the geometric interpretation of the simplex method.

The next eight chapters give “applications” of the theory of the first part. These include both real-world models and applications to theoretical questions. First there is a very useful discussion of modelling, issues of accuracy, uncertainty, and availability of data, and what aspects of sensitivity analysis should be presented to the decision-maker. Then particular applications to production smoothing, cutting stock and regression problems are described. These problems are used to illustrate special structures in linear programming. There follow chapters on game theory, connections with geometry (with proofs of Carathéodory’s and Helly’s theorems), and computational methods for enumerating the vertices of a polyhedron.

Network flow problems are treated in the next part. Again the focus is on efficient implementation. Thus the special data structures used recently for the network

simplex method are described fully, and the fast maximum flow algorithm of Malhotra, Kumar and Maheshwari is presented. There is a chapter on applications, nicely combining practical and theoretical implications of the results.

Finally the author covers some more advanced topics: triangular factorizations, generalized upper bounds, and Dantzig-Wolfe decomposition. The implementations of Bartels-Golub and Forrest-Tomlin are described, along with the more recent schemes of Reid and Saunders. The book concludes with an appendix on the ellipsoid method, complementing an informative discussion of the efficiency of algorithms in theory and practice in Chapter 4.

In general, the author is lucid and engaging in style, presenting complicated material clearly and concisely with many examples and economic interpretations. There are some illuminating historical references, and well-chosen exercises describe extensions (for instance, cyclic polytopes—or rather, their duals—are introduced in a series of problems). However, there are some drawbacks. I have already mentioned the lack of geometric motivation until Chapter 17—this is of course a matter of personal taste. Also surprising is the scrupulous avoidance of subscripts or transposes on vectors; partly for these reasons the author never writes an elementary matrix as a rank-one perturbation of the identity matrix, which makes some arguments on updating representations of the basis matrix less clear than one might have hoped. Since the book can be used at a variety of levels, there is a lack of consistency in the mathematical sophistication necessary. It seems unlikely to me that a reader who has not seen matrices before will find the development in Chapter 6 sufficient for easily understanding the “eta factorization” of the basis in the following chapter, let alone the *LU* factorization in Chapter 24. The organization of material is sometimes confusing: theorems of the alternative, for instance, are considered on pages 144 and 248. Finally, while the text is marred by very few typographical errors (the large-print section heading “Narrow Flow Problems” for “Network Flow Problems” on page 289 notwithstanding), the chapter on triangular factorizations seems to imply that all the triangular factors can maintain unit diagonals, which might well confuse the reader.

These minor flaws do not detract significantly from an important, very up-to-date book with admirable coverage of the crucial implementation details of algorithms for linear programming and network flow problems. I recommend it highly.

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12[34–00, 35K55, 35Q20, 35R35, 35R60, 45D05].—V. LAKSHMIKANTHAM (Editor), *Trends in Theory and Practice of Nonlinear Differential Equations*, Lecture Notes in Pure and Applied Mathematics, v. 90, Marcel Dekker, Inc., New York and Basel, 1984, xviii + 562 pp., 25¼ cm. Price \$59.75.

This volume contains 73 invited and contributed papers presented at an international conference held June 14–18, 1982, at the University of Texas at Arlington.