REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the American Mathematical Society classification scheme. The 1980 Mathematics Subject Classification can be found in the December index volumes of Mathematical Reviews.

7[65–01].–JAMES S. VANDERGRAFT, *Introduction to Numerical Computations*, Academic Press, New York, 1978, xi + 344 pp., $23\frac{1}{2}$ cm. Price $21.00.

The title of this book conveys quite clearly the intent of author James Vandergraft to study numerical *computation*, i.e. the performance of algorithms to solve many commonly encountered problems of science and engineering as they actually behave when implemented on a (serial) digital computer. Adhering to this approach, he presents an intriguing blend of traditional mathematical analysis and floating point error analysis of many frequently used methods for problems in interpolation and approximation, differentiation and integration, linear and nonlinear equations, and ordinary differential equations. He does not aim to be encyclopedic, so he therefore limits his choice of algorithms in most cases to the most well-known, but these are analyzed "completely and in a uniform manner", so as to provide "a solid foundation for more advanced work in algorithm development". This approach distinguishes the text from those of the cookbook variety as well as those which attempt to be all-inclusive and heavily mathematical.

In order for the student to appreciate the qualities to be strived for in a suitable numerical algorithm, basic aspects of numerical computation, e.g., computer representable numbers, rational function computation, discretization, iteration, rounding and truncation error, are early introduced. The concepts of mathematical and numerical instability, and some of their sources, are discussed. The chapter on computer arithmetic is more extensive than will be found in most numerical analysis texts. A notation, introduced by Stewart, for assessing rounding error requires some getting used to, but it does simplify the presentation. The author makes here the very important, but often neglected, distinction between an error estimate and an error bound, which may sometimes contain almost no useful information.

Before proceeding to specific algorithms, the problem of trying to evaluate a function on the computer is studied thoroughly and several handy devices to avoid common difficulties are presented. As an example of the philosophy of the book, rational function approximation of transcendental functions motivates the section, but no attempt is made to explain how such rational functions are obtained.

Interpolation is studied thoroughly in the Lagrangian manner, and a complete truncation and rounding analysis is performed. The permanence problem, and its solution by the Newton form, are, however, overlooked. It must be pointed out that many formulas in the text are presented rather than derived; on the other hand, the author does choose in some instances, e.g., cubic spline interpolation, to provide a full derivation.

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The study of numerical integration is restricted to standard methods (Newton-Cotes, Gaussian) and simple problems (no singularities, infinite intervals), and again the error analysis is emphasized. Romberg integration is presented but is not completely analyzed.

The treatment of linear equations is consistent with the author's philosophy, emphasizing error analysis, efficiency, and condition estimation (the latter at an elementary level). Convergence theory for iterative methods is presented in a manner so as to be understood without extensive matrix theory background, although matrix notation might be used more advantageously. The author has chosen to avoid eigenanalysis completely.

Many of the usual methods for the solution of a single nonlinear equation are considered; a simplified version of the Dekker-Brent algorithm nicely incorporates features of false position, secant, and bisection. The effect of rounding on interval methods, often overlooked in numerical analysis texts, is explained here. The author also discussed informatively the problem of starting iterative schemes, both in the search for real and complex roots.

The study of differential equations, initial and two-point boundary value problems, concludes the text. The presentation is not elaborate, only the most common Runge-Kutta and linear multistep methods being considered, but many important ideas of stability, error estimation and stepsize control are covered. While the difficulty of solving stiff equations is mentioned, there is no attempt to discuss methods appropriate for these problems.

This text is well-written, reasonably error free, and well-suited for a course to advanced undergraduate students, particularly those with a strong attraction to computing, since many of the exercises require significant programming for their successful completion, while many others require mathematical derivations not performed in the text.

STEVEN M. SERBIN

Department of Mathematics
University of Tennessee
Knoxville, Tennessee 37996-1300

8[65M10, 65N10].– THEODOR MEIS & ULRICH MARCOWITZ, *Numerical Solution of Partial Differential Equations*, Appl. Math. Series 32, Springer-Verlag, New York, 1981, viii + 541 pp., $23\frac{1}{2}$ cm. Price $24.00.

This book, a translation of the German edition published in 1978, resulted from courses of lectures given at the University of Cologne. It consists of three parts and a set of appendices containing computer programs implementing some of the methods described in the text.

Much of Part I, which is entitled "Initial value problems for hyperbolic and parabolic differential equations", comprises a discussion of stability theory for difference schemes. There is an in-depth treatment of Lax-Richtmyer theory, and an extensive section devoted to Fourier transforms of difference methods for pure initial value problems with constant coefficients. The difference methods discussed are all classical and can be found, for example, in Richtmyer and Morton's book, as