## 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 (1985 Revision) can be found in the December index volumes of Mathematical Reviews.

**23[65-01, 65-04].**—DAVID KAHANER, CLEVE MOLER & STEPHEN NASH, *Numerical Methods and Software*, Prentice-Hall Series in Computational Mathematics, Prentice-Hall, Englewood Cliffs, N.J., 1989, xii + 495 pp., 24 cm. Price $50.00.

This book is a sequel to the widely acclaimed *Computer Methods for Mathematical Computations* by G.E. Forsythe, M.A. Malcom, and C.B. Moler. Although only one of the original authors is represented, its format is retained: presenting numerical methods along with useable software that implements the methods. The major distinction is that the present volume provides software that is close to state-of-the art, even though this means that not all details of the implementation can be presented at the level of the text.

To quote from the Introduction, "This book is written for students of science and engineering. It is intermediate between a cookbook and a numerical analysis text. The reader is assumed to have completed two years of university mathematics including differential and integral calculus as well as a little matrix theory and differential equations." To indicate the scope of this book, a list of the chapter titles follows: 1. Introduction; 2. Computer Arithmetic and Computational Errors; 3. Linear Systems of Equations; 4. Interpolation; 5. Numerical Quadrature; 6. Linear Least-Squares Data Fitting; 7. Solution of Nonlinear Systems; 8. Ordinary Differential Equations; 9. Optimization and Nonlinear Least Squares; 10. Simulation and Random Numbers; 11. Trigonometric Approximation and the Fast Fourier Transform. The book can be viewed as either a user's guide to numerical software or as a textbook on numerical methods. In this reviewer's opinion, it is a success on both counts.

As a software guide, this book contains complete prologues for twenty-one user-callable Fortran subprograms implementing the numerical methods described in the text, and there are numerous references to sources of additional software. Although the prologues are somewhat uneven in style, presumably due to the many sources from which the software was obtained, all contain sufficient guidance for the intelligent use of the subprograms. There is a list of these subprograms by chapter in the front endpapers, with calling sequences,


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brief descriptions, and references to the complete prologues in the text. The text is organized in such a way that only the details needed for understanding the prologues is provided prior to their appearance.

Machine-readable copies of the subprograms are provided with the book on a double-density DOS diskette for the IBM PC and compatible computers. The information provided with the diskette indicates that the software is also available in either 5.25 or 3.5 inch high-density form or on a Macintosh diskette. The supplied version is single-precision, with the exception of UNCMND, the double-precision equivalent of the unconstrained minimization routine UNCMIN. A double-precision version of the complete collection is available from the authors. The supplied diskette contains a total of 14 files. Excellent information on the contents of the remaining files is given in readme.nms. Twelve files contain source code and data files, which have been packed in order to fit on a single diskette, and the remaining file, arce.com, is a utility provided to do the unpacking. This worked fine in this reviewer's environment, and he was soon using the software to solve the sample problems. The software package itself (ten files which unpack to 26) consists of a total of 13,990 lines of text in 143 subprograms. The other two files contain the sample programs discussed in the text and several associated data sets.

As a textbook, the scope of coverage is appropriate for a two-semester numerical methods course, but the authors provide guidance as to how a one-semester course may be achieved by suitable selection from the material provided. Numerous problems are given at the end of each chapter. Most of these are computational in nature. Because of the quality of the software, it is possible to give quite realistic examples and problems, even though a high level of mathematical sophistication is not required. Very few proofs are given, but references are generally provided. In addition to the standard material found in most numerical mathematics texts, this book provides excellent advice on how to detect when a method has failed to provide an adequate solution to the problem posed. Most chapters are quite understandable, although this reviewer had trouble following Chapters 8 and 11 (possibly due to their remoteness from his areas of expertise). The text includes numerous references to current literature, if the reader would like more details on the methods presented. This reviewer especially appreciated the occasional "Historical Perspective" sections, which provide insights into the origin of some of the methods and the lives of their developers that are not generally provided in textbooks. These breathe life into the otherwise dry subject of numerical mathematics.

This book generally escapes the problems of uneven style that plague multiple-authored texts. There are some minor stylistic differences between chapters, but these are generally confined to the form of reference to the bibliography and other chapters of the book. While there are some typographical errors, they are small in number for a first edition, and most do not detract from the understanding of the material. A list of errata is available from the reviewer. The book includes an extensive index. This reviewer was disappointed to find that

the first topic he looked up (Interpolation, visually-pleasing) had two incorrect page references: there is no material on this topic on pages 106 or 116 (try 112 and 114). However, a random selection over a dozen other index entries revealed no additional errors.

All in all, this reviewer highly recommends *Numerical Methods and Software* to any scientist or engineer who would like insight into current mathematical software or to those who find themselves in the position of teaching a course on numerical mathematics. This reviewer hopes that *he* has the opportunity to teach from this text!

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**24[65–02, 65F05, 65F10].**—ALEKSANDR A. SAMARSKIĬ & EVGENIĬ S. NIKOLAEV, *Numerical Methods for Grid Equations*, Translated from the Russian by Stephen G. Nash, Vol. I: *Direct Methods*, Birkhäuser, Basel, 1989, xxxv + 242 pp., Vol. II: *Iterative Methods*, Birkhäuser, Basel, 1989, xv + 502 pp., 24 cm. Price $260.00.

These volumes are devoted to the solution of systems of equations that arise in applying the finite difference method to problems of mathematical physics, mainly to boundary value problems for second-order elliptic equations. They are focused on iterative methods, although direct methods are also discussed. The aim is to gather in one place information on iterative methods for solving difference equations. The book has primarily been written for students of applied mathematics at the Moscow State University. The revised second edition was issued in the Soviet Union in 1987.

There are two volumes. The first volume (Chapters 1–4) deals with the application of direct methods to the solution of difference equations, the second volume (Chapters 5–15) considers iterative methods.

Chapter 1 provides the necessary foundations for solving linear difference equations. Chapter 2 describes some variants of the Gauss elimination method for solving one-dimensional 3- and 5-point difference equations. In Chapter 3 the cyclic reduction method is studied, and Chapter 4 deals with the separation of variables method (FFT method) for solving Poisson's difference equations in a rectangle.

The theory of iterative methods is introduced in Chapter 5. Iterative methods are considered as operator difference schemes. This approach has many advantages. The method does not depend on a choice of particular basis functions and on a representation of the operators in this basis. The authors introduce the