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.

10[65-01, 65Dxx, 65Fxx, 65Gxx, 65Hxx, 65Kxx].—GÜNTHER HÄMMERLIN & KARL-HEINZ HOFFMANN, *Numerische Mathematik*, Grundwissen Mathematik, vol. 7, Springer, Berlin, 1989, xii+448 pp., 24 cm. Price: Softcover DM 38.00.

This is an introductory text, roughly at the first-year graduate level, covering some basic topics of numerical analysis, not including, however, differential and integral equations. The topics are organized in nine chapters, entitled: Computing, Linear Systems of Equations, Eigenvalues, Approximation, Interpolation, Splines, Integration, Iteration, and Linear Optimization. Every chapter has several subsections, each with its own set of exercises. In line with the objectives of the series *Grundwissen Mathematik*, the authors have made an attempt to emphasize cross connections with other disciplines of mathematics, notably the theory of normed linear spaces, and to place the subject in historical perspective by providing numerous historical and biographical notes. While the treatment, on the whole, follows standard patterns, there are topics rarely found in texts at this level, for example, a discussion of complexity measures for algorithms, the Peano representation of the remainder term in polynomial interpolation, multidimensional splines, and the recent polynomial algorithms of Khachiyan and Karmarkar in linear programming. On the other hand, no detailed analysis is given of rounding errors in the basic algorithms of numerical linear algebra.

The reviewer noted only very few typographical errors and found the exposition carefully and expertly done. A few minor inaccuracies, nevertheless, might be corrected in future editions: On p. 174, Rodrigues's formula for Legendre polynomials is (incorrectly) attributed to Gauss. In connection with Bernstein's example on p. 223, the sequence of polynomials interpolating $f(x) = |x|$ on equally spaced points in $[-1, 1]$ is said to diverge for all $0 \leq |x| < 1$, whereas it actually converges (nontrivially) at $x = 0$. The Pólya-Steklov theory does not cover, as claimed on p. 336, convergence of Gaussian quadrature rules on infinite intervals. Finally, on p. 104, the biographical note on Gerhard Hessenberg (1847–1925) seems out of place, since Hessenberg matrices are named

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after K. Hessenberg who, in his 1941 T. H. Darmstadt dissertation, developed a similarity transformation of an arbitrary matrix to "Hessenberg form" (cf. [1, pp. 314ff]).

In spite of these minor blemishes, the book is a welcome addition to the literature on basic numerical analysis and should especially appeal to mathematically mature students (who are conversant with the German language).

W. G.

1. R. Zurmühl, *Matrizen*, Springer, Berlin, 1950.

11[65M05, 65M10, 65M20, 76-08].—F. W. Wubs, *Numerical Solution of the Shallow-Water Equations*, CWI Tract 49, Centre for Mathematics and Computer Science, Amsterdam, 1988, iv+115 pp., 24 cm. Price Dfl17.80.

This tract is the summary of a research project on the shallow water equations from 1983–1988. The tract consists of two parts. The first part describes the numerical model used and its implementation on the Cyber 205 computer. The second part is a reprint of two papers. One is by Wubs on the stabilization of explicit methods by smoothing. The other paper is by Van der Houwen, Sommeijer, and Wubs on residual smoothing. The implicit smoothing used in the first paper is similar to that proposed both by Lerat and Jameson for fluid dynamic problems. It has also been used by Chima and Jorgenson for time-dependent problems. Here, Wubs describes some theory for this residual smoothing and considers applications to the shallow water equations. The second paper is an extension of the first; the authors derive smoothers for both hyperbolic and parabolic equations.

In the first section a staggered grid is introduced and the two velocity components and height are defined at different locations. A Cartesian grid is used, and so general boundaries are approximated by polygonal approximations. There is no discussion of using body-fitted coordinates. Both second-order and fourth-order central differences are constructed for this staggered mesh. Special formulas are needed near the boundaries. The finite difference equations are integrated in time by a Runge-Kutta scheme, and there is a short description of the stability theory, including the effects of residual smoothing. There is a detailed description of the vectorization of the code and its implementation on the Cyber 205. Finally, results are presented for the Taranto bay in Italy and for the Anno Friso Polder in the Netherlands.

The tract is mainly of interest for people in oceanography. It is nice, however, to see the interplay between this field and fluid dynamics in the use of residual smoothing. This may encourage additional interaction between these close fields. Finally, the description of the vectorization complements that