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.

4[65–01].—R. L. JOHNSTON, *Numerical Methods—A Software Approach*, Wiley, New York, 1982, ix + 276 pp., $23\frac{1}{2}$ cm. Price $24.95.

Several years ago, I proposed to some of my colleagues the following thesis on the subject of teaching numerical methods to scientists and engineers. Since it is difficult enough for most professionals to keep abreast of one's specialty, they will certainly not be up-to-date concerning the state-of-the-art in numerical algorithms and software. Hence they will continue to use the methods they learned in college throughout their entire career. This is borne out by the experience of many numerical analysts associated with scientific computing centers who discover in their conversations with customers that they have been using obsolete and inefficient methods to solve their problems. Therefore, I suggested that instead of teaching numerical methods, we teach how to use the mathematical software libraries such as IMSL and NAG. This is by no means a trivial task, and it requires much thought and effort to prepare such a course. The hope is that the libraries will be periodically updated and will incorporate the latest numerical analysis wisdom. In this way, the user will always have the best methods at his disposal. Thus, we should condition the user of numerical methods to turn to the latest edition of the mathematical software library, and we should teach how to read the manuals and use the software. This involves choosing the appropriate program, testing the programs before using them, understanding how to prepare the input and interpret the output, knowing what to do in case the software doesn't work, etc. Pressure should also be put on the writers of these manuals to make them easier to understand and on the writers of the programs to make them easier to use and more automatic and foolproof. One could develop this thesis at greater length but I believe the reader will get the flavor of the idea. Note, however, that the rapid spread of microcomputers may require a modification of this thesis; the problems are much more difficult!

Now when I received the book by Johnston, I hoped it would be a step in the direction of implementing this approach. And indeed, there are some indications that this book is going in the right direction in that it includes calling sequences to subroutines for executing many of the standard procedures in numerical analysis such as solving a system of linear algebraic equations, finding a least squares fit of data using cubic splines, evaluating a fast Fourier transform, finding the root of a nonlinear equation or the zeros of a polynomial, and integrating a system of ordinary differential equations. On the other hand, much more space is devoted to

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describing the algorithms for these tasks and others such as computing the eigenvalues and eigenvectors of a matrix, interpolation and approximation, quadrature, etc. The treatment of these matters is on a very elementary level and is to a great extent superfluous. And if we were to accept the assumption of the author that a good knowledge of the algorithms is necessary in order to use them, then there are some serious omissions. Thus, in the discussion of the solution of linear equations, there is no mention of scaling, while in the description of the QR algorithm, the crucial point of using shifts is ignored. One serious mistake occurs on p. 225, where the definition that is given for a (convergent) improper integral is actually the definition of a Cauchy principal value integral.

Finally, since this book also deals with the writing of mathematical software, it provides at least one example of our thesis. In the chapter on quadrature, adaptive quadrature is described using a local strategy. Current practice prefers the use of a global strategy. Hence, anyone writing an adaptive quadrature routine based on the material in this book is not using the best strategy, and twenty years from now, he will still be writing such programs, instead of referring to a mathematical software library for a program using the latest techniques.

P. R.

5[46-01, 65J10].—COLIN W. CRYER, *Numerical Functional Analysis*, Oxford University Press, New York, 1982, iv + 568 pp., 24 cm. Price $39.00.

This book is intended as the first volume of two. It is concerned with teaching the foundations of Functional Analysis and with its interplay with Numerical Analysis. The second volume will treat elliptic boundary value problems and nonlinear problems.

Special features of this text are as follows: In the systematic introduction of concepts of Functional Analysis frequent stops are made for applications relevant to Numerical Analysis. Thus the students immediately see the concepts in action. Many counterexamples are given to delineate the basic definitions and theory. There is plenty of exercises, and they come with solutions or references.

The choice of material is standard, as the following list of the first eight chapter headings indicates: Introduction, Topological vector spaces, Limits and convergence, Basic spaces and problems, The principle of uniform boundedness, Compactness, the Hahn-Banach theorem, Bases and projection. The ninth and last chapter covers approximate solution of linear operator equations (about a hundred pages) with emphasis on integral equations. This book also includes a list of notation, an excellent index and, still more excellent, a list of theorems, lemmas and corollaries. It ends with references and solutions, the latter covering a hundred and fifty pages.

I found the treatment very well suited to what I perceive as the "typical student" in Applied Mathematics. Concepts are thoroughly motivated, and interesting and enlightening applications to Numerical Analysis (and related fields) are given. In the long list of counterexamples I missed one of a linear map defined on the whole of a Banach space but discontinuous (one occurs implicitly on p. 273). In my experience in teaching Functional Analysis this is one counterexample students will be asking for if you withhold it for too long. It should be pointed out that it is not assumed