REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the indexing system printed in Volume 22, Number 101, January 1968, page 212.

41[2, 2.05, 2.10, 2.20, 3, 4, 7, 8].—*Procedures ALGOL en Analyse Numérique*, Éditions du Centre National de la Recherche Scientifique, Paris, 1967, 324 pp., 24 cm. Price 35 F.

This book is the combined effort of several university numerical analysis teams working in cooperation with the French National Centre of Scientific Research. The book is essentially a collection of Algol procedures arranged by subject in seven chapters. At the beginning of each chapter is a brief description of each procedure in the chapter. Unfortunately, few reasons for preferring one particular algorithm to another are supplied. The actual description of each Algol procedure consists of a brief but clear account of the method, a listing of the actual Algol procedure, and a listing of a driver program showing the use of the procedure on a numerical example. This makes the use of these procedures an easy task. Evaluation of the numerical results of these examples is difficult since a description of the computers used (word length, arithmetic unit etc.) is supplied in only a few cases. There is no indication that the procedures have undergone any formal certification.

Chapter one, edited by C. Bonnemoy, is concerned with the solution of linear systems of equations. The more important procedures include Gaussian elimination (with and without partial pivoting), determinant evaluation, Cholesky decomposition, solution of tridiagonal systems, least squares solution of linear systems, and the computation of the pseudo-inverse of a square matrix.

The second chapter, edited by J. L. Rigal, deals with the problem of finding the eigenvalues and eigenvectors of matrices. A number of methods are presented for both the symmetric and unsymmetric cases. For the symmetric case, the methods of Jacobi, Givens, and Householder are given, as well as a number of methods for finding the eigenvalues of the tridiagonal systems that result from the latter two methods. Methods of Wilkinson and Householder for reducing a general matrix to lower Hessenberg form are given. Rutishauser's LR method is presented along with some variants of the ordinary power method.

Solution of nonlinear algebraic equations is the subject of chapter three, edited by J. L. Lagouanelle. The procedures given use the well-known methods of Lin, Bairstow, Muller, Newton, and Laguerre for polynomial equations, and an ordinary bisection algorithm for finding a zero of a general function of one variable. Two procedures for solving systems of nonlinear equations are provided, a special one for two equations in two unknowns, and a general procedure for n equations in n unknowns which uses Newton's method.

Chapter four, edited by P. Pouzet, deals with differential, integral, and integro-differential equations. The procedures given are primarily Runge-Kutta methods which differ in details depending on the type of equation being solved. One multistep method (Adams) and a mixed method are given.

Edited by J. Legras, chapter five is concerned with numerical quadrature. Here some standard procedures using Newton-Cotes formulas of degrees one, three, and five are presented for use with functions of one and two variables. Procedures utilizing Romberg integration for rectangular regions in one, two and three dimensions are given.

Approximation is the subject of chapter six, under P. J. Laurent's editorship. It consists of two parts, the first dealing with approximation using the infinity norm, and the second dealing with approximation in the least squares sense. In the first section two versions of Remez' algorithm are provided as well as several procedures for finding uniform approximations on discrete sets of points. Procedures for obtaining least squares approximations (a direct method and one using orthogonal polynomials) appear. A procedure for generating approximations using spline functions ends the chapter.

The last chapter, edited by P. L. Hennequin, is entitled "Probability and Special Functions" and, as the editor states, deals with algorithms which could not logically be placed elsewhere in the book. They include one related to the decomposition of the set of states in a stationary Markov process into classes, an optimized Runge-Kutta procedure, two random number generators, a procedure to find the upper limit of integration of a Gaussian distribution when the cumulative probability is known, and two algorithms related to Mathieu functions.

Although the book contains a large number of very useful procedures, the reviewer feels that it should be approached with caution by the inexperienced computer. A few of the algorithms presented are of questionable reliability, and some of the limitations of the algorithms are not stated. For example, the inversion of a matrix using Schmidt orthogonalization can lead to severe round-off error and it is not generally regarded as a satisfactory numerical procedure. (By contrast, the same basic procedure using Householder transformation matrices to carry out the factorization enjoys good numerical stability.) Repeated use of Hotelling's deflation with the power method is suggested for finding all the eigenvalues of a given matrix when the eigenvalues are known to be distinct. It is often satisfactory only for a few iterations.

Despite these reservations, the authors deserve a great deal of credit for gathering together such a comprehensive set of algorithms. The procedures in the book would enable one to attack the majority of standard numerical computation problems. There are a few misprints in the book and sources for most of the methods are supplied.

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42[2.10, 7].—David Galant, *Gauss Quadrature Rules for the Evaluation of* $2\pi^{-1/2}\int_0^\infty \exp(-x^2)f(x)dx$, 6 pages of tables, reproduced on the microfiche card attached to this issue.

With $\{p_j(x)\}$ denoting the orthogonal polynomials associated with the weight function $\exp(-x^2)$ on $[0, \infty)$, the coefficients $\{b_j\}$ and $\{g_j\}$ in the recurrence relation $p_j(x) = (x - b_j)p_{j-1}(x) - g_jp_{j-2}(x)$ are given in Table I to 20S for $j = 1(1)20$.