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.

5[65Fxx, 65Kxx].–P. G. CIARLET, *Introduction à l'Analyse Numérique Matricielle et à l'Optimisation*, Masson, Paris, 1982, xii + 279 pp., 24 cm. Price 100 F. and P. G. CIARLET & J. M. THOMAS, *Exercises d'Analyse Numérique Matricielle et d'Optimisation*, Masson, Paris, 1982, 144 pp., 24 cm. Price 70 F.

In this textbook the author takes the somewhat original approach to cover basic numerical linear algebra and optimization theory in one volume. It is directed to first-year university students in the French system and its purpose is to give a reasonably complete description and mathematically rigorous analysis of the most commonly used methods in the field. The presentation aims at showing not only the efficiency of the methods described but also their mathematical interest, and the author expresses the hope that the reader will enjoy these aspects simultaneously.

The first half of the book is devoted to numerical linear algebra. After an introductory Chapter 1, recalling basic definitions and properties of vectors, matrices and norms, Chapter 2 states the main problems of numerical linear algebra as solving linear systems of equations and finding the eigenvalues and eigenfunctions of matrices, and discusses the concept of conditioning for such problems. Chapter 3 gives an inventory of sources of linear algebra problems with emphasis on numerical solution of boundary value problems for partial differential equations. The standard direct and iterative methods for solving linear systems are presented in Chapters 4 and 5 and methods for eigenvalues and eigenfunctions are collected in Chapter 6.

The second half of the book is concerned with optimization. The introductory Chapter 7 starts with a summary of calculus in normed vector spaces with applications to free and constrained extremum problems, including a discussion of convexity, and ends with an analysis of Newton's method. Chapter 8 proceeds with examples of minimization problems and analyzes relaxation, gradient and conjugate gradient methods and penalization methods for constrained problems. Chapter 9 is an introduction to nonlinear programming with the Kuhn-Tucker conditions, duality and a section on Uzawa's algorithm for constrained convex programming, and Chapter 10, finally, deals with linear programming.

The book is accompanied by a separate issue of exercises of varying degree of difficulty (without solutions). These contain valuable additional theoretical material and a limited number of numerical applications.

The level of difficulty increases throughout the book, and in the second half, constant use is made of Banach and Hilbert spaces and differential calculus in topological vector spaces. Although, in principle, it is possible for the reader to

0025-5718/84 $1.00 + $.25 per page

specialize the analysis to finite dimensions, this way of presenting the material will undoubtedly incur some psychological difficulties for the less advanced student.

The two halves of the text could each be used for a one-semester course, and our feeling is that at least the second of these would be best suited to the beginning graduate level. The mathematically elegant exposition would also make the book ideal for the pure mathematician with an interest in applications.

The book is a valuable and welcome addition to the literature. It is written in French; it ought to be translated into English.

V. T.

6[10H05, 10–04, 65E05, 30–04].–J. VAN DE LUNE, H. J. J. TE RIELE & D. T. WINTER, *Rigorous High Speed Separation of Zeros of Riemann's Zeta Function*, Report NW 113/81, Mathematisch Centrum, Amsterdam, October 1981.

This report announces that the first 200,000,001 zeros of the Riemann zeta function $\zeta(s)$ in the critical strip are simple and lie on the line $R(s) = \frac{1}{2}$. Previously the best published result [1] was for the first 80,000,001 zeros, and an unpublished result by the reviewer extended this to the first 156,800,001 zeros.

The method used is essentially the same as that used by earlier authors, but some improvements in the search for "missing" zeros in Gram blocks has improved the efficiency of the method by about 20 percent.

The combined results of the reviewer and van de Lune, te Riele and Winter have appeared as [2], but the present report includes significantly more details of the error analysis and computer programs, so is essential for anyone trying to verify or extend the computational results.

R. P. BRENT

Centre for Mathematical Analysis
Australian National University
G.P.O. Box 4, Canberra, A.C.T. 2601
Australia

1. R. P. BRENT, "On the zeros of the Riemann zeta function in the critical strip," *Math. Comp.*, v. 33, 1979, pp. 1361–1372. MR **80g**: 10033.

2. R. P. BRENT, J.. VAN DE LUNE, H. J. J. TE RIELE & D. T. WINTER, "On the zeros of the Riemann zeta function in the critical strip. II," *Math. Comp.*, v. 39, 1982, pp. 681–688.