further conditions to arrive at the principal object of study, the Moore-Penrose generalized inverse. This is applied to the problem $a \times b = c$ in the next chapter. The third chapter introduces a new approach (though already foreshadowed) in terms of minimizing norms of x and $a\,x - c$. However, the development is meager except for the Euclidean norm, which leads back again to Moore and Penrose. Finally, the last chapter describes a number of numerical methods for computing the generalized inverse.

There are no exercises, but there are numerical examples. A two-page general bibliography of items on matrices and functional analysis is given at the outset, and a rather extensive special bibliography is given at the end of each part. There is no index.

This is by no means an elementary text. But the numerical analyst with some degree of mathematical maturity can find here a great deal of interesting material. Although the literature on generalized inverses has expanded considerably since the book went to press, it gives a quite complete and systematic coverage of the theory up to that time, and the diverse points of approach suggest aspects of the subject that are by no means yet fully explored.

A. S. H.

21[3].—E. H. CUTHILL, *Tables of Inverses and Determinants of Finite Segments of the Hilbert Matrix*, Applied Mathematics Laboratory, Naval Ship Research & Development Center, Washington, D. C., ms. of 9 typewritten pp. + 346 computer sheets deposited in the UMT file.

The main table (Appendix A) gives on 326 computer sheets the exact (integer) values of the elements of the inverses of the first 37 segments of the Hilbert matrix. The symmetry of the inverse matrices is exploited through the printing of only those elements situated on or below the main diagonal. Included are the exact values of the determinants of these segments.

The underlying calculations were performed in variable-precision rational arithmetic on an IBM 360/50 system at the IBM Boston Programming Center, using programs written in PL/1-FORMAC. The program used in calculating the results in Appendix A is listed in Appendix B.

The exact values of the determinants of the segments of the Hilbert matrix were calculated independently from the well-known formula

$$\det H_n = \prod_{r=1}^{n-1} (r!)^4 / \prod_{r=1}^{2n-1} r!\,,$$

corresponding to $n = 2(1)62$. (Beyond this point the range permitted by PL/1-FORMAC was exceeded.) These 61 numbers (which are reciprocals of integers) are separately tabulated in Appendix C, and the underlying program is listed in Appendix D.

Relevant mathematical formulas, as well as details of the computer calculations, are given in the introductory text, to which is appended a useful list of six references.

These extensive manuscript tables greatly exceed the range of similar earlier tables, such as those of Savage & Lukacs [1] and R. B. Smith [2], to which the present author refers.

J. W. W.

1. RICHARD SAVAGE & EUGENE LUKACS, "Tables of inverses of finite segments of the Hilbert matrix," in *Contributions to the Solution of Systems of Linear Equations and the Determination of Eigenvalues*, NBS Applied Mathematics Series No. 39, U. S. Government Printing Office, Washington, D. C., 1954, pp. 105–108.

2. RICHARD B. SMITH, *Table of Inverses of Two Ill-Conditioned Matrices*, Westinghouse Electric Corporation, Bettis Atomic Power Division, Pittsburgh, Pa., 1957. (See *MTAC*, v. 11, 1957, p. 216, RMT **95.**)

22[3, 4].—JOEL N. FRANKLIN, *Matrix Theory*, Prentiss-Hall, Inc., Englewood Cliffs, N. J., 1968, xii + 292 pp., 23 cm. Price $10.95.

The author states in his preface that this book, developed from a course given over the past ten years, intended originally to be a preparation for courses in numerical analysis, but in fact attended by juniors, seniors, and graduate students majoring in mathematics, economics, science, or engineering. Thus, Chapter 3 (optional) is entitled "Matrix analysis of differential equations," and here and there are to be found more concrete applications. The book is probably unique in that, while presupposing almost nothing at the outset, it very quickly but easily arrives at the main theoretical portion dealing with normal forms and perturbation theory, and concludes with a long chapter of nearly 100 pages on numerical methods for inversion and the evaluation of eigenvalues and eigenvectors.

The first two chapters develop the theory of determinants, and that of linear bases (56 pages). Chapter 6, entitled "Variational principles and perturbation theory," includes the minimax and separation theorems for Hermitian matrices, Weyl's inequalities, the Gershgorin theorem, norms and condition numbers, and ends with a continuity theorem. For solving systems and inverting matrices only triangular factorization is included, but with special attention to band matrices; and among iterative methods chief attention is given to Gauss-Seidel, with mention of overrelaxation. For eigenvalues the power method with deflation (but not the inverse power method) is given; reduction to Hessenberg form for a general matrix, and unitary tridiagonalization of a Hermitian matrix with the Givens application of the Sturm sequence; and, finally, the QR method.

A set of exercises of reasonable difficulty follows each section, and there is a three-page index. Unfortunately there is no bibliography, and only very few references (a half dozen or so).

A. S. H.

23[7].—D. S. MITRINOVIC, *Kompleksna Analiza* (*Complex Analysis*), Gradjevinska Knjiga, Belgrade, Yugoslavia, 1967, xii + 312 pp., 24 cm.

This volume in the series *Matematicki Metodi u Fizici i Tehnici* consists mainly of text and numerous examples on complex numbers and functions of a complex variable, in the Serbian language. Its connection with computation arises mainly from the appended *Mali Atlas Konformnog Preslikavanja* (*Small Atlas of Conformal Representation*), by D. V. SLAVI´. This atlas contains 30 finely drawn diagrams showing level curves u = constant and v = constant in the z-plane when $w = u + iv$ and $z = x + iy$ are connected by functional relationships. The relationships considered are as follows, where the reviewer has grouped pages together, somewhat arbitrarily, for the sake of conciseness.