43[G, H, X].—Richard S. Varga, *Matrix Iterative Analysis*, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1963, xiii + 322 p., 23.5 cm. Price $10.00.

This book is concerned with the solution of large systems of linear algebraic equations by means of iteration methods. In particular, the aim is to develop a theory of cyclic interative methods which is particularly useful for dealing with (and which was, in fact, motivated by) systems of equations arising from discrete approximations to elliptic and parabolic boundary-value problems. Such problems give rise to systems often consisting of thousands of linear equations whose associated square matrices have mostly zero elements and whose non-zero entries occur in some regular pattern. With present-day high-speed computing machines, many problems of the above-mentioned type have been successfully treated, using methods described in this book.

Chapter I introduces some fundamental concepts in matrix theory. In particular, some eigenvalue inequalities are given and the concept of irreducibility is introduced. The very useful notion of a directed graph is given and used as a geometric description of irreducibility.

The second chapter treats the Perron-Frobenius theory of non-negative matrices, which forms the basis for some of the later material. Cyclic and primitive matrices are discussed, and graph theory is again shown to be a helpful tool.

The next chapter deals with three basic iterative methods: Jacobi, Gauss-Seidel, and Successive Overrelaxation (SOR). Rates of convergence are discussed, and in this connection the comparison theorem of Stein-Rosenberg is given. The theorem of Ostrowski-Reich, which provides necessary and sufficient conditions for convergence of SOR for Hermitian matrices, is presented.

Matrices whose inverses have only non-negative entries are discussed, and iterative methods obtained from "regular splittings" of matrices are studied.

The SOR method is discussed further in Chapter IV, particularly in connection with the theoretical determination of the optimum relaxation factor for p-cyclic matrices. This is an extension of the important work of D. Young (1950) in the case $p = 2$. Further extensions due to Kahan (1958) and Varga (1959) are given.

Chapter V describes the so-called Chebyshev semi-iterative method. The connection between this method and SOR is discussed, as well as the relation between the rates of convergence.

The next chapter is concerned with the derivation of difference equations corresponding to elliptic boundary-value problems. Several points of view are presented. The equations derived here are meant to motivate the matrix analysis, and hence no convergence proofs are given.

The widely used alternating direction implicit (ADI) methods of Peaceman and Rachford (1955) and Douglas and Rachford (1956) are presented in Chapter VII. An analysis of these methods as applied to a certain system arising from a discrete approximation to the Dirichlet problem is given. Some experiments comparing ADI with SOR are discussed at the end of the chapter.

Chapter VIII deals with matrix problems resulting from discrete approximations in parabolic problems. Various iterative methods are applied.

The final chapter is concerned with estimation of acceleration parameters. Numerical examples are given in Appendices A and B.

Professor Varga's book is very clearly written and contains a large amount of quite recent material. The reviewer especially liked the "Bibliography and Discussion" at the end of each chapter. The pertinent comments are made at this time rather than interrupting the mathematical development of the subject matter.

The level of the book is sufficiently elementary so that first year graduate students could be expected to grasp the material. Some knowledge of matrix theory is required. *Matrix Iterative Analysis* belongs in the personal library of every numerical analyst interested in either the practical or theoretical aspects of the numerical solution of partial differential equations.

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44[I].—D. S. MITRINOVIĆ & R. S. MITRINOVIĆ, *Tableaux d'une classe de nombres reliés aux nombres de Stirling, Publ. Fac. Elect. Univ. Belgrade* (*Serie: Math. et Phys.*), No. 77, 1962, 78 p.

Pages 7–76 contain tables of the integers ${}^pP_n{}^r$ defined by

$$\prod_{r=0}^{n-1} (x - p - r) = \sum_{r=0}^{n} {}^pP_n{}^r x^r$$

The values are for $p = 2(1)5$, $n = 1(1)50 - p$, $r = 0(1)\ n - 1$; for a few p and r, n assumes values to 50 instead of $50 - p$. The values are exact, several having 64 digits. Connections with Stirling and generalized Bernoulli numbers are explained. For earlier work on Stirling numbers by the same authors, see *Math. Comp.*, vol. 15, 1961, p. 107 and vol. 16, 1962, p. 252.

A. F.

45[K].—B. M. BENNETT & E. NAKAMURA, *Significance Tests in a 2 × 3 Contingency Table, A = 3(1)20,* University of Washington, Seattle, February 1963. Deposited in UMT File.

For qualitative data classified in the form of a 2 × 3 contingency table

	Sample 1	Sample 2	Sample 3	Total
'Successes'	a_1	a_2	a_3	$a = \Sigma a_i$
'Failures'	$A - a_1$	$A - a_2$	$A - a_3$	$N - a$
Total	A	A	A	N

where each a_i $(0 \leqq a_i \leqq A)$ represents the results of A independent binomial trials in each of which "Success" or "Failure" has been observed, it is known that the conditional probability of obtaining a particular configuration subject to a fixed overall marginal total $(= a)$ is

$$f(a_1, a_2, a_3 \mid a) = \binom{A}{a_1}\binom{A}{a_2}\binom{A}{a_3} \Big/ \binom{N}{a}$$

Freeman & Halton (*Biometrika*, v. 38, 1952, p. 141–149) suggested a randomized test procedure using these conditional probabilities in evaluating the significance of 2×3 and $r \times c$ contingency tables generally. This method is used to obtain the