Interest in the theory and application of nonnegative matrices has been growing rapidly since about 1950. An indication of this interest is the appearance of this book with its fifteen-page bibliography. A brief comparison of this work with the earlier one by Eugene Seneta [7] is natural. Of course, the two have some topics in common, such as the basic Perron-Frobenius theory and finite homogeneous Markov chains. However, there are enough differences to make the works complementary. In the chapter on Markov chains, for instance, Berman and Plemmons present the recent analysis by Meyer [3, 4] which utilizes the group generalized inverse. Seneta on the other hand has a discussion of inhomogeneous chains and a long Part II dealing with countably infinite nonnegative matrices.

The area of nonnegative matrices is so vast that no single book can be all things to all people. The present work perforce reflects the interest of the authors. Such an orientation can, and in the present case does, result in a very interesting text. In Chapter 3, for example, there is a detailed analysis of the semigroup of nonnegative matrices. Chapter 10, the final chapter, deals with the linear complementary problem. Strangely enough, although the authors begin the book with a chapter on the generalization of nonnegative matrices to cone preserving maps which material they utilize several times (especially in Chapter 5, "Generalized Inverse Positivity"), they do not employ this generality in Chapter 10. Some indications of the possibilities can be found in the papers referenced in notes 10 and 11 of this chapter and in Chapter 2 of Berman [1].

As previously mentioned, the authors begin with a study of cone preserving maps, and in the second chapter they restrict their attention to elementwise nonnegative matrices. The results concerning the existence of eigenvalues and eigenvectors are proved in Chapter 1 and are summarized for elementwise nonnegative matrices in the introductory section of the next chapter. This arrangement may be awkward for some. However, a user such as a mathematical economist who either knows these basic results or is willing to accept them should be able to digest the material in this chapter without first studying its predecessor.

*Academic, New York, 1979; 316 pp., $32.00.

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52 Vanderbilt Ave., New York, NY 10017 0024-3795/81/010293+3$02.50
Chapter 1 is a bit uneven, many of the results being left as exercises. This feature is not unexpected if one bears in mind that what is presented is a survey of the state of the subject at the time of writing.

The fourth chapter contains a treatment of symmetric nonnegative matrices and in particular of the inverse eigenvalue problem. While this topic appears to be outside the mainstream of the text, its inclusion adds to the pleasure of reading the book.

The exegesis of $M$-matrix theory given in Chapter 6 is in the style of Plemmons's survey paper [6]. The notes to this section are particularly useful to someone wending his way through the literature. These results form the foundation for the remaining material.

Chapter 7 deals with iterative methods for linear systems. For the sake of completeness, systems whose coefficient matrix is a nonsingular $M$-matrix and systems with a hermitian coefficient matrix are considered.

Perhaps the weakest part of the text is the chapter on input-output analysis in economics. There has arisen within mathematical economics a significant body of results dealing with nonnegative matrices and $M$-matrices (cf. Kemp and Kimura [2]). The work in economics has been largely independent of the work in mathematics, and as a consequence the two disciplines often employ different names for the same objects. Although the authors do deal rather nicely with open and closed Leontief models, they do not attempt to deal with the parallel theories previously discussed.

The reader should pay particular attention to the exercises and notes at the end of each chapter. These provide extensions of the results given in the body of the text and a guide to the literature. It should be noted that the conjecture mentioned in note (6.5) of Chapter 1 has been answered in the negative by R. C. O'Brien [5].

On the whole the exposition is well done, and this is an excellent companion to Seneta's text. The prerequisites have been kept to the level of matrix theory through the Jordan canonical form, which should make the work accessible to a wide audience.

REFERENCES


*Received 28 January 1980; revised 24 April 1980.*