Preface

Linear algebra and matrix theory are among the most important and most frequently applied branches of mathematics. They are especially important in economic models, where either the model is assumed linear, or the nonlinear model is approximated by a linear model, and the resulting linear model is examined.

This book is mainly a textbook, that covers a one-semester upper division course or a two-semester lower division course on the subject. The book is written for students studying economics and business, however it can also be used in courses offered by the mathematics department, or any kind of engineering departments.

Each chapter consists of three major parts. The first part introduces the new concepts, discusses and proves the main theorems. The new concepts and theoretical results are always illustrated by easy-to-follow numerical examples. The second part of each chapter presents some applications of the material of the chapter. We have selected these applications from special methodology of linear algebra and matrix theory (such as block matrices, matrix exponential, singular value decomposition, pseudoinverses, etc.), linear systems theory (such as discrete and continuous systems), statistics (for example, the least squares method), numerical analysis (such as interpolation polynomials, integral equations), as well as economic modelling (for example, oligopoly, and producer-consumer models). The last section of each chapter offers exercises to improve understanding of the material and to help students to gain experience in problem solving. In each set of exercises we have presented some simple examples which can be solved easily by using the methodology of that chapter, however in each set we also offer some more difficult problems which require deeper understanding and skill in mathematical developments.

The book is organized as follows. Chapter 1 introduces the concept of vectors and matrices, and discusses the elements of matrix algebra. Vector spaces, subspaces, linear independence, basis, and inner-product spaces are examined in Chapter 2. The most important application of linear algebra is

the solution of systems of linear algebraic equations. In Chapter 3 the elimination method is introduced and we demonstrate how to use this method to determine inverses of square matrices. Determinants and their main properties are discussed in Chapter 4. Linear mappings, linear transformations, the vector space of linear mappings, and matrix representations are investigated in Chapter 5. The discussion on diagonal, triangular, and Jordan canonical forms of matrices is based on the theory of eigenvalues and eigenvectors as well as on the main properties of invariant subspaces. The fundamentals of these topics are given in Chapter 6, and special matrices are introduced and examined in Chapter 7. Here we discuss the special properties of diagonal, tridiagonal, triangular, selfadjoint, unitary, and normal matrices, and introduce different kinds of definite matrices and related special matrix classes (such as quasi-definite, quasi-semi-definite, N-, P-, N-P, and P-N matrices). The last chapter of the book introduces and discusses the elements of matrix analysis including vector and matrix norms, and related topics. In a one-semester introductory course we suggest to cover Chapters 1, 2, 3 and large part of Chapters 6. In a one-semester higher level (or in a second) course on the subject we suggest to cover Chapters 4, 5, part of 6, 7, and 8.

It is our pleasure to acknowledge encouragement we have received from our colleagues and friends in both Hungary and the USA. In preparing the manuscript we obtained significant help from our students, and colleagues. Our special thanks should be addressed to Dr. Zoltan Varga for providing us with helpful critique, and to Mark Molnar for all the editorial help we needed in finalizing the manuscript. Finally we mention that it was through various grants from the National Science Foundation and the Joint U.S.–Hungarian Research and Technology Fund that the authors were able to enjoy the continuation of their productive and happy collaboration.

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