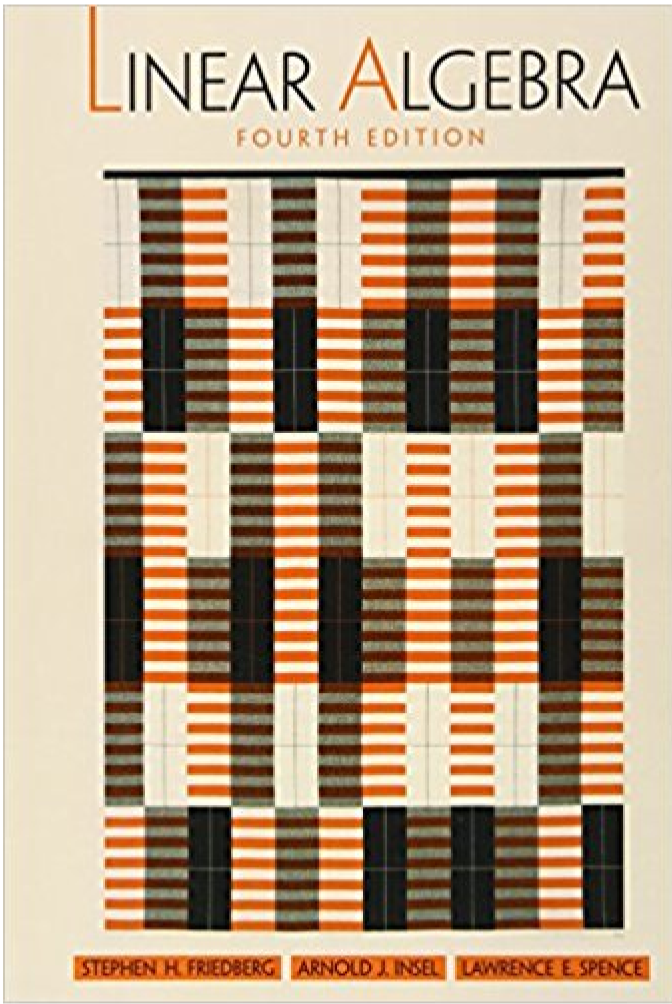
Linear Algebra, 4th Edition



Synopsis

For courses in Advanced Linear Algebra. This top-selling, theorem-proof text presents a careful treatment of the principal topics of linear algebra, and illustrates the power of the subject through a variety of applications. It emphasizes the symbiotic relationship between linear transformations and matrices, but states theorems in the more general infinite-dimensional case where appropriate.

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Customer Reviews

This top-selling, theorem-proof book presents a careful treatment of the principle topics of linear algebra, and illustrates the power of the subject through a variety of applications. It emphasizes the symbiotic relationship between linear transformations and matrices, but states theorems in the more general infinite-dimensional case where appropriate. Chapter topics cover vector spaces, linear transformations and matrices, elementary matrix operations and systems of linear equations, determinants, diagonalization, inner product spaces, and canonical forms. For statisticians and engineers.

The language and concepts of matrix theory and, more generally, of linear algebra have come into widespread usage in the social and natural sciences, computer science, and statistics. In addition, linear algebra continues to be of great importance in modern treatments of geometry and analysis. The primary purpose of this fourth edition of Linear Algebra is to present a careful treatment of the principal topics of linear algebra and to illustrate the power of the subject through a variety of applications. Our major thrust emphasizes the symbiotic relationship between linear transformations and matrices. However, where appropriate, theorems are stated in the more general infinite-dimensional case. For example, this theory is applied to finding solutions to a homogeneous linear differential equation and the best approximation by a trigonometric polynomial to a continuous function.   Although the only formal prerequisite for this book is a one-year course in calculus, it requires the mathematical sophistication of typical junior and senior mathematics majors. This book is especially suited for a second course in linear algebra that emphasizes abstract vector spaces, although it can be used in a first course with a strong theoretical emphasis.   The book is organized to permit a number of different courses (ranging from three to eight semester hours in length) to be taught from it. The core material (vector spaces, linear transformations and matrices, systems of linear equations, determinants, diagonalization, and inner product spaces) is found in Chapters 1 through 5 and Sections 6.1 through 6.5. Chapters 6 and 7, on inner product spaces and canonical forms, are completely independent and may be studied in either order. In addition, throughout the book are applications to such areas as differential equations, economics, geometry, and physics. These applications are not central to the mathematical development, however, and may be excluded at the discretion of the instructor.   We have attempted to make it possible for many of the important topics of linear algebra to be covered in a one-semester course. This goal has led us to develop the major topics with fewer preliminaries than in a traditional approach. (Our treatment of the Jordan canonical form, for instance, does not require any theory of polynomials.) The resulting economy permits us to cover the core material of the book (omitting many of the optional sections and a detailed discussion of determinants) in a one-semester four-hour course for students who have had some prior exposure to linear algebra.   Chapter 1 of the book presents the basic theory of vector spaces: subspaces, linear combinations, linear dependence and independence, bases, and dimension. The chapter concludes with an optional section in which eve prove that every infinite-dimensional vector space has a basis.   Linear transformations and their relationship to matrices are the subject of Chapter 2. We discuss the null space and range of a linear transformation, matrix representations of a linear transformation, isomorphisms, and change of coordinates. Optional sections on dual spaces and homogeneous linear differential equations end the chapter.   The application of vector space theory and linear transformations to systems of linear equations is found in Chapter 3. We have chosen to defer this important subject so that it can be presented as a consequence of the preceding material. This approach allows the familiar topic of linear systems to illuminate the abstract theory and permits us to avoid messy matrix computations in the presentation of Chapters 1 and 2. There are occasional examples in these chapters, however, where we solve systems of linear equations. (Of course, these examples are not a part of the theoretical development.) The necessary background is contained in Section 1.4.   Determinants, the subject of Chapter 4, are of much less importance than they once were. In a short course (less than one year), we prefer to treat determinants lightly so that more time may be devoted to the material in Chapters 5 through 7. Consequently we have presented two alternatives in Chapter 4—a complete development of the theory (Sections 4.1 through 4.3) and a summary of important facts that are needed for the remaining chapters (Section 4.4). Optional Section 4.5 presents an axiomatic development of the determinant.   Chapter 5 discusses eigenvalues, eigenvectors, and diagonalization. One of the most important applications of this material occurs in computing matrix limits. We have therefore included an optional section on matrix limits and Markov chains in this chapter even though the most general statement of some of the results requires a knowledge of the Jordan canonical form. Section 5.4 contains material on invariant subspaces and the Cayley-Hamilton theorem.   Inner product spaces are the subject of Chapter 6. The basic mathematical theory (inner products; the Gram-Schmidt process; orthogonal complements; the adjoint of an operator; normal, self-adjoint, orthogonal and unitary operators; orthogonal projections; and the spectral theorem) is contained in Sections 6.1 through 6.6. Sections 6.7 through 6.11 contain diverse applications of the rich inner product space structure.   Canonical forms are treated in Chapter 7. Sections 7.1 and 7.2 develop the Jordan canonical form, Section 7.3 presents the minimal polynomial, and Section 7.4 discusses the rational canonical form.   There are five appendices. The first four, which discuss sets, functions, fields, and complex numbers, respectively, are intended to review basic ideas used throughout the book. Appendix E on polynomials is used primarily in Chapters 5 and 7, especially in Section 7.4. We prefer to cite particular results from the appendices as needed rather than to discuss the appendices independently. DIFFERENCES BETWEEN THE THIRD AND FOURTH EDITIONS The principal content change of this fourth edition is the inclusion of a new section (Section 6.7) discussing the singular value decomposition and the pseudoinverse of a matrix or a linear transformation between finite-dimensional inner product spaces. Our approach is to treat this material as a generalization of our characterization of normal and self-adjoint operators.   The organization of the text is essentially the same as in the third edition. Nevertheless, this edition contains many significant local changes that improve the book. Section 5.1 (Eigenvalues and Eigenvectors) has been streamlined, and some material previously in Section 5.1 has been moved to Section 2.5 (The Change of Coordinate Matrix). Further improvements include revised proofs of some theorems, additional examples, new exercises, and literally hundreds of minor editorial changes.   We are especially indebted to Jane M. Day (San Jose State University) for her extensive and detailed comments on the fourth edition

manuscript. Additional comments were provided by the following reviewers of the fourth edition manuscript: Thomas Banchoff (Brown University), Christopher Heil (Georgia Institute of Technology), and Thomas Shemanske (Dartmouth College).

Pros:1. Great for self-study. If you work the problems in each section, you'll have a much better grasp of the topic as a whole. There is no official answer key, but many of the problems that look tough are not. (Do not skip the quotient space problems!)2. Elegantly prepares its readers for upcoming topics to the point where important results begin to seem obvious. This book can make you feel smarter than you are, because there are no ugly surprises in the exercise sections and each new section builds from its predecessors.3. Errata provided online.4. Problems which provide results used later in the textbook are (usually) marked.Cons:1. Too expensive, especially considering I've had to use book glue in three places to keep it together. The paper isn't as thick as it should have been -- notes in pencil are obvious on the flipside of the page. At $80 retail, I would give this book its fifth star.2. The optional sections provide only a basic overview of their topic. They are the weakest part of the book. They are worth some effort, but without a more thorough treatment, the exercises become more difficult than they should have been.Con #1 can be said about many math textbooks, so while you shouldn't take that point too harshly, be prepared to do maintenance on your copy. Similarly, con #2 is a minor issue, but it ought to be addressed in the 5th edition, given the price.Pros #1-2 are its main selling points. If I ever write math textbook, I hope that it's of this caliber.

This is a wonderful textbook. It explains nearly everything extremely well and makes you like linear algebra, because many theorems are built on the previous ones and this is like building an edifice step by step. At the end, I feel like all the theorems and lemmas are perfectly interconnected with each other in my brain, and this is a great feeling.

I use this book for reference/review purposes and I am very satisfied with it.The book has a nice emphasize on the mutual relationship between linear transformations and matrices. And it is very readable for me. I finish all materials in a short time.I believe that this book has a fourth edition now, though I don't think that it would be much difference to use an older one.Perhaps the book can be more concise by combining several lemmas/theorems together. For instance, theorem 5.13 and the previous lemma seem not to be necessary (and too easy to prove) and should be combined with theorem 5.14. Also I doubt if this book can be used for the first course in algebra as the author indicated, unless you are teaching a group of genius, of course.

I have 3-4 other books on linear algebra, this one definitely seems the most rigorous. The logical development, as it has been presented thus far, is fine. Exercises often present additional material, which makes it hard to use as a self-teaching guide. (I bought the book for a class, but if I hadn't, I would be in desperate need of the solutions manual.)Applications abound, as well. Skimming through the book, I saw several examples incorporate ideas from physics, natural sciences, or social sciences.I suppose I will update this book if it ends up being terrible in the latter half, but I highly doubt that will end up being the case.

The book isn't well structured and isn't as dense with information as it should be. It is also very poorly constructed for the cost. I wouldn't be so unhappy if its price wasn't so incredibly unreasonable considering much better, much nicer books are considerable cheaper.

Good book

Great book for pure mathematics major.

Saved me a bunch of money, it's the exact same book I needed, but soft cover.

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