{End of previous article - see below}

Title: Linear Algebra and its Applications (Third edition)
Author: David C. Lay
Addison Wesley 2003, ISBN: 0-201-70970-8

Reviewed by: Hugh Porteous
h.l.porteous@shu.ac.uk

This book is a fairly standard treatment of this important topic. Chapter one begins immediately with the solution of simultaneous equations via row operations and continues with a fairly informal discussion of vectors, linear combinations, linear independence and linear transformations. Chapter two discusses matrix operations, including matrix inversion via row operations. It maintains the rather informal approach in a discussion of null spaces, column spaces, dimension and rank. Chapter three introduces determinants, initially via cofactors, but the relation with row operations and matrix operations is also covered. Applications include Cramer's rule and matrix inversion. The determinant is given some intuitive meaning as the change in area or volume arising from a linear transformation.

In chapter four we finally get to the formal definition of a vector space via a set of axioms. Many of the concepts introduced in the first two chapters are now revisited with more formal definitions. Chapter five introduces eigenvectors and eigenvalues, including the characteristic equation and the concept of similarity. Chapter six discusses inner products and orthogonality, while chapter seven is about symmetric matrices and quadratic forms.

The reference to applications in the title of the book is justified in two ways. Each of the chapters is introduced by what the author describes as a "vignette" in which a real life problem is discussed where linear algebra may be used in the solution. These are perhaps a little ambitious, as the reader gets nowhere near seeing how the problems could actually be solved. One of these, perhaps unfortunately, includes a picture of the Columbia shuttle lifting off, described as a "triumph of control systems engineering design". The suggestion is that linear algebra makes it safe to fly.

There are also numerous simple applications of the various parts of the theory incorporated into the text. These include input-output models, computer graphics, Markov chains, dynamical systems and regression. The treatment is fairly superficial and should be regarded as no more than motivation for the linear algebra itself. Indeed I would expect any book on linear algebra to give application examples of this sort.

Throughout the book the scalar field is the real numbers. At one point in the discussion of dynamical systems in chapter 5 complex numbers creep into the story, but the author seems quite apologetic about them. They do not come into the chapter on inner products at all, and so the proof of the fact that symmetric matrices must have only real eigenvalues is hidden in an exercise in another chapter. Although matrix similarity is introduced, it is not explored in any depth, and concepts such as the trace of a matrix, the Jordan form and the Cayley-Hamilton theorem appear only in examples and exercises.

The book is smartly produced with a clear typeface and important items highlit in colour. The page format is almost square, with the left hand third of each page largely blank, but used for the occasional diagram. This convention does not apply to exercises, which are spread in two columns over the page. Rather confusingly the theorems are numbered within the chapters, starting from one each time, but the examples and figures are numbered in the sections, so that a chapter can include several figure ones. Some of the figures are not numbered at all.

The text is supported by a study guide, which I have not seen, and by a web site. This can be found at www.laylinalgebra.com. There is a large selection of exercises, and answers to the odd-numbered exercises in the back. An instructor's edition, which I have not seen, gives answers to all the exercises.