ZMATH 2015a.00680

Baker, Roger; Kuttler, Kenneth

Linear algebra with applications.

Hackensack, NJ: World Scientific (ISBN 978-981-4590-53-2/hbk). ix, 320 p. (2014).

Linear algebra is the most widely studied branch of mathematics after calculus. There are good reasons for this as it plays an important role in many fields. The readership the authors had in mind for this book includes majors in disciplines such as mathematics, engineering and social sciences. It will be useful for beginners and also as a reference for graduates. It introduces linear algebra, but at the same time it is tersely written and includes a great deal of material, a good lot contained in the exercises which, however, also contain many numerical ones. The chapter headings are: (1) Numbers, vectors and fields, (2) Matrices, (3) Row operations, (4) Vector spaces, (5) Linear mappings, (6) Inner product spaces, (7) Similarity and determinants, (8) Characteristic polynomial and eigenvalues of a matrix, (9) Some applications, (10) Unitary, orthogonal, Hermitian and symmetric matrices, (11) The singular value decomposition, and an appendix on using Maple. Several comments are necessary. Chapter (1) introduces 3-dimensional vectors, including their inner product and also their cross-product which is not mentioned again. The angle between two 3-dimensional vectors enters here without formal introduction and is not introduced later via the Cauchy-Schwarz inequality where it arises naturally. Moreover, the cosine rule is fished out of trigonometry. In the other chapters scalars are in an arbitrary field, with the special cases of the real and complex numbers in mind. This poses no pitfalls until one comes to roots of polynomials. In the section on the Cayley-Hamilton theorem, eigenvalues are briefly defined for the first time as roots of the characteristic polynomial of a linear mapping. Then, in Chapter (8), an eigenvalue of a linear mapping is defined as a scalar with the property that there are vectors which are just multiplied by this scalar. Eigenvectors are not defined before eigenvalues, namely as vectors which are just scaled. It is then shown that eigenvalues are roots of the characteristic polynomial, all this without mention of a particular field, without discussing what can happen in the case of real numbers. Thus the student is misled into thinking that in the real case $n \times n$ matrices have n real eigenvalues. These are, however, small quibbles with a well-written book packed with rigorously developed information, plus a great amount of extra theory in the exercises. It also deals with more specialized topics like linear differential equations, difference equations, Markov processes, least squares and the pseudo-inverse. It will thus provide the reader with a solid grounding in linear algebra. *Rabe von Randow (Bonn)*

Classification: H65
Keywords: textbook; numbers; vectors; fields; matrices; row operations; vector spaces; linear mappings; inner product spaces; similarity; determinants; characteristic polynomial; eigenvalue; unitary matrix; orthogonal matrix; Hermitian matrix; symmetric matrix; singular value decomposition; cross-product; Cayley-Hamilton theorem; linear differential equations; difference equations; Markov process; least squares; pseudo-inverse
doi:10.1142/9111