Kwantitatieve Methoden: boekbespreking 70B18

HARVILLE, D.A. (2001).
Matrix algebra: exercises and solutions.
Springer-Verlag, Berlin.
ISBN 0-387-95318-3, xv+271 blz, EUR 39.95 [via de VVS 25% korting].

Matrices are essential in more advanced statistical methods, such as multivariate analysis and linear models. In his earlier book Matrix algebra from a statistician's perspective (1997), David Harville has given an extensive, almost encyclopedic, treatment of matrices useful for statisticians. The present book, Matrix algebra: exercises and solutions, collects the more than 300 exercises from the earlier book and presents their solutions. It is intended for use by students and teachers, studying either on their own or in a course.

The exercises and solutions book begins with some 25 pages for a list of notation and a list of definitions and then proceeds with the same arrangement of chapters as the theory book. The number of exercises varies from 1 per chapter to 51 per chapter. The space allocated to the exercises for the various subjects is roughly proportional to the space allocated to the corresponding subjects in the theory book. Thus, most attention (20 or more exercises) is given to advanced subjects such as linear and quadratic forms (chapter 14: 51 exercises), matrix differentiation (chapter 15), Kronecker products and the vec operator (chapter 16), intersections and sums of subspaces (chapter 17), sums of matrices (chapter 18), and eigenvalues and eigenvectors (21). Less attention (less than 20 exercises) is given to the other subjects, such as basic properties (chapter 1), submatrices and partitioned matrices (chapter 2), linear dependence (chapter 3), linear spaces (chapter 4), trace (chapter 5), geometrical considerations (chapter 6), linear systems (chapters 7, 1 exercise, and 11), inverses (chapter 8), generalized inverses (chapter 9), idempotent matrices (chapter 10), projections (chapter 12), determinants (chapter 13), minimization of second-degree polynomials subject to constraints (chapter 19), the Moore-Penrose inverse (chapter 20) and linear transformations (chapter 22).

The nature of most exercises is theoretical, i.e. they deal with proofs of theoretical results. Only a few have practical calculations with numbers. Most are subdivided into steps that build on each other, so that the way to go is always clear. Some solutions are fairly easy, involving only a short sequence of applying results from theory, but others are complex. Most solutions of steps within exercises are shorter than half a page, and only very few longer than one page. All exercises deal with concepts from the theoretical book, and no new concepts are developed in the exercises, so that they are never theoretically difficult or theoretically challenging. It is somewhat a pity that the chapter on matrix differentiation does not use differentials, which although some additional machinery would have been needed, could have simplified the solutions.

Since the exercise book is complementary to the theory book, it shares the same characteristics: technical in nature, no connection to statistics, and omission of all that

is superfluous to matrices in statistics such as matrices with complex numbers and general vector spaces. In view of the length of the books (almost 300 pages for the exercise book and more than 600 for the theory book), the omission of any statistics seems justified in the treatment of methods and results, where no examples from statistics are given; but references to the statistical literature are also missing.

Judging the book as a whole, I found it a good and readable complement to the theory book. It can also be used with another theory book, but then the references to theorems and sections will have to be translated. It requires some basic knowledge of matrix algebra, such as provided in an introductory course. Its technical nature and the omission of examples from and references to statistics makes the book hard reading for students that are not already well versed in advanced statistical methods; they will wonder what all the results are needed for, and they will probably have difficulty reading the book on their own. It is thus most suited for a specialized course in matrix algebra. The strong points are the same as those of the theory book: a fairly complete and straightforward treatment of matrix methods and matrix results for use in statistics.

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