Nonparametric Functional Data Analysis: Theory and Practice, by Frédéric FERRATY and Philippe VIEU, Berlin: Springer, 2006, ISBN 0-378-30369-3, xx + 258 pp., $79.95.

This is a research monograph rather than a practical book or, even less, a textbook. For the latter, your needs are better served by Ramsay and Silverman (2005a, b). In a sense, the present book is heavily biased toward statistical theory and is weak on practice and applications. For the theory aspect, the present book does bring something new and, indeed, some novel theoretical investigations into the kinds of functional data problems not addressed by Ramsay and Silverman (2005a). While Ramsay and Silverman's books focus on exploratory and data analytic techniques for sparsely observed functional data, and employ techniques for smoothing and extrapolation using smoothing spline methods, the present book focuses on issues that arise from analysis of high resolution functional data, which can be easily registered or made to balance (pp. 33–34). The present book applies kernel regression techniques to functional data problems such as functional regression or classification, where the predictor is a function. The use of "nonparametric" in the title, although appropriate, is not totally distinctive, because I consider most techniques used in Ramsay and Silverman (2005a) nonparametric as well.

The book mentions several applications in chemometrics, speech recognition, and electricity consumption forecast. I would like to add more, such as climate data analysis, material sciences, and bioinformatics. As someone who works closely with scientists on various interdisciplinary investigations on a daily basis, I feel strongly that there is need for new statistics that can deal with increasingly high throughput and high resolution measurements. Modern data analysis can benefit greatly from the recent statistical advent in functional data analysis. I think there will be many developments in the area of high-dimensional statistics when there are more observed variables than the number of replicates or samples, and multivariate statistics should receive revived interest in statistical research. In a sense, rather than sticking strictly with the existing techniques, one should adopt a pioneering attitude toward functional data analysis, and professional statisticians should be prepared to develop on their own techniques appropriate for a given problem, because much new statistics remains to be developed for the emerging problems (Lu 2006).

Nonparametric statisticians should feel very much at home with the approach taken in this book. The authors have defined a broad and interesting framework in Part I, such as functional statistics, semimetrics, and locally weighted regression for functional data. Theoretical results, mainly asymptotics, are provided in Part II. Part V also contains some relevant theory and should be read right after Part II. I should point out some very relevant early work on nonparametric regression with fractal design (Lu 1999). Part III of the book deals with classification problems of functional data. Part IV is unusual, in that it deals with time series and dependent data. Although time series is among my favorite subject, it does not appear obvious how this part fits into the functional data framework, although one may argue that for high frequency time series, functional statistics may be very relevant.

Notwithstanding, I do think the present book is a worthy contribution to the literature. The authors have done a nice job of summarizing some of ongoing research, on which some of the papers exist only in proceedings or in the French literature. Researchers in the growing functional statistics community should be glad to have a copy of the book.

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Matrix Analysis for Statistics (2nd ed.), by James R. SCHOTT, Hoboken, NJ: Wiley, 2005, ISBN 0-471-66983-0, xiii + 456 pp., $105.00.

The first edition of this book was published in 1996, and in 2005, the current second edition was published, expanding the number of pages from 426 to 456. It is intended to be used mainly as a textbook for a course about matrix methods for graduate students in statistics, but a secondary intention is that it could also be useful as a reference book for applied and research statisticians. The prerequisites for this book are an introductory statistics course and an undergraduate course in matrices and linear algebra. In some parts of the book, knowledge of calculus is also necessary.

As the title says, this is a book on matrix analysis that is useful for statisticians, and although it could be used by nonstatisticians as a regular textbook on matrix analysis, it is obvious from many of the examples and some of the special topics covered that special attention is given to the parts of matrix analysis that are of special interest to a statistician. The first chapter, which gives a review of elementary matrix algebra, thus also has a section on random vectors and some related statistical concepts, in which some of the basic definitions and results in statistical distribution theory are reviewed. The second chapter is devoted to vector spaces, where the statistical aspect is an interest in reference regarding a vector of parameters, and the statistical examples are from the area of simple and multiple regression models.

Eigenvalues and eigenvectors is the subject of Chapter 3. Statistical applications of these are, for example, multicollinearity in regression analysis, construction of correlation matrices with some special structure, and principal components analysis. Chapter 4 considers matrix factorizations and matrix norms, which are useful in multivariate distribution theory. Examples in this chapter are from standardization of random vectors, generalized least squares regression, and canonical variate analysis. The following chapter discusses generalized inverses, which in statistics are useful in applications involving quadratic forms and chi-squared distributions, but also for results involving the consistency of an estimator, which is shown in an example.

Systems of linear equations are discussed in Chapter 6, with a special focus on least squares solutions and estimation, while Chapter 7 considers partitioned matrices. The latter chapter has statistical examples that concern comparisons of complete regression models with reduced regression models and derivation of conditional distributions with different forms of covariance matrices. Chapter 8 is devoted to discussions about some special matrices and matrix operations, such as the Kronecker product for analysis of variance, the vec operator for studying the distribution of a sample covariance matrix, the Hadamard product for the covariance structure of certain functions of a sample covariance matrix, and circulant and Toeplitz matrices, with applications in stochastic processes and time series analysis.

Chapter 9 considers matrix derivatives and related topics, such as the method of Lagrange multipliers, which are discussed in relation to maximum likelihood estimation, finding a least squares estimate for an inconsistent system of equations, and obtaining the best quadratic unbiased estimator of the variance in an ordinary least squares regression model. Chapter 10, which is the last chapter, is concerned with some special topics related to quadratic forms, especially in connection to the multivariate distribution. It devotes entire sections to theorems and examples regarding the Wishart distribution, the distribution of quadratic forms in normal variates, the statistical independence of quadratic forms, and the expected values of quadratic forms.

This is an excellent book that fulfills its intentions very well. As a regular textbook on matrix analysis, it covers all the necessary theorems and corollaries, and gives proofs of them, illustrates them with nice examples, and has many interesting exercises at the end of each chapter. The many examples of regular matrix analysis method applied to statistical problems make the book of special interest for a statistician. By supplementing this with theorems and corollaries that are unique to statistics, and thus will not be found in regular textbooks on matrix analysis, the author has produced an excellent textbook for the statistically inclined student of matrix analysis. An applied or research statistician, using it as a reference book, will find all the necessary definitions, theorems, corollaries, and examples. This is a book that all statisticians using matrix analysis would find very useful.

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