Numerical Analysis for Statisticians, Kenneth Lange, second edition, Statistics and Computing, Springer Verlag, New York, ISBN 978-14419594474 (hardcover, $99), xx+600 pages, by Christian P. Robert, Université Paris-Dauphine, Institut Universitaire de France, and CREST, Paris.

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Readership: broad, from graduate students with calculus and mathematical statistics prerequisites to researchers to instructors.

Somehow, I had missed the first edition of this book (Lange, 1999) and thus I read it with a newcomers eyes. (Obviously, I will not comment on the differences with the first edition, sketched by the author in the Preface). Past the initial surprise of discovering *Numerical Analysis for Statisticians* was a mathematics book rather than an algorithmic book, I became quickly engrossed into my reading, so fascinating a book it is! *Numerical Analysis for Statisticians* provides most of the necessary background in calculus and some algebra to conduct rigorous numerical analyses of statistical problems and models. As indicated above by the table of contents, the coverage includes expansions, eigen-analysis, optimisation, integration, approximation theory, and simulation, in exactly 600 pages. The quality of the coverage is uniformly superb, including the simulation chapters that extend all the way to functional distances for MCMC convergence assessment and to Rao-Blackwellisation (with a mention of one of my favourite paper, Casella and Robert, 1996). While a mathematical book, the book is furthermore enjoyable to read from beginning till end as the author links mathematical notions with statistical applications in most chapters: as stated in the Pref-

ace, "each of the chapters weaves a little mathematical tale with a statistical moral."

The above may sound as if *Numerical Analysis for Statisticians* does not fulfill its purpose and is too much of a mathematical book. Be (re)assured this is not the case: the contents are firmly grounded in calculus (i.e., analysis) but the corresponding (numerical) algorithms are only one code away. An illustration (among many) is found in Section 8.4: *Finding a Single Eigenvalue*, where Kenneth Lange shows how the Raleigh quotient algorithm of the previous section can be exploited to this aim, when supplemented with a good initial guess based on Gerschgorins circle theorem. This is brilliantly executed in two pages and the code is just begging to be designed. The EM algorithm (Chapter 13) is immersed into a larger MM perspective (Chapter 12) I particularly liked. Problems are numerous and mostly of high standards, meaning one (including me) has to sit and think about them. References are kept to a minimum, they are mostly (highly recommended) books, plus a few papers primarily exploited in the problem sections.

While I am reacting so enthusiastically to the book (imagine, there is even a full chapter on continued fractions!), it could be that my French math background biases my evaluation and that graduate students over the World would find the book too hard. However, I do not think so: the style of *Numerical Analysis for Statisticians* is very fluid and the rigorous mathematics are mostly at the level of undergraduate calculus. The more advanced topics like wavelets, Fourier transforms and Hilbert spaces are very well-introduced and do not require prerequisites in complex calculus or functional analysis. (Although I bemoan this, even measure theory does not appear to be a prerequisite!) The derivation of Fourier transforms is for instance obtained without residues nor contours. On the other hand, there is a prerequisite for a good background in statistics. This book will clearly involve a lot of work from the reader, but the respect shown by Kenneth Lange to those readers will sufficiently motivate them to keep them going till assimilation of those essential notions. *Numerical Analysis for Statisticians* is also strongly recommended for more senior researchers and not only for building one or two semester courses on the bases of statistical computing, a purpose for which the book is perfectly calibrated. *Numerical Analysis for Statisticians* contains most of the math bases that we need for computational statistics, even if we do not know we need them! Truly, this is an essential book.

Bibliography

Casella, G. and Robert, C. (1996). Rao-Blackwellisation of sampling schemes. *Biometrika*, **83** 81–94.

Lange, K. (1999). *Numerical Analysis for Statisticians.* 1st ed. Springer–Verlag, New York.