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BOOK REVIEW
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Bradley P. Carlin and Thomas A. Louis, Bayesian Methods for Data Analysis (3rd edn).

BAYESIAN METHODS FOR DATA ANALYSIS (3rd edn). Bradley P. Carlin and Thomas A. Louis, Chapman & Hall/CRC, Boca Raton, 2008. No. of pages: 552. Price: $69.95. ISBN 9781584886976

Bayesian Methods for Data Analysis is broad in focus and gives a rigorous introduction to Bayesian methods. This new volume has the feel of a textbook for graduate students in statistics with an emphasis on applied work. It would also be a valuable resource for statisticians seeking to incorporate Bayesian thinking and modelling into their research. Indeed the presentation has a firm theoretical foundation and would be a good resource for academic statisticians who are investigating Bayesian methodologies. The text presumes no previous experience in Bayesian analysis, but the reader should have a background in mathematical statistics at the graduate level.

A strength of this book are the numerous detailed examples that accompany the material in the text. The focus is primarily on biomedical applications and the examples are worked out in detail with clear illustrations and accompanying computer code for the software packages R and BUGS. Thus while the writing is fairly theoretical, the reader can follow along by working through the examples. The final chapter of the book is devoted entirely to three case studies in clinical trials, infectious disease and HIV/AIDS.

The first three chapters of the text give an overview of the Bayesian approach to data analysis. The authors contrast Bayesian and frequentist statistics, and then review concepts in estimation, testing and the role of the prior distribution. Chapter 3 features an overview of computation and Monte Carlo methods for posterior simulation. Unlike other introductory Bayesian texts, this volume is not exhaustive in its detail of basic models and does not provide a catalogue of posterior distributions for the usual parametric models. The discussion of hierarchical modelling and generalized linear models is also fairly brief. Instead of dwelling on the basics, the text emphasizes important and sometimes neglected topics in Bayesian statistics.

For example, Chapter 4 features a rich description of model selection and goodness of fit, with emphasis on Bayes factors and penalized likelihood criteria like DIC. As elsewhere in the text, the writing includes detailed examples with accompanying computer code. I particularly enjoyed the discussion of computational approaches for calculating Bayes factors. The authors review marginal density estimation and computations that average over the model space. Methods for assessing prior sensitivity on analysis results are also discussed.

Chapter 5 discusses the empirical Bayes (EB) approach to data analysis. With the advent of easy to use Bayesian analysis software, EB methods are sometimes neglected in introductory courses. Practitioners can easily fit full hierarchical models averaging over nuisance parameters, and this gives little understanding of the underlying machinery. Thus I found it refreshing to read an accessible account of EB estimation. The authors review parametric and non-parametric approaches and discuss interval estimation and Bayes and frequentist performance.

Chapter 6 discusses principles of Bayesian study design. The focus is on Bayesian clinical trial design, with applications in drug and medical device trials. The authors illustrate how a Bayesian perspective allows the investigators to incorporate other previous trial data and research findings into design via prior distributions. The chapter draws on concepts of statistical decision theory, and an accompanying appendix at the end of the text gives a review for readers in need of a refresher. The chapter works through an example designing a sequence of randomized trials of the efficacy of antiretroviral therapy.

Chapter 7 describes an array of special methods that have useful interpretations when viewed from a Bayesian perspective. The authors describe non-parametric and robust statistics, time series, longitudinal data and survival analysis among other topics. I particularly liked the discussion of spatial and spatio-temporal methodologies including kriging. Indeed this chapter contains something for everyone and it intended to give brief overviews of important analysis problems from a Bayesian perspective.

This is a nice text and would be appropriate as a reference or teaching aid for a graduate level course in applied Bayesian statistics. The emphasis on biomedical applications makes it a valuable resource for research in biostatisitics. Each chapter includes several homework exercises with selected solutions which are worked in detail in the appendix.

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