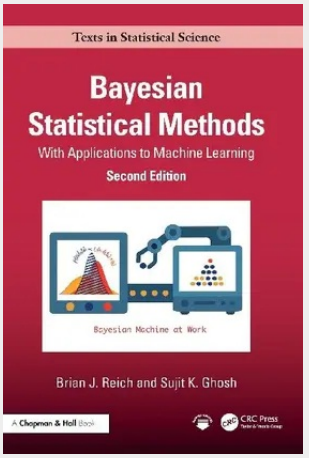
Reich / Ghosh

Bayesian Statistical Methods

With Applications to Machine Learning



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Bayesian Statistical Methods: With Applications to Machine Learning provides data scientists with the foundational and computational tools needed to carry out a Bayesian analysis. Compared to others, this book is more focused on Bayesian methods applied routinely in practice, including multiple linear regression, mixed effects models and generalized linear models. This second edition includes a new chapter on Bayesian machine learning methods to handle large and complex datasets and several new applications to illustrate the benefits of the Bayesian approach in terms of uncertainty quantification. Readers familiar with only introductory statistics will find this book accessible, as it includes many worked examples with complete R code, and comparisons are presented with analogous frequentist procedures. The book can be used as a one-semester course for advanced undergraduate and graduate students and can be used in courses comprising undergraduate statistics majors, as well as non-statistics graduate students from other disciplines such as engineering, ecology and psychology. In addition to thorough treatment of the basic concepts of Bayesian inferential methods, the book covers many general topics: - Advice on selecting prior distributions - Computational methods including Markov chain Monte Carlo (MCMC) sampling - Model-comparison and goodness-of-fit measures, including sensitivity to priors. To illustrate the flexibility of the Bayesian approaches for complex data structures, the latter chapters provide case studies covering advanced topics: - Handling of missing and censored data - Priors for high-dimensional regression models - Machine learning models including Bayesian adaptive regression trees and deep learning - Computational techniques for large datasets - Frequentist properties of Bayesian methods. The advanced topics are presented with sufficient conceptual depth that the reader will be able to carry out such analysis and argue the relative merits of Bayesian and classical methods. A repository of R code, motivating data sets and complete data analyses is made available on the book's website.

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