Uppsala University

Bayesian Statistics and Data Analysis

Reading Instructions

Contents

1 The Bayesian Data Analysis book: Reading instructions

1.1 Chapter 1

- 1.1-1.3 important terms, especially 1.3 for the notation
- 1.4 an example related to the first exercise, and another practical example
- 1.5 foundations
- 1.6 good example related to visualization exercise
- 1.7 example (can be skipped)
- 1.8 background material, good to read before doing assignment 1
- 1.9 background material, good to read before doing assignment 2
- 1.10 a point of view for using Bayesian inference

1.2 Chapter 2

- 2.1 Binomial model (*very important*, related to assignment 2)
- 2.2 Posterior as compromise between data and prior information
- 2.3 Posterior summaries
- 2.4 Informative prior distributions
- 2.5 Gaussian model with known variance
- 2.6 Other single parameter models
  - in this course the normal distribution with known mean but unknown variance is the most important
  - glance through Poisson and exponential
- 2.7 glance through this example, which illustrates benefits of prior information, no need to read all the details (it's quite long example)
- 2.8 Noninformative and weakly informative priors

1.3 Chapter 3

- 3.1 Marginalisation (*very important*)
- 3.2 Normal distribution with a noninformative prior (*very important*)
- 3.3 Normal distribution with a conjugate prior (*very important*)
- 3.4 Multinomial model (*can be skipped*)
- 3.5 Multivariate normal with known variance (needed later)
- 3.6 Multivariate normal with unknown variance (glance through)
- 3.7 Bioassay example (*very important*, related to one of the exercises)
- 3.8 Summary (*can be skipped*)

1.4 Chapter 5

- 5.1 Lead-in to hierarchical models
- 5.2 Exchangeability (a useful theoretical concept)
- 5.3 Bayesian analysis of hierarchical models

- 5.4 Hierarchical normal model
- 5.5 Example: parallel experiments in eight schools (uses hierarchical normal model, details of computation can be skipped)
- 5.6 Meta-analysis (*can be skipped*)
- 5.7 Weakly informative priors for hierarchical variance parameters

1.5 Chapter 6

- 6.1 The place of model checking in applied Bayesian statistics
- 6.2 Do the inferences from the model make sense?
- 6.3 Posterior predictive checking (p-values (*can be skipped*)
- 6.4 Graphical posterior predictive checks
- 6.5 Model checking for the educational testing example

1.6 Chapter 7

- 7.1 Measures of predictive accuracy
- 7.2 Information criteria and cross-validation (*skip, instead read Vehtari, Gelman, and Gabry (2017)*)
- 7.3 Model comparison based on predictive performance (*skip, instead read Vehtari, Gelman, and Gabry (2017)*)
- 7.4 Model comparison using Bayes factors
- 7.5 Continuous model expansion / sensitivity analysis
- 7.6 Example (*can be skipped*)

1.7 Chapter 9

- 9.1 Context and basic steps (*very important*)
- 9.2 Example
- 9.3 Multistage decision analysis (*can be skipped*)
- 9.4 Hierarchical decision analysis (*can be skipped*)
- 9.5 Personal vs. institutional decision analysis (*very important*)

1.8 Chapter 10

- 10.1 Numerical integration (overview)
- 10.2 Distributional approximations (overview)
- 10.3 Direct simulation and rejection sampling (overview)
- 10.4 Importance sampling (used in PSIS-LOO discussed later)
- 10.5 How many simulation draws are needed? (*very important* Exercise. 10.1 and 10.2)
- 10.6 Software (*can be skipped*)
- 10.7 Debugging (*can be skipped*)

1.9 Chapter 11

- Markov chain simulation: before section 11.1, pages 275-276
- 11.1 Gibbs sampler (an example of simple MCMC method)
- 11.2 Metropolis and Metropolis-Hastings (an example of simple MCMC method)
- 11.3 Using Gibbs and Metropolis as building blocks (*can be skipped*)
- 11.4 Inference and assessing convergence (*very important*)
- 11.5 Effective number of simulation draws (*very important*)
- 11.6 Example: hierarchical normal model (*can be skipped*)

1.10 Chapter 12

- 12.1 Efficient Gibbs samplers (*can be skipped*)
- 12.2 Efficient Metropolis jump rules (*can be skipped*)
- 12.3 Further extensions to Gibbs and Metropolis (*can be skipped*)
- 12.4 Hamiltonian Monte Carlo (used in Stan)
- 12.5 Hamiltonian dynamics for a simple hierarchical model (read through)
- 12.6 Stan: developing a computing environment (read through)