Study Group, spring 2012

Bayesian core: a practical approach to computational Bayesian statistics (study group)

Scope

4 weekly exercises (1 for everybody plus 3 exercise of your own choice) are needed to collect credits.

Type

Advanced studies

Prerequisites

The minimal prerequisites for this course are a mastering of basic probability theory for discrete and continuous variables and of basic statistics (MLE, sufficient statistics).

Lectures

Room C131 on Thursdays 10-12 during period IV (on May 3 in room C130).

Content scheme

The purpose of this book is to provide a self-contained entry to practical & computational Bayesian statistics using generic examples from the most common models. The emphasis on practice is a strong feature of this book in that its primary audience is made of graduate students that need to use (Bayesian) statistics as a tool to analyze their experiments and/or data sets. The book should also appeal to scientists in all fields, given the versatility of the Bayesian tools. It can also be used for a more classical statistics audience when aiming at teaching a quick entry to Bayesian statistics at the end of an undergraduate program for instance.

The chapters of the book and their topics are:

1. **Normal models**
    - Conditional distributions, priors, posteriors, improper priors, conjugate priors, exponential families, tests, Bayes factors, decision theory, importance sampling
2. **Regression and variable selection**
    - G-priors, noninformative priors, Gibbs sampling, variable selection
3. **Generalised linear models**
    - Probit, logit and log-linear models, Metropolis Hastings algorithms, model choice
4. **Capture--recapture experiments**
    - Sampling models, open populations, accept reject algorithm, Arnason Schwarz model
5. **Mixture models**
    - Completion, variable dimensional models, label switching, tempering, reversible jump MCMC
6. **Dynamic models**
    - AR, MA and ARMA models, state-space representation, hidden Markov models, forward-backward algorithm
7. **Image analysis**
    - k-nearest-neighbor, supervised classification, segmentation, Markov random fields, Potts model

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- Readings (and required exercise for everyone):
- Week 1 (31.01.2012) : Chapter 2
- Week 2 (07.02.2012) : - (exercise 2.22)
- Week 3 (14.02.2012) : Chapter 3 up to 3.3 (exercise 3.4)
- Week 4 (21.02.2012) : Chapter 3 from 3.3 to end (exercise 3.13)
- Week 5 (28.02.2012) : No meeting because of exams
- Week 6 (06.03.2012) : No meeting because of period break
- Week 7 (15.03.2012) : All of Chapter 4 (exercise 4.4)
- Week 8 (22.03.2012) : All of Chapter 5 (exercise 5.5)
- Week 9 (29.03.2012) : Chapter 6 up to 6.6 (exercise 6.1)
- Week 10 (05.04.2012) : No meeting because of easter break
- Week 11 (12.04.2012) : Chapter 6 from 6.6 to end (exercise 6.17)
- Week 12 (19.04.2012) : Chapter 7 up to 7.2.2 (exercise 7.9)
- Week 13 (26.04.2012) : Chapter 8 up to 8.3

Bibliography

- Marin J, Robert C. Bayesian core: a practical approach to computational Bayesian statistics. New York: Springer; 2007.
- Banerjee S. Bayesian linear model: Gory details 1 the NIG conjugate prior family [document on the internet]. Minneapolis (MN): University of Minnesota; 2008 [cited 2012 Feb 16]. Available from: http://www.biostat.umn.edu/~ph7440/pubh7440/BayesianLinearModelGoryDetails.pdf.