Bayesian Statistics – AS 2019

People, Place, Time

Lecturer: Fabio Sigrist, fabio.sigrist@math.ethz.ch

Place: HG G 3

Time: Tuesday, 15.15 – 17.00

Course Schedule (subject to minor modifications)

Week	Date	Topic
1	17.09.2019	Introduction, Bayes formula, basics of Bayesian statistics, interpretations of probability
2	24.09.2019	Point estimation and decision theory, testing, Bayes factor
3	01.10.2019	Credible sets, Bayesian asymptotics, likelihood principle, conjugate priors
4	08.10.2019	Non-informative priors, improper priors, Jeffreys prior
5	15.10.2019	Reference prior, expert priors, priors as regularizers
6	22.10.2019	Hierarchical Bayes models
7	29.10.2019	Empirical Bayes
8	05.11.2019	Bayesian linear regression model & model selection
9	12.11.2019	Laplace approximation, independent Monte Carlo methods
10	19.11.2019	Rejection sampling, importance sampling, Basics of Markov chain Monte Carlo
11	26.11.2019	MCMC, Gibbs sampler, Metropolis-Hastings algorithm
12	03.12.2019	Adaptive MCMC, Hamiltonian Monte Carlo
13	10.12.2019	Sequential Monte Carlo, approximate Bayesian computation

Exercise Schedule

There are no exercise lessons for this course. Nonetheless, exercise series will be provided on the course webpage. Solutions will also be provided on the course webpage, but they will not be discussed in class. For some of the exercises, the statistical software package R is recommended.

Series	Topic	Hand out	Hand in
1	Posterior predictive distribution, Bayesian decision theory, Bayesian testing, Bayes factor	24.09.2019	01.10.2019
2	Credible intervals, conjugate priors, improper priors	08.10.2019	15.10.2019
3	Jeffreys prior, reference prior, expert priors	22.10.2019	29.10.2019
4	Empirical Bayes, Bayesian regression model	05.11.2019	12.11.2019
5	MCMC: Gibbs sampler, random walk Metropolis algorithm	26.11.2019	03.12.2019
6	Hamiltonian Monte Carlo	10.12.2019	17.12.2019

Software

Some examples in the lecture and exercises will be based on the statistical software R. This is a freely available open source software that works on all platforms. It can be downloaded from CRAN (http://cran.r-project.org/). An R Tutorial can be found on the course homepage. Additional Tutorials for R can be found under http://www.rstudio.com/ide/docs/help_with_r and http://tryr.codeschool.com/.

Written Material

A script as well as the slides used in the course are available on the course webpage. Exercises as well as solutions will also be provided on the course webpage.

Exam

There will be a 20-minutes oral exam during the regular ETH exam sessions. It covers all topics which were discussed and/or applied during either the lectures or the exercises. Upon successfully passing the exam, the students will be awarded 4 ECTS credit points.

PhD students who would like to obtain credit points but do not need to take the exam and obtain a grade need to sign up with the lecturer at the beginning of the semester and hand in at least five well-solved exercises. Exercises should be handed in by email to **Marco Eigenmann (eigenmann@stat.math.ethz.ch).**

Literature

- Christian Robert, The Bayesian Choice, 2nd edition, Springer 2007.
- I A. Gelman et al., Bayesian Data Analysis, 3rd edition, Chapman & Hall (2013)