FALL 2015

MATH 7/8680: BAYESIAN INFERENCE

Class Meeting Monday, Wednesday 5:30 - 6:55

Room:	Dunn 231
Instructor:	E. O.George
	Dunn 237
	Office Phone: 678-5088
	e-mail:eogeorge@memphis.edu
Text:	Bayesian Methods
	Jeff Gill
	CRC Press , A CHAPMAN & HALL BOOK, 2015)
Reference :	Bayesian Data Analysis (3^{rdd} Edition)
	Andrew Gelman, John, B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, and
	CRC Press
Office Hours:	Monday,Wednesday 4:00-5:00
	or by appointment

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Objective

The purpose of this course is to will introduce the basic ideas of modern Bayesian inference using the computational tools of Gibbs sampling and s of Markov Chain Monte Carlo (MCMC) in general. Although some of the philosophical differences between the frequentist and the Bayesian approaches will be discussed, the emphasis of this course will be understanding of the practical application of Bayesian methods to statistical modeling and inference. In this regards, we will develop familiarity with R, WinBUGS and JAGS. The first few weeks of the course will be used to review standard materials of elementary Bayesian estimation. One of the requirement of this class is for each student to have a laptop, and down-load and learn how to use WinBUGS and R. We will cover mainly Chapters 1-5, 6,7, 10-12 and 14 of the text book.

Homework Assignments

There will be weekly homework assignments. Assignments will count for 20% of your course grade.

Tests and Final Exam

There will be a take-home test and a course project, each of which will count for 40% of the course grade.

Topics

1. Introductory Discussion and Background

- (a) Bayes Law
- (b) Bayes Law for Multiple Events
- (c) Conditional inference with Bayes Law
- (d) Introduction to Markov Chain Monte Carlo Techniques
- (e) Simple Gibbs Sampling
- (f) Simple Metropolis sampling
- 2. Specifying Bayesian Models
 - (a) Likelihood Theory and Estimation
 - (b) The Basic Bayesian Framework -Bayesian Credible Intervals and Highest Posterior Density Intervals
 - (c) R for Basic Analysis
- 3. The Normal versus Student's -t Models
 - (a) The Normal Model with and with known parameters
 - (b) Multivariate Normal Model
 - (c) The Student's t-Model
 - (d) Normal Mixture Model
- 4. Prior Distributions
 - (a) Conjugate Priors
 - (b) The Exponential Family Model
 - (c) Uninformative Priors
 - (d) Informative Priors

- (e) Hybrid Priors
- 5. Linear Models
 - (a) The basic Regression Model
 - (b) Posterior Predictive Distribution
 - (c) Linear Regression with Heteroscedasticity
- 6. Model Assessment
 - (a) Posterior Data Repication and Likelihood Function Robustness
 - (b) Sensitivity Analysis
- 7. Bayesian Hypothesis Testing and Bayes Factor
 - (a) The problem with conventional hypothesis testing
 - (b) The Bayes Factor
 - (c) Bayesian Information Criterion and Deviance Information Criterion
- 8. The Basics of Markov Chain Monte Carlo
 - (a) Markov Chains
 - (b) The Gibbs Sampler
 - (c) The Metropolis- Hastings Algorithm
- 9. Implementing Bayesian Models with MCMC
 - (a) Model Specification with BUGS
 - (b) Running WiBUGS
 - (c) Running JAGS
- 10. Hierarchical Models
 - (a) Multilevel Specifications
 - (b) Exchangeability
 - (c) Multilevel Linear Regression
 - (d) Multilevel Generalized Linear Regression