جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Bayesian Statistics - STAT 240

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	STAT 240
Course Title	Bayesian Statistics
Academic Semester	Spring
Academic Year	2018/2019
Semester Start Date	01/27/2019
Semester End Date	05/23/2019
Class Schedule (Days & Time)	02:30 PM - 04:00 PM | Mon Thu

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Haavard Rue	HAAVARD.RUE@KAUST.EDU.SA	+966128080640	4110, 1, Al-Khawarizmi (bldg. 1)	By appointment only.

Teaching Assistant(s)

Name	Email
Cristian Chiuchiolo	cristian.chiuchiolo@kaust.edu.sa

Course Information

Comprehensive Course Description	This course will give an introduction to applied Bayesian statistics from a statistical modelling point of view. We will discuss Bayesian statistics in general and how to do simulation-based inference using Markov chain Monte Carlo (MCMC). We will then use MCMC to analyse various statistical models, discuss techniques for model criticism and comparison, prior choice, sensitivity analysis and the concept of hierarchical models. We will make extensive use of the programming language R and the JAGS program for analysis of Bayesian hierarchical models using Markov chain Monte Carlo.
Course Description from Program Guide	This course will provide an introduction to the theory and methods of Bayesian statistics. In Bayesian statistics, one's inference about parameters and hypotheses are updated, using Bayes rule, as evidence/data accumulates. We will discuss the theory and how to do Bayesian data analysis. Computational aspects will also be discussed, and we will make use of R, JAGS/Stan, to do the inference.
Goals and Objectives	The goal of this course is to prepare the student with practical experience and methodological knowledge, to apply Bayesian methods to real-world problems.
Required Knowledge	Advanced and multivariable calculus, linear algebra, good knowledge in R.
Reference Texts	-The BUGS Book: A Practical Introduction to Bayesian Analysis, CRCPress, 2012. By D. Lunn, C. Jackson, N. Best, A. Thomas, D. Spiegelhalter. (Main text) -The JAGS manual, 2016, by M. Plummer, (User Manual for the JAGS program) -Penalising Model Component Complexity: A Principled, Practical Approach to Constructing Priors, D. Simpson, H. Rue, A. Riebler, T.G. Martins and S.H. Sørbye, Statistical Science, 2017, Vol. 32, No. 1, 1–28 (with discussion). -Bayesian Data Analysis, Third Edition (Chapman & Hall/CRC Texts in Statistical Science) 3rd Ed, by A.Gelman, J.B.Carlon, H.S.Stern, D.B.Dunson, A.Vehtari, D.B.Rubin (Optional additional text)

Method of evaluation	**40.00**% - Final exam **60.00**% - Course Project(s)
Nature of the assignments	This course has two large course projects and a final closed book written exam. There will be optional weekly exercises. The students are encouraged to work together on the course projects, but collaboration is limited to discussing the project, each student still has to write your own report and R/JAGS code.
Course Policies	Grades will be posted on the course website and may be disputed only within 48 hours. If you are unable to complete a course project on time please contact me for appropriate arrangements, otherwise, it will be given a grade of zero.
Additional Information	

Tentative Course Schedule
(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Mon 01/28/2019 Thu 01/31/2019	Introduction to Bayesian statistics
2	Mon 02/04/2019 Thu 02/07/2019	Bayesian inference: learning, prediction and conjugate cases
3	Mon 02/11/2019 Thu 02/14/2019	Prior distributions: vague, “objective” and “reference” priors, and informative priors
4	Mon 02/18/2019 Thu 02/21/2019	Introduction to Markov chain Monte Carlo (I): Gibbs sampling and the Metropolis-Hastings algorithm
5	Mon 02/25/2019 Thu 02/28/2019	Introduction to Markov chain Monte Carlo (II): Gibbs sampling and the Metropolis-Hastings algorithm
6	Mon 03/04/2019 Thu 03/07/2019	Introduction to Markov chain Monte Carlo (III): hierarchical models defined on Directed Acyclic Graphs and Gibbs sampling of these, and the JAGS program
7	Mon 03/11/2019 Thu 03/14/2019	Discussing course project 1
8	Mon 03/18/2019 Thu 03/21/2019	Regression models, linear regression with normal and non-normal errors, generalised linear models
9	Mon 03/25/2019 Thu 03/28/2019	Spring Break
10	Mon 04/01/2019 Thu 04/04/2019	Multinomial models, the multinomial/Poisson transformation
11	Mon 04/08/2019 Thu 04/11/2019	Model checking and comparisons: residuals, predictive checks, model comparison using deviance, and model uncertainty
12	Mon 04/15/2019 Thu 04/18/2019	Issues in modelling: missing data, measurement errors and censoring
13	Mon 04/22/2019 Thu 04/25/2019	Discussing course project 2
14	Mon 04/29/2019 Thu 05/02/2019	Hierarchical models: exchangeability, priors, hierarchical regression models, hierarchical models for variances
15	Mon 05/06/2019 Thu 05/09/2019	Penalized Complexity priors
16	Mon 05/13/2019 Thu 05/16/2019	The road ahead: selected topics in contemporary Bayesian statistics
17	Mon 05/20/2019 Thu 05/23/2019	Final Exam Week

Note

The instructor reserves the right to make changes to this syllabus as necessary.