Instructor: Dr. Maggie Myers  myers@cs.utexas.edu
Office hours:  T 11-12, W 2-3, TH 3:30-4:30, extra hours and appointment
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Intended audience: Masters and Ph.D. students in machine learning, data mining, computational biology, engineering, psychology, geography, business, statistics, mathematics and other fields in need of advanced statistical tools.

Prerequisites: Previous experience in probability, statistics, and linear algebra including computational components is ideal.

Evaluation: Grades will be based on homework exercises (150), quiz/attendance/participation (50), a project (100), a midterm (100) and final (100). Attendance is expected. Please let me know if you will be missing class. Also, probability and statistics are not spectator sports. You will need to roll up your sleeves and work some exercises. To dig deeper into your areas of interest and capitalize on integrating probability and statistics tools with your strengths, you will complete and present a project. Projects can be done individually or with a team. Of course, I am always available for advise and support.

Assignments: Exercises will be assigned and expected to be completed by the following Monday.

Support groups: Please organize yourselves into support groups to discuss the exercises. The ideal model to follow is first to work independently, then to discuss issues with your fellow students, and then to prepare the final write-up. In addition, support groups will be responsible advising and providing practice runs for presentations of the projects at the semesters end.

Course goals and objectives: This course is intended to illustrate current approaches in Bayesian modeling and computation in statistics. It will combine theory and practice. Through a variety of applications, students will learn the basics of designing and carrying out Bayesian analyses, and interpreting and communicating the results. Students will use software packages including WinBUGS and R to fit Bayesian models.

Content

Fundamentals of Bayesian Inference
Setting up probability models
Priors and Prediction
Bayesian Approaches for Standard Univariate Models
Bayesian Approaches for Multivariate Models
Inference from Large Samples and Comparison with non-Bayesian Methods

Fundamentals of Bayesian Analysis
Hierarchical Models/ Estimating Population Parameters from Data
Model Checking and Improvement
Accounting for Data Collection

Advanced Computation
Uses of Simulations
MCMC and BUGS

Regression Models
Linear regression from a Bayesian Perspective
Hierarchical Linear Models
Generalized Linear Models
Other topics as time permits and student interest lead

These concepts will be illustrated using applications drawn from a variety of contexts. Students will apply techniques to data sets using R (and other appropriate packages) for single and multi-parameter models for Bayesian inference, including simulation of posterior distributions, Markov chain Monte Carlo methods, and hierarchical models.

Schedule
Aug. 29 Operations/Example
Sept. 5  Compare Bayesian and Classical /R
Sept. 10  Intro to the Bayesian Method
Sept. 12  Types of Priors
Sept. 17  More Prior Choices
Sept. 19  Bayesian Inference for Poisson
Sept. 24  Bayesian Inference for Univar Normal
Sept. 26  Bayesian Inference for Multinomial
Oct.  1  Bayesian Inference for Multivar Normal
Oct.  3  Hierarchical Models
Oct.  8  Hierarchical Models
Oct. 10  LAB
Oct. 15  Exam
Oct. 17  Hypothesis Testing the Bayesian Way
Oct. 22  Model Checking and Improvement
Oct. 24  Accounting for Data Collection
Oct. 29  MCMC
Oct. 31  LAB
Nov.  5  Bayesian Regression
Nov.  7  Hierarchical Linear Models
Nov. 12  LAB
Nov. 14  Bayesian and Hierarchical GLM
Nov. 19  EM
Nov. 21  Final Exam
Nov. 26  Choice Day
Nov. 28  Presentations
Dec.  3  Presentations
Dec.  5  Presentations / Loose Ends
Dec.  9  Papers due
Dec. 12  Final Presentations