MA 556, Applied Bayesian Statistics Spring 2012

COURSE OUTLINE **01/19/12**

Instructor: Balgobin Nandram; Tel.#: 831-5539; E-mail: balnan@wpi.edu

Office: Stratton 103; Office Hours: Mon: 3:00-4:00, Thu 3:00-4:00; other times by appointment

Class SH106: Thu 5:30-6:25; Break; 7:30-7:25; Break;7:30-8:20

Theme: Applications of methods of Bayesian data analysis to real problems

The emphasis is on Applied Bayesian Statistics. Some knowledge of a programming language (e.g., Fortran, C, Mathlab) and a statistical software (e.g., SAS) would be useful but these are not required. However, you are advised to learn to use R.

Text:

Andrew Gelman, John B. Carlin, Hal S. Stern, and Donald B. Rubin (2004), Bayesian Data Analysis, Second Edition, Chapman & Hall, New York.

The text book is required and I will supplement most of the materials with my own notes. I will point out the sections that you need to read as the course progresses.

A list of topics, which we would cover, is shown below. These topics would not be covered in any specific order.

(1) **One Sample Problems**

Conditional probability and Bayes' Theorem; Coherence; Exchangeability; Priors (conjugate/nonconjugate, non-informative); Prior-Posterior Analysis; Propriety; Binomial, Normal, Gamma models; Loss functions and Bayes estimators (3 weeks)

(2) **Inference**

HPD interval; Marginal likelihood; Bayes factor; Prediction; Model selection (1 week)

(3) **Extra Variation-type problems**

Hierarchical models including Beta-binomial, normal means, exponential means, Poisson means, multinomial model, multivariate normal (3 weeks)

(4) **Numerical Computations**

Laplace approximation; Monte Carlo (MC) methods; Rao-Blackwellization; Markov chain Monte Carlo (MCMC) methods; SIR sampler; Gibbs sampler; Metropolis sampler; Metropolis-Hastings sampler; Diagnostics; Goodness of fit tests; Cross validation; Model uncertainty and model averaging (RJMCMC) (3 weeks)

(5) **Generalized Linear Models**

Logistic regression, Probit regression and Poisson regression models (1 week)

(6) **Some Applications**

Survey sampling; Categorical data analysis; Time series; Missing data; Spatial Statistics; etc. (3 weeks)

Course Activities

(1) **Homework Assignments**

There will be one assignment (4-8 problems) every two weeks; the number of problems will depend on the amount of work required. A few problems will be taken from the text book and most will be made up by the instructor. Many of the problems will be of a practical nature and you will need to use a computer. Some problems will be of a theoretical nature and will require analytical skills.

(2) **Tests**

There will be a test every other week at 8:00pm, and you will be given twenty (20) minutes to do it. The test will be given on a week when a homework assignment is not due. Each test is of a technical nature and it would be based on a single question that requires analytical skills. Although there is a test on the first class, each test will be based on the previous week's materials. Thus, there are seven (7) tests, and your best five (5) tests will be selected when your final grade is computed.

(3) **Final Exam**

The final exam is based on the materials we covered in the course. There will be four or five essay-type questions which will require analytical skills. The final examination will last for two hours.

(4) Participation

Your participation in class is important. You must ask questions, and raise issues. If you can find any errors in the lecture notes, homework solutions or test solutions, this will count towards your participation. If you never participate in class, you will be graded zero for this activity.

(5) **Notebook**

You are required to provide neat and clearly written lecture notes. You will be graded for demonstrating that you clearly understand the course materials. You

must motivate the lecture notes, and simply reproducing the lecture notes is not enough. You are not required to discuss new materials, but there will be added incentives if you have new ways of presenting the same course materials already presented in each class. You need to state explicitly in a table of contents where you have made changes in the lecture notes. On top of the activities involving homework assignments, participation and bi-weekly tests, this pedagogical activity will help you to master the course materials. Please note that you must turn in your individual notebook at the end of the course, and you are allowed to discuss how to present the course materials with your class mates.

Homework Assignments	25
Participation	5
Notebook	10
Tests	30
Final Exam	30

	100

Final Grade (A, B, C, D, F)

F: less than 50
D: 50 to 60
C: 60 to 74
B: 75 to 84
A: more than 84

Important Dates

Test	8:00pm every other week
Home Work	Every other week
Notebook	Thursday, April 26, 2012
Final Exam	Thursday, April 26, 2012

Disability

If you need course adaptations or accommodations because of a disability, or if you have medical information to share with me, please make an appointment with me as soon as possible; see my office hours on the first page of this document. If you have not already done so, students with disabilities, who believe that they may need accommodations in this class, are encouraged to contact the Disability Service Office (DSO) as soon as possible to ensure that such accommodations are implemented in a timely fashion. The

DSO is located in the Student Development and Counseling Center, the phone number is 508-831-4908 and e-mail is DSO@WPI.EDU.

Academic Dishonesty

The web site, http://www.wpi.edu/Pubs/Policies/Honesty, states "Any act that interferes with the process of evaluation by misrepresentation of the relation between the work being evaluated (or the resulting evaluation) and the student's actual state of knowledge is an act of academic dishonesty." See the web site for the procedures associated with academic dishonesty.