SYLLABUS

STAT 664: Advanced Statistical Inference

Spring 2006

Instructor: Dr H. Bensmail
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Office Hours:

Monday	3:00-5:00p.	p.m. or by appointment.
Wednesday	3:30-5:00	p.m. or by appointment.

Course Time & Place: Section 001 M-W 12:40-2:00 or to be decided later

Text & Lecture Notes: Lecture Notes on: **Bayesian Data Analysis** by Gelman et al.

Optional: **Likelihood, Bayesian, and MCMC Methods in Quantitative Genetic by Sorensen** and D. Gianola

My own Notes: **Dr. H. Bensmail** (in preparation-sole author)

Statistical Software & Calculator: WinBugs(free software) + (Mathlab or Splus)+R+Octave.

Course Grade & Evaluation:

Project (Article to study)	100 points	20%
Test 1 (Take home)	100 points	25%
Test 2 (Take home)	100 points	25%
Final Exam (Take home)	100 points	30%
Total	**400 points**	**100%**

Chapters:

Chapter 1: Review:

1.1 Probabilities and Random variables
1.2 Bayes theorem
1.3 Posterior, prior, marginal, conditional
1.4 Simulation using Cummulative function
1.5 Measure of uncertainty
1.6 Useful results from probability theory
1.7 Some useful integration to know
1.8 Functions of Random variables

Chapter 2: Single parameter models:

2.1 Binomial
2.2 Posterior distribution
2.3 Summarizing posterior inference
2.4 Informative and vague prior
2.5 Conjugate prior
2.6 Unique prior using maximum entropy
2.7 Univariate normal with known variance
2.8 Univariate mean with unknown variance
2.9 Other standard single parameter models
2.10 Noninformative prior

Chapter 3: An introduction to Likelihood Inference

3.1: Likelihood function and MLE
3.2: Likelihood for Gaussian Model
3.3: Fisher's information Measure
3.3: Asymptotic properties
3.5: Computation
3.6: Evaluation of hypothesis

Chapter 4: Multivariate models

4.1 Averaging over the "nuisance parameters"
4.2 Normal with noninformative prior
4.3 Normal with conjugate prior
4.4 Normal with semi-conjugate prior
4.5 Multinomial

Chapter 5: Bayesian inference
5.1 Bayes theorem (detail)
5.2 Posterior
5.3 Bayesian updating
5.4 Feature of posterior distribution
5.5 Normal approximations to the posterior
5.6 Large sample theory
5.7 Frequency evaluation of the Bayesian inferences

Chapter 6: Linear models
6.1: Linear regression
6.2: Mixed linear model

Chapter 7: Hierarchical models
7.1 Parameterized prior
7.2 Exchangeability
7.3 Computation with hierarchical models
7.4 Hierarchical modeling applied to Meta-analysis

Chapter 8: Prior and Bayesian analysis
8.1 Effect of priors
8.2 Bayesian asymptotics
8.3 Statistical information and Entropy
8.4 priors with little information

Chapter 9: Model checking and uncertainty
9.1 Principles and models for model checking
9.2 Model selection: Bayes factor
9.3 Posterior as a mean for checking a model
9.4 Estimating the marginal likelihood
9.4 Sensitivity analysis and Goodness of fit
9.5 Bayes factor using Gelfand and Laplace approximation

Chapter 10: Advanced computation
10.1 Finding posterior modes
10.2 Mixture approximations
10.3 Finding marginal posterior using EM algorithm
10.4 Finding conditional posterior density
10.5 Hierarchical logistic regression
10.6 Logistic discrimination and the construction of neural nets

Chapter 11: Simulation

11.1 Posterior inference from simulation
11.2 Direct simulation
11.3 Importance resampling
11.4 Makov chain monte carlo
11.5 Metropolis algorithm
11.6 Data augmentation algorithm
11.7 Gibbs sampling
11.8 Reversible Jump MCMC
11.8 Convergence

Chapter 12: Mixture models

12.1 Setting up the model
12.2 Unsupervised and supervised clustering
12.3 Computation

SOME IMPORTANT DATES TO REMEMBER–Spring 2004

January 11	**Classes Begin.**
January 16	**Martin Luther King Day**
March 18-24	**Spring Break**
April 15	**Spring Recess**
April 28	**Classes End**
April 29-30	**Study Period**
May 3-7	**Final Exams**
May 7	**Doctoral Hooding Ceremony**
May 8	**Commencement**