REVIEW

1. Setting up a probability model, Bayes'rule, posterior means and variances, binomial model
2. Standard univariate models including the normal model, conjugate and noninformative prior distribution
3. Multiparameters models, normal with unknown mean and variance, the multivariate normal distribution, multinomial models
4. Hierarchical models, estimating populations parameters from the data
5. Posterior simulation and integration
6. Markov Chain Simulation
7. Data Analyses with implementation of MCMC methods
8. Bayesian hierarchical linear regression models
9. Hierarchical Generalized Linear Models
10. Bayesian Semi-Parametric GLM



1. Setting up a probability model

- Bayes' Theorem
- Single parameter models
  Binomial Model
- Summarizing Posterior Inference
- Informative Prior Distributions
- Conjugacy
- Exponential Families and Sufficient Statistics
- Example: Bayesian inference under a binomial model



2. Standard univariate models

- Normal model, mean unknown
- Predictive distribution
- Normal model, multiple obs., mean unknown
- Normal model, multiple obs., variance unknown
- Standard distributions
  Binomial
  Poisson (with application)
  Exponential
- Non informative Prior Distributions
  Jeffrey's invariance principle



3. Standard univariate models

- Multiparameters models
- Normal model with mean and variance unknown, with
  – non-informative,
  – conjugate and semi-conjugate prior
- Monte Carlo integration (example for normal data)
- Multinomial model with conjugate Dirichlet prior
  – example (Presidential election)
- Multivariate Normal model with mean and covariance unknown, with
  – non-informative prior
  – conjugate prior
- Application: analysis of bioassay experiment

## 4. Hierarchical Models

- Hierarchical models for combining information and meta-analysis
- Rat-tumor example
  - analysis with a fixed prior
  - analysis with historical data
- Exchangeability (de Finetti's theorem)
- Posterior predictive distributions
- Fully Bayesian treatment of the hierarchical model
  - computation
  - Rat-tumor example (cont.)



## 5. Posterior Simulation

- Posterior simulation and integration
- Direct simulation
  - by calculating at a grid of points
  - Rejection Sampling
- Numerical Integration
- Importance Sampling
- Importance Resampling (SIR)



## 6. Markov Chain Simulations

- Markov Chain
- Differences between MC and iterative simulations (IS)
- Metropolis algorithm (MA)
  - Bivariate unit normal density with bivariate normal jumping kernel
  - Theoretical concerns about the MA
- Metropolis Hastings algorithm (MHA)
- Gibbs Sampler (GS)
- Metropolis within Gibbs
- Assessing convergence
- Adaptive simulation algorithm



## 7. Data Analyses with Implementation of MCMC methods

- Hierarchical Linear Regression Model: analysis of the Rat Population Growth Data
- Generalization of the Binomial Logistic Model: analysis of the Beetles data

## 8. Bayesian hierarchical linear regression models

- Bayesian analysis of the "ordinary linear regression" (Chapter 8)
- Example: analysis of radon measurements
- Hierarchical Linear Regression Models (Chapter 13)
- Simple random effect model
- Mixed effect model
- Bayesian Variable Selection



## 9. Hierarchical Generalized Linear Models

- GLM from a Bayesian prospective
- Hierarchical models, focusing on the normal model for the GLM-coefficients
- Hierarchical logistic regression
- Example: rat tumor data



## 10. Bayesian Semi-Parametric GLMs

- Developmental Toxicology Studies in Laboratory Animals
- Standard Approaches
- Semiparametric Extensions of GLM's
  - Semiparametric Logistic Regression
  - Semiparametric Poisson Regression
- Bayesian Data Analyses of Teratological Experiments
- Results and Discussion