

# Bayesian Statistics, 22S:138

## Fall 2009

### 1 General Information

Instructor:	Kate Cowles, 374 SH, 335-0727 kcowles@stat.uiowa.edu
Office hours:	T 1:30 - 2:20 p.m. W 12:30 - 1:20 p.m. Th 1:30 - 2:20 p.m. Please feel free to make appointments to see me outside of office hours, and to send me questions by e-mail.
Department:	Statistics and Actuarial Science, 241 SH
DEO:	Luke Tierney, 241 SH, 335-0712
Lectures:	M, W, F 11:30 - 12:20 61 SH
Lab:	Alternate F 11:30 - 12:20 41 SH
Web page:	<a href="http://www.stat.uiowa.edu/~kcowles/s138_2009">http://www.stat.uiowa.edu/~kcowles/s138_2009</a> Handouts, homework assignments, datasets, etc. will be posted on the web page for you to download.
Textbook:	Gelman, Carlin, Stern, and Rubin, <i>Bayesian Data Analysis</i> 2nd ed., Chapman & Hall/CRC, 2004
On reserve:	Berry, <i>Statistics: A Bayesian Perspective</i>
Math Sciences Library	Johnson and Albert, <i>Ordinal Data Modeling</i>
125 McLean Hall	Lee, <i>Bayesian Statistics: An Introduction</i> Carlin and Louis, <i>Bayes and Empirical Bayes Methods for Data Analysis</i> WinBUGS manuals

### 2 Course goals and objectives

Through hands-on experience with real data from a variety of applications, students will learn the basics of designing and carrying out Bayesian analyses, and interpreting and communicating the results. Students will learn to use software packages including WinBUGS and BOA to fit Bayesian models.

### 3 Evaluation of students

#### 3.1 Homework

Homework assignments will consist of data analysis on the computer, written interpretation of computer output, and other written questions. In general, homework will be assigned each Fri. and will be due in class the following Fri. Exceptions to this schedule will be announced in class.

Show your work when solving written homework problems. For computer problems, turn in printouts of your commands or programs and their output.

You are encouraged to study with others. However, if you do work with others on homework assignments, please: a) write up your own assignment and make sure you completely understand all solutions that you submit, and b) write the names of the others in your study group on your assignment.

Late homework will not be accepted except as required by university policy, i.e. because of “illness, mandatory religious obligations, or other unavoidable circumstances or University activities.”

## 3.2 Projects

Students will work in groups of three to carry out projects involving application of Bayesian methods to problems of their own choosing. Some examples are:

- Carry out a complete Bayesian analysis of a real dataset. This might involve:
  - description of the research question and dataset
  - specifying an appropriate Bayesian model
  - determining appropriate values for prior parameters
  - fitting the model using WinBUGS
  - checking convergence
  - analyzing the output using BOA
  - reporting and interpreting the results
- Compare different methods of fitting the same model to the same dataset
  - normal approximations
  - MCMC
  - other simulation methods
  - analytical computation (if feasible)
  - etc.
- Carry out a Bayesian analysis of a dataset for which a classical analysis has been reported in a journal. Compare and contrast the results obtained by the two approaches.
- Fit a Bayesian model to a dataset using several different choices of prior (hyperparameters and/or functional form). Discuss the meaning of the different results, and the robustness of the model to prior specifications.
- Fit several different plausible Bayesian models to the same dataset. Carry out a check of model adequacy and model fit. Discuss the results.

- There are endless other possibilities. Find something that interests you, or see me for ideas.

I will expect more sophisticated projects from graduate students.

Projects will be carried out in three phases. Please meet with me at least once while you are working on each phase.

- Project proposal (due 11/02)

This is a detailed description of what you plan to do, including question(s) to be addressed, dataset to be used, methods to be applied. Also specify the method of presentation that you intend for the final project. (See below.)

- Project interim report (due 11/18)

This informal report will indicate that your project is “on track.” All computing should be done at this time. The report will include results obtained thus far and a brief summary (hand-written is O.K.) of what they mean and what remains to be done. In addition, the report will include a list of the tasks performed by each member of the project team.

- Project presentation (papers or presentation materials must be posted or submitted by 12/07)

Projects must be finalized in a form that can be shared with the entire class, such as:

- posting a document on the course web page
- preparing a poster
- giving an oral presentation with overheads, slides, or computer images

Posters and oral presentations will be given in class during the final week of classes.

### 3.3 Exams

There will be two 1-hour midterm exams and one comprehensive 2-hour final. Students may bring one 8-1/2 x 11 in. sheet of paper with notes to each midterm, and 3 sheets to the final.

Missed exams may be made up only with documentation of reasons required by university policy (see “Late Homework” above).

Exam dates and times:

Midterm 1	Fri. 10/02	in class
Midterm 2	Fri. 10/30	in class
Final	Mon. 12/14	2:15