

AMS 206

Bayesian Statistics

Winter 2007

## Course Policies and Syllabus

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**Web page:** <http://www.soe.ucsc.edu/classes/ams206/Winter07/>

**Lectures:** Monday, Wednesday, and Friday, 11:00am-12:10pm, Earth & Marine Sciences B-214

**Required Texts:** *Bayesian Methods* by Thomas Leonard and John Hsu, Cambridge University Press; and *Finite Markov Chains and Algorithmic Applications* by Olle Häggström, Cambridge University Press

**Prerequisites:** Knowledge of calculus (one-variable required, multivariate very helpful) and some prior exposure to probability and statistics (at least at the level of AMS 5, preferably calculus-based, i.e., at the level of AMS 131).

**Course Objectives:** To introduce the basic ideas of Bayesian statistics, including both foundations of the philosophy and practical aspects of implementation (such as computing), so that by the end of the course, students should be able to apply these skills and produce a complete analysis of a (straightforward) real-world problem. This course is also meant as a pre-requisite for AMS 207.

**Homework:** There will be eight short weekly assignments, due at the beginning of class on the dates specified on the schedule on back. You may discuss homework freely with other students, but you must write up assignments on your own. You must show your work for full credit. The material in this course will build upon itself, so it is important for you to keep current. Please note that if enrollment is high, not all problems on each assignment may be graded. Assignments will have both required and optional problems. The optional problems will not count toward the course grade, but it is highly recommended that you do the optional problems if you plan to take AMS 207.

**Reading:** There is a lot of material in this course and it will go quickly. I may not have time to cover everything in class, so you will be expected to read the relevant sections of the texts (listed on the schedule).

**Computing:** We will be using the statistical package **R**, which is open-source, so you can download and run it on the computer of your choice. Some homework problems will require extensive computation.

**Exams:** There will be an in-class midterm on Wednesday, February 21. This exam will be open book/notes, and will have the weight of two homework assignments in the course grade. There is no final exam.

**Course Grade:** Homework: 80%  
Midterm: 20%

## Tentative Schedule

Date	Sections	Topics
Jan 5	1.0, H1	Intro to the course; probability review and philosophy
8	1.1	Review of probability distributions and CLT
10	1.1-1.4	Likelihoods and (Frequentist) maximum likelihood estimation
12	1.1-1.8	Likelihoods; using R
15		Holiday (no class)
17	2.0-2.2	Bayes Theorem - discrete version (HW #1 due)
19	2.3-2.4	Simple model selection; Exchangeability
22	3.0-3.2	The Bayesian paradigm
24	3.2-3.3	Posteriors, conjugate priors (HW #2 due)
26	3.3	Poisson likelihoods
29	3.4	Gaussian likelihoods with known variance
31	3.5	Other likelihoods (HW #3 due)
Feb 2	3.6-3.7	Vague Priors
5	5.0-5.2	Multiparameter likelihoods
7	6.4	Monte Carlo estimation (HW #4 due)
9	H2-6	Review of Markov chains
12	H7	Metropolis-Hastings sampling
14	6.6, H7	Gibbs sampling (HW #5 due)
16		Review
19		Holiday (no class)
21		Midterm exam
23		(no class)
26		More on complete conditionals
28		MCMC monitoring and convergence diagnostics
Mar 2		More on MCMC (HW #6 due)
5	6.9	Hierarchical modeling I
7		Hierarchical modeling II
9		Additional examples (HW #7 due)
12		Special Topics
14		Recap
20		(HW #8 due at 10am in BE 151)