
COURSE SYLLABUS

Overview

Course Description	<p>This 4-unit course involves the mathematical underpinnings of the Bayesian approach to statistical inference; closed form computations; computation; hierarchical models; model selection; hypothesis testing; prior specification; comparative inference; nonparametric methods.</p> <p>Letter Grading or SU grading.</p>
Prerequisites	<p>Biostatistics 200A, B. Biostatistics 202A, B.</p>
Instructor	<p>Andrew Holbrook Assistant Professor Department of Biostatistics UCLA Fielding School of Public Health (FSPH) Office: CHS 76-062A Email: aholbroo@g.ucla.edu</p>
Class Days, Times, Location	<p>Course meets 3 hours per week + 1 hour per week discussion. Lectures are Monday 1:00-2:50pm and Wednesday 1:00-1:50pm.</p>
Office Hours	<p>Wednesday 2:00-3:00pm.</p>
Course Texts	<p>Recommended texts:</p> <ol style="list-style-type: none">1. Gelman, Carlin, Stern, Dunson, Vehtari, Rubin (2013). Bayesian Data Analysis. 3rd edition, Chapman & Hall/CRC Press.2. Christensen Ron, Johnson Wesley O., Branscum Adam J., Hanson, Timothy E. (2011). Bayesian Ideas and Data Analysis: An Introduction for Scientists and Statisticians. Chapman & Hall/CRC.

Required Readings | Reading for a particular class should be completed before coming to class.

Course Format | Lecture 3 hours a week and 1 hour of discussion.

Classroom Participation & Attendance	Student participation and attendance will be measured during each lecture and included in the course grade. Students are expected to actively engage in discussions/ask questions/participate.
UCLA ADA Policy	Students needing academic accommodations based on a disability should contact the Center for Accessible Education (CAE) at (310) 825-1501 or in person at Murphy Hall A255. When possible, students should contact the CAE within the first two weeks of the term as reasonable notice is needed to coordinate accommodations. For more information visit www.cae.ucla.edu .
ADA Contact	Nickey Woods Center for Accessible Education A255 Murphy Hall Phone: (310) 825-1501 TTY / TTD: (310) 206-6083 Fax: (310) 825-9656
Inclusivity	UCLA's Office for Equity, Diversity, and Inclusion provides resources, events, and information about current initiatives at UCLA to support equality for all members of the UCLA community. I hope that you will communicate with me or your TA if you experience anything in this course that does not support an inclusive environment, and you can also report any incidents you may witness or experience on campus to the Office of Equity, Diversity, and Inclusion on their website (https://equity.ucla.edu/).

Learning Objectives

To understand:

1. The difference between Bayesian and classical inference
2. Theory and mechanics of Bayesian inference
3. How to fit Bayesian models algebraically and understand how models combine data and prior inference to make an inference.
4. Understand computing for Bayesian models
5. Bayesian approaches to regression and other models

Course Assignments & Exams

Grading:

Grades are based on homework 60%, presentation 20% and associated report 20%. Please email each homework as a single pdf to me. Same for the associated report. All homework should preferably be typed (else extremely neat) and the associated report must be typed. Equations and math will be required, but words are also necessary to explain what you are doing in the homework.

Presentation and Report:

You will present on a relevant Bayesian paper of your choice. Identify paper for presentation by October 27. Papers must be cleared with me. A list of possible papers is available from the web site. We will use the last 2 class meeting days for student presentations. If needed, we will also meet finals week. Presentations are scheduled for 20 minutes. Then turn in a 3 page typed report (figures/tables may be included after the 3 pages) summarizing your presentation. Due Monday December 6, 11:59pm. It is expected that you will cut and paste tables and figures from the paper in your presentation and report.

Course Exams Schedule

Final report is due on December 6 at 11:59pm.

Course Policies & UCLA Policies

Message about Academic Integrity to all UCLA Students from UCLA Dean of Students:

UCLA is a community of scholars. In this community, all members including faculty, staff and students alike are responsible for maintaining standards of academic honesty. As a student and member of the University community, you are here to get an education and are, therefore, expected to demonstrate integrity in your academic endeavors. You are evaluated on your own merits. Cheating, plagiarism, collaborative work, multiple submissions without the permission of the professor, or other kinds of academic dishonesty are considered unacceptable behavior and will result in formal disciplinary proceedings usually resulting in **suspension** or **dismissal**.

Forms of Academic Dishonesty: As specified in the UCLA Student Conduct Code, violations or attempted violations of academic dishonesty include, but are not limited to, cheating, fabrication, plagiarism, multiple submissions or facilitating academic dishonesty:

Cheating: Unauthorized acquiring of knowledge of an examination or part of an examination

- Allowing another person to take a quiz, exam, or similar evaluation for you
- Using unauthorized material, information, or study aids in any academic exercise or examination – textbook, notes, formula list, calculator, etc.
- Unauthorized collaboration in providing or requesting assistance, such as sharing information
- Unauthorized use of someone else's data in completing a computer exercise
- Altering a graded exam or assignment and requesting that it be regraded

Plagiarism: Presenting another's words or ideas as if they were one's own

- Submitting as your own through purchase or otherwise, part of or an entire work produced verbatim by someone else
- Paraphrasing ideas, data or writing without properly acknowledging the source
- Unauthorized transfer and use of someone else's computer file as your own
- Unauthorized use of someone else's data in completing a computer exercise

Multiple Submissions: Submitting the same work (with exact or similar content) in more than one class without permission from the instructor to do so. This includes courses you are currently taking, as well as courses you might take in another quarter

Facilitating Academic Dishonesty: Participating in any action that compromises the integrity of the academic standards of the University; assisting another to commit an act of academic dishonesty

- Taking a quiz, exam, or similar evaluation in place of another person
- Allowing another student to copy from you
- Providing material or other information to another student with knowledge that such assistance could be used in any of the violations stated above (e.g., giving test information to students in other discussion sections of the same course)

Fabrication: Falsification or invention of any information in an academic exercise

- Altering data to support research
- Presenting results from research that was not performed
- Crediting source material that was not used for research

While you are here at UCLA, if you are unsure whether what you are considering doing is cheating, **don't take chances**, ask your professor. In addition, avoid placing yourself in situations which might lead your professor to **suspect you of cheating**.

Alternatives to Academic Dishonesty

- **Seek out help** – Meet with your professor, ask for assistance as needed.
- **Ask for an extension** – if you explain your situation to your professor, she/he might be able to grant you an extended deadline for an upcoming assignment.
- **See a counselor** at Student Psychological Services, and/or your school, college or department – UCLA has many resources for students who are feeling the stresses of academic and personal pressures.

If you would like more information, please come see us at the Dean of Students' Office in 1206 Murphy Hall, call us at (310) 825-3871 or visit their website at www.deanofstudents.ucla.edu.

Course Outline

This outline may change as the semester progresses, according to student enrollment and needs.

1. Introduction to Bayesian reasoning and Bayes' Theorem
2. Fundamental Prior/Likelihood/Posterior examples
 - a. Normal-normal
 - b. Beta-binomial
 - c. Poisson gamma
 - d. Normal, unknown mean and variance
 - e. Dirichlet-multinomial
 - f. Relationship of fundamental examples to complex data analysis
3. Bayesian regression models
 - a. Conjugate prior
 - b. Grouping/indicator variables
 - c. Logistic regression
4. Hierarchical models
 - a. Hierarchical Priors
 - b. Exchangeable Priors
 - c. Independent Priors
 - d. Flat/Improper/Uninformative/Vague/Automatic Priors
 - e. Conjugate Priors
 - f. Data Augmentation Priors
 - g. Zellner g-prior
 - h. Popular generic priors
5. Computation
 - a. Closed form posterior inference
 - b. Modal approximations
 - c. Variational inference
 - d. Monte Carlo
 - i. Rejection sampling
 - ii. Importance sampling
 - e. Markov chain Monte Carlo
 - i. Metropolis
 - ii. Metropolis-Hastings
 - iii. Gibbs sampling
 - iv. Hamiltonian Monte Carlo
 - v. Multiproposal methods
6. Posterior predictive inference and cross-validation

7. Bayesian nonparametrics
 - a. Dirichlet process mixture models
 - b. Gaussian process regression/classification