UCLA Department of Statistics

Applied Bayesian Social Statistics

Course Information

Professor:	Mark S. Handcock (https://bruinlearn.ucla.edu/courses/210009/pages/i information)
Lectures:	Tuesday and Thursday, 3:30pm - 4:15pm, Franz Hall 2258A
Office Hours:	Friday 10:30am to 11:30am. In-person and zoom at this link (https://ucla.zoom.us/j/93912347016) Also feel free to post a question on the Bruin Learn Discussic (https://bruinlearn.ucla.edu/courses/210009/discussion_topics) ar
Office Location:	8105, Suite C, Mathematical Sciences Bldg or zoom at this lir (https://ucla.zoom.us/j/93912347016)

Course description: Lecture, three hours; Preparation: some knowledge of basic calculus and linear algebra. Requisites: courses 100A and 100B or 101B and 101C, or one course from 10, 12, 13, 15, Psych 100A, or Econ 41. Designed for social sciences graduate students and advanced undergraduate students seeking training in the theory and application of Bayesian statistical ideas. Concurrently scheduled with course C216. P/NP or letter grading.

Discussion

We will use the **Bruin Learn Discussion board (https://bruinlearn.ucla.edu/courses/210009/discussion_topics)** for Q&A, discussions on topics, FAQ, etc. Please use it freely.

Motivation and Synopsis

Statistics C116/C216 is a second course in social statistics and will *focus on Bayesian statistical analysis*. It will cover the principles of Bayesian statistics, Bayesian data analysis and modeling. In particular it will develop the ideas in the context of linear regression, its non-linear generalizations, and hierarchical models. While the idea and principles are general, all applications and models will be chosen from those most relevant to the social sciences.

This course is designed for graduate students majoring in Statistics, the Social Sciences and advanced undergraduate students who are planning to attend graduate school.

This course is most appropriate for student seeking additional training in the application of Bayesian statistics to data and are looking for an introductory course that advances rapidly. The ultimate goal is to equip students with the analytical and programming skills necessary to address social statistics problems within the Bayesian paradigm based on current data and technologies.

The course has various perspectives:

- It focuses on conceptual understanding of the Bayesian statistics.
- It focuses on conceptual understanding of the the primary models used in social statistics.
- It involves the analysis of real-data.
- It involves implementing the methods using freely available software.

The course will also involve the practical application of the ideas of statistical computing and their implementation through statistical software, particularly R. As statistical computation is essential for many of the modeling approaches, expertise will need to be developed.

Prerequisites

- At least two courses in statistics, one of which is on regression modeling..
- People may still take this class as long as they have background on matrix algebra, probability theory, and programming skills. To do this attend the first classes and we can assess if this is advisable.

Course Materials

Required Textbook

[**H**] Hoff, Peter D.

A First Course in Bayesian Statistical Methods (2009).
Springer

Required and available online as a ebook from the library, free for UCLA students.
http://link.springer.com/book/10.1007%2F978-0-387-92407-6 (https://link.springer.com/book/10.1007/978-0-387-92407-6)

[**GH**] Gelman, Andrew and Hill, Jennifer

Data Analysis Using Regression and Multilevel/Hierarchical Models (2007).
Cambridge University Press

Required (but not free for UCLA students).
http://www.amazon.com/Analysis-Regression-Multilevel-Hierarchical-Models/dp/052168689X (http://www.amazon.com/Analysis-Regression-Multilevel-Hierarchical-Models/dp/052168689X)

Students must be connected to the UCLA network to obtain their free download. Students
who would like to download the textbook off-campus may do so by connecting the the UCLA
network via VPN **https://www.bol.ucla.edu/services/vpn/all.html (https://www.bol.ucla.edu/services/vpn/all.html)** .

In addition to these books, there are a multitude of books covering pieces of the course content and from varying perspectives. For an indepth reference on computational

statistics, I suggest:

Course Resources

[**JGCS**] Gentle, James E.

Computational Statistics (2009).
Springer: New York.

Required and available online as a ebook from the library, free for UCLA students.
http://link.springer.com/book/10.1007/978-0-387-75936-4
(http://link.springer.com/book/10.1007/978-0-387-75936-4)

Background on R

[**W**] Wickham, Hadley.

Advanced R. (2014).
Chapman and Hall/CRC.

Required and available online as a ebook from the library, free for UCLA students.
http://www.crcnetbase.com/doi/book/10.1201/b17487
(http://www.crcnetbase.com/doi/book/10.1201/b17487)

[**C**] Chang, Winston.

R Graphics Cookbook. (2012).
O'Reilly.

Required and available online as a ebook from the library, **free for UCLA students**
(https://r-graphics.org/) .

[**M**] Maillardet, Robert, Owen Jones, and Andrew Robinson.

Introduction to Scientific Programming and Simulation Using R. (2014).
Chapman and Hall/CRC.

Required and available online as a ebook from the library, free for UCLA students.
http://www.crcnetbase.com/doi/book/10.1201/9781420068740
(http://www.crcnetbase.com/doi/book/10.1201/9781420068740)

Syllabus of the Course

The syllabus of the course will develop on the following weekly schedule. The some later topics may not be reached and we will make choice among them toward the end of the quarter.

Week	Contents
1	Introduction and examples • Philosophies of Statistics • Why the Bayesian paradigm?
2	• Statistical Decision Theory • Specifying Prior Distributions
3	• Case Studies: The Binomial and Poisson Models • Bayesian Hypothesis Testing and Prediction
4	• Conjugate Prior Families • Some Bayesian answers for traditional models
5	• Application: Poisson Models for Birth rates • Group comparisons and hierarchical modeling
6	• Linear regression • Logistic and Probit Regression
7	• Latent variable methods for ordinal data • Generalized Additive Mixed Effects Models
8	Comparing Model Fit using Bayesian ideas
9	Assessing Model Fit
10	Using STAN for your own model

Learning Outcomes

- Students will explain the concept of subjective probability.

- Students will be able to formulate simple stochastic models for social phenomena.
- Students will be able to explain Bayesian inferential procedures for stochastic models for social phenomena.
- Students will explain the difference between Bayesian and Frequentist statistical analyses.
- Students will be able to write code in Stan and R to implement Bayesian inference.

Course Webpage and Discussion Forum

The course has a webpage through the **UCLA Bruin Learn system (https://bruinlearn.ucla.edu/)** . The webpage will be continuously updated throughout the course with handouts, homework assignments and solutions. Users sign in to Bruin Learn with their UCLA Logon IDs.

I will be using **Bruin Learn Discussion board (https://bruinlearn.ucla.edu/courses/210009/discussion_topics)** to provide discussion of issues in class and related questions. For questions that might be of interest to other students, please use it to ask a question rather than solely emailing me. There other students and the TA can answer questions in addition to me. Example of questions are about interesting articles you have seen in the media, problems with access to resources, homework or computer questions. Enjoy!

Please regularly consult this classes Bruin Learn home page, the Discussion board and the archive of the Announcements mailing list. It will contain lecture notes, homework, solutions and course information.

Computer Usage and Software

The computer is the scientific laboratory of the applied researcher in quantitative fields. As such this course requires the student to develop a degree of comfort and competence “in the lab”.

Our computer interface to R will be the RStudio IDE, which you can download from **Posit (https://posit.co/downloads/)** .

Course Requirements and Grades

- 50% Homework (4-5 assignments, weighted equally, none are dropped)

- 50% Final project (written report)

Homework

There will be regular homeworks on the theory, modeling and data analysis. All homework assignments will be made available from the Bruin Learn *Assignments* page. Students will submit the solution as PDF files electronically via the gradescope link on the Bruin Learn home page.

Students will be graded on a scale of 1 to 10 for each homework. None of the homework scores will be dropped. It is your responsibility to verify that your homework assignment successfully uploaded by the deadline.

Files must not refer to any resources on the local machine or to files that are not publicly available online. No one should make manual edits to a data file on his or her local machine.

Students are free to discuss homework problems and solutions. Discussing the contents of the course with fellow students can be a valuable element of the learning process, and doing so is therefore generally encouraged. However, each student must hand in their own solutions, and the student should, if asked, be able to explain the solutions.

The project can take one of two forms. You should choose one only.

The **first** is to review a topic in Bayesian Analysis.
This topic should extend or expand on a topic covered in the class, but not be just that topic. The report should be stand-alone, starting from the level of the lecture notes and expanding out to review the existing literature on that topic. It should be written at the level so that a fellow student can read it (after they have taken the course). It need not analyze real data, but may use real or simulated data to illustrate the main points. The length can vary, but projects from prior times I have taught this class have been 15 pages in length. If you choose this form you must pass the topic by me first by sending me a description in an email, chatting with me after class or coming to my office hours.

The **second** is to undertake an Bayesian analysis of data that you find interesting. You can select any data-set you find interesting, but preferable related to your graduate work or major area. You can select any multivariate dataset you like, but preferable related to your graduate work or thesis area. I do not want a quick and routine analysis; a good job will show understanding of the problem and possible solutions and techniques to consider. The technical results should be stated clearly. The report must contain a

clearly written conclusion section giving a non-technical summary that is concise and informative. Do not merely use data from a textbook - the world is an interesting place! All data sources must be cited, and described.

For details of the project, see the *Assignments* section.

Late Submissions

There is a 10 minute grace period. Submissions up to 10 minutes late will be accepted with no penalty.

Homework assignments submitted 11 minutes late or more will be accepted with penalty. There is a minimum deduction of 1 point for being less than one hour late. An additional 0.5-point deduction will be taken for each additional hour it is late.

Thus, an assignment that is between 11 and 59 minutes late will receive a 1-point deduction. An assignment that is between 1 hour and 1:59 late will receive a 1.5-point deduction. An assignment that is between 2 hours and 2:59 late will receive a 2-point deduction, and so on.

I strongly advise uploading the homework to the Bruin Learn well in advance of the deadline in case there are connectivity problems or server issues.

Comments of suggestions about the course

I welcome comments or suggestions about the course at any time, either in person, by letter, or by email. Please feel free to use these ways make comments to me about any aspect of the course.

University Policies

Academic Integrity

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. See the **Dean of Students website (https://deanofstudents.ucla.edu/)** for more information.

[source: Dean of Students syllabus statement (**syllabus (https://deanofstudents.ucla.edu/file/4b995724-f033-476a-bccc-f6103528d959)**)]

Accommodations for Students with Disabilities:

If you are already registered with the Center for Accessible Education (CAE), please request your Letter of Accommodation in the Student Portal. If you are seeking registration with the CAE, please submit your request for accommodations via the CAE website. Students with disabilities requiring academic accommodations should submit their request for accommodations as soon as possible, as it may take up to two weeks to review the request. For more information, please visit the **CAE website (http://www.cae.ucla.edu/)**, visit the CAE at A255 Murphy Hall, or contact us by phone at (310) 825-1501.

[source: Center for Accessible Education (**Faculty Questions (https://cae.ucla.edu/faculty/faqs)**)]

Resources for Students

UCLA provides resources if you are feeling overwhelmed and need personal and/or academic assistance.

Please see the **Red Folder REV2020 web (https://studentincrisis.ucla.edu/file/39679e1c-a57d-48d0-83a2-a906c1e53669)** for more information.

Title IX

Advocacy and Confidential Services

Please note that Title IX prohibits gender discrimination, including sexual harassment, domestic and dating violence, sexual assault, and stalking. If you have experienced sexual harassment or sexual violence, you can receive confidential support and advocacy at the CARE Advocacy Office for Sexual and Gender-Based Violence, 205

Covel Commons, Los Angeles, CA, 90095, care@careprogram.ucla.edu, (310) 206-246 5. Counseling and Psychological Services (CAPS) provides confidential counseling to all students and can be reached 24/7 at (310) 825-0768.

Reporting and Non-confidential Services

Your professor is required under the UC Policy on Sexual Violence and Sexual Harassment to inform the Title IX Coordinator should he become aware that you or any other student has experienced sexual violence or sexual harassment. In addition, You can also report sexual violence or sexual harassment directly to the University's Title IX Coordinator, 2255 Murphy Hall, titleix@equity.ucla.edu , (310) 206-3417. Reports to law enforcement can be made to UCPD at (310) 825-1491.