Applied Bayesian Methods Workshop

Sarah Hunter

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Office Hours: 2:30-3:30pm   Class Hours: MTWTh 9:30am-Noon
Office: Ketchum 233   Class Room: TBA
Lab Room: TBA   Lab Hours: 1-2:30pm

Course Description

This workshop is designed to give a quick introduction to applied Bayesian Analysis. In this course, we still start by learning a bit of the theory behind Bayesian analysis by comparing it to frequentist analysis. Bayesian methods differ both in their approach to hypothesis testing and the actual estimation of models. In this workshop, you will gain the foundation to be able to use Bayesian analysis in your own work.

We will be covering many topics in our four day workshop. We will begin with an introduction to Bayesian probability theory and hypothesis testing. The second day, we will focus on Bayesian priors and work on Bayesian linear models. The third day, we will learn about model convergence and fit. The last day the will focus on more special topics and advanced models, especially models for limited dependent variables.

By the end of this course, students should be able to:

- Understand the basics of probability theory as it pertains to hypothesis testing

- Apply Bayesian hypothesis testing to political science research

- Estimate and interpret Bayesian regression models

Prerequisites

At least Data I (and preferably Data II) with basic knowledge of probability thoery and linear regression.

Recommended Text

- Gill, Jeff. 2015. *Bayesian Methods: A Social and Behavioral Sciences Approach, 3rd ed..* New York: CRC Press.

Software

We will use R for this course, but you will also need to download a new program called **JAGS**. JAGS is a free, open source program that can be run through R. You can download these programs:

- R: https://cran.r-project.org

- JAGS: https://sourceforge.net/projects/mcmc-jags/files/

Communication

This course presents the unique challenge of being taught online. Because of this, communication will be very important. You can email me at the email above. I will also have Zoom office hours set up for one hour after lab every day. I will be on Zoom, so you will just need to send an invitation. Any communication from me will be through your official CU email unless you specify otherwise.

Grades

There are no grades for this course.

Daily Workshop Schedule

The schedule is tentative and subject to change. Each day, we will have a lecture and a lab component. The topics for each are listed below with some suggested readings for each. The last day of class is flexible and can be altered to reflect popular preferences. If you have a specific interest in advanced models beyond basic MLE models (logit, probit, ordered logit, multinomial, etc.) please contact me on the first day at the latest.

Day 1

Lecture Introduction to Bayesian Hypothesis Testing

- Reading:
  * Gill: Chapters 1 & 2
  * Siegfried, T. (2010). Odds are, it's wrong: Science Fails to Face the Shortcomings of Statistics. Science News, 177(7):26–29.
  * Senn, S. (2003). Bayesian, Likelihood, and Frequentist Approaches to Statistics. Applied Clinical Trials, 12(8):35–38.
  * Western, B. and Jackman, S. (1994). Bayesian Inference for Comparative Research. American Political Science Review, 88(2):412–423.

Lab Installing R and JAGS

- Reading:
  * Plummer, M. (2013). JAGS Version 3.4.0 User Manual.

Day 2

Lecture Priors and Posteriors

- Reading:
  * Gill: Chapters 3 - 5
  * Gill, J. and Walker, L. D. (2005). Elicited Priors for Bayesian Model Specifications in Political Science Research. Journal of Politics, 67(3):841– 872.

Lab The Bayesian Linear Model

Day 3

Lecture Convergence and Sampling

- Reading:
  * Gill: Chapters 9 & 10

Lab Convergence Diagnostics

- Reading:
  * Plummer, M., Best, N., Cowles, K., and Vines, K. (2006). CODA: Convergence Diagnosis and Output Analysis for MCMC. R News, 6(1):7–11.

Day 4

> **Lecture** Advanced Models
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> – Reading:
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>   ∗ Gill: Appendix A
>   ∗ Stegmueller, D. (2013b). Modeling Dynamic Preferences: A Bayesian Robust Dynamic Latent Ordered Probit Model. Political Analysis, 21(3):314– 333.
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> **Lab** Bayesian MLE Models

University of Colorado Policies

Accommodation of Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website.

Classroom Behavior

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu); 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions

from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the Honor Code Office website.

Sexual Misconduct, Discrimination, and/or Related Retaliation

The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct intimate partner abuse (including dating or domestic violence), stalking, protected-class discrimination or harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or cureport@colorado.edu. Information about the OIEC, university policies, anonymous reporting, and the campus resources can be found on the OIEC website. Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, please inform me via email with at least one week's notice. We can then find the best accommodation. See the campus policy regarding religious observances for full details.