Network Science Special Topics: Bayesian and Network Statistics

Syllabus

NETS 7983
Northeastern University

Professor: Nick Beauchamp
Email: n.beauchamp@northeastern.edu
Office: 931 Renaissance Park
Office Hours: Th 3:00pm-4:30pm, and by appointment.

Course Description

This course offers an introduction to advanced quantitative methods including maximum likelihood, hierarchical models, sampling, and network modeling. Students with some experience in basic econometric methods will learn to estimate and develop models from the probabilistic and Bayesian perspective, and will pursue their own research project along the way, with a particular attention the the methodological challenges. The course begins with a review of probability, then examines maximum likelihood methods for estimating regression models with continuous and categorical dependent variables. This is followed by examining a variety of procedures for sampling from posterior distributions, including grid, quadratic, Gibbs, and Metropolis sampling. These methods are then applied to hierarchical modeling and other simple probabilistic models. The course then takes a closer look at the statistical modeling of networks as it has been developed in the social sciences, beginning with the Exponential Random Graph Model (ERGM), and finishing with the temporal SIENA model. Along the way, students will develop their own modeling projects using datasets of their own devising, which will be presented, reviewed, and discussed in detail in the latter third of the course, giving close attention to methodological issues and potential solutions.

Requirements

Students are expected to have taken a prior graduate-level course in statistics or econometrics. For this course, the main project will be a final paper, worth 50% of the grade. The final paper will be a research paper in the student's preferred field of study, with an emphasis on crafting, implementing, and testing the appropriate statistical models. There will also be three problem sets, each worth 10$ of the grade, which will focus primarily on preliminary data analysis and exploration rather than rote solutions. The remaining 20% of the grade will be the project presentation (10%) and participation (10%).

Required texts

(Available at the Northeastern bookstore or via Amazon.)

1. *Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan* (Second Edition). John Kruschke, 2015.
2. *Statistical Rethinking: A Bayesian Course with Examples in R and Stan.* Richard McElreath, 2014.
3. *Bayesian Data Analysis* (Third Edition). Andrew Gelman et al, 2013.

Schedule

Note that topics map only approximately onto weeks, depending on time and student interest.

1. Probability, Bayes, and sampling
2. Maximum Likelihood: Logit and Probit
3. Grid sampling and quadratic approximation
4. MCMC: Gibbs and Metropolis
5. Hierarchical models
6. ERGM 1
7. ERGM 2
8. TERGM and Siena
9. Project discussions and presentations

Policies

Attendance. Attendance is mandatory, particularly for a once-weekly class. More than 1 absence will reduce your final grade by 1/3 a letter for each additional absence, unless there are extenuating circumstances approved by me ahead of time. I'll be using the reading questions as an attendance-checking mechanism, so be sure to get those in every day you're here.

Devices. All phones and similar devices should be off during class. Laptops are permitted, but only for note taking and brief research when requested. Other use of the internet, email, Facebook, Twitter, etc, etc, is not permitted. I can usually tell when you're doing it even if I can't see your screen (either a person is looking steadily down, or they are looking up and down repeatedly without typing much ;)

Incompletes. Except in the most serious circumstances, Incompletes in this course are not possible. If the professor agrees to an Incomplete, a form in the Political Science Department must be filled out, representing a contract between the student and the faculty member on when and how the course will be completed.

Plagiarism and Academic Dishonesty. The Department of Political Science takes very seriously the issue of academic honesty. Any student who cheats on an exam or in the preparation and writing of a course assignment at minimum will fail the assignment in question, and may fail the course. Further, the Department can recommend that the student be put on academic probation (as outlined in the University's Code of Conduct). Individual faculty, with the support of the Department, can impose harsher penalties as they deem necessary.

Cheating includes plagiarism, which is defined broadly as taking ideas, concepts, or actual words of another person or author and passing them off as your own work. This includes but is not limited to cut and paste construction of a paper, buying a term paper, pulling a paper off of the Internet, or using materials from the Internet without acknowledging the source. If you have any questions regarding proper attribution of the work of others, contact your instructor prior to submitting the work for evaluation.