Course description

The course is really split between two components: maximum likelihood estimation and a variety of models to which it can be applied. Many of these models fall into a larger class known as generalized linear models. Among the models considered will be binary dependent variables, ordered and unordered discrete choice models, duration models, and selection models. While the title of the course is maximum likelihood, it is at least as much about these applications.

These models have wide-ranging applications in political science and many other fields. They also have something else in common: they cannot be estimated correctly using OLS, but can be with maximum likelihood. One of the great advantages of maximum likelihood is that it provides a unified framework for estimating a huge variety of models.

These models are of great importance to work in political science and other social sciences. While OLS is an incredibly useful tool, it will not be appropriate for much—if not most—of the data you encounter. For example, many of the dependent variables we wish to use involve discrete choices (e.g., voting decisions), counts (e.g., number of coups per year), durations (e.g., length of time between conflicts), and so on. The models discussed in this class can handle these situations and more. In addition to studying maximum likelihood and related models, we will look at examples of its applications within political science.

Learning outcomes

Students will be able to:

• understand basic theoretical properties of maximum likelihood estimators
• estimate and conduct inference using maximum likelihood and diagnose issues that arise
• apply generalized linear models and survival analysis to social science data
• interpret generalized linear models and survival models
• use multiple imputation to address missingness in data
How the credit hours are met

This class meets for a 115-minute lecture and a 50-minute section each week over the fall semester and carries the expectation that students will work on course learning activities (reading and working on research project) for about 3 hours out of classroom for every class period.

Prerequisites

This course assumes you have taken Poli Sci 812 and 813 or the equivalent and have some experience with statistical computing in R.

Statistical computing

Computational components of the problem sets will make use of R, an implementation of the S statistical programming language. Students may make use of other statistical software, such as Stata, in their final project. It can be downloaded for free from: http://www.r-project.org/

Textbooks

The primary textbook for this course is:


The following books also cover some of the material in the course at various levels:


Grading

Grading will be divided between problem sets (25%), a midterm exam (25%), partner comments (10%), and a final paper and poster (40%).

Problem sets

There will be short problem sets handed out in class, typically one every one to two weeks and due on the Friday of the following week (unless otherwise noted). All homework must be typewritten and submitted in PDF format through the course website on Learn@UW. These will be graded on a check-plus/check/check-minus/zero basis. Late assignments are strongly discouraged. A pattern of late assignments will result in a grade penalty. Assignments more than one week late will not be accepted.

The problem sets will cover both theory and application. You are welcome to discuss the problem sets with each other, but the final write-ups, results, and coding should be your own.

Midterm exam

There will be a take-home midterm given at a time to be determined in early November. You should work on the exam individually and may not consult with anyone before submitting your exam. In addition to counting towards your final grade, the exam should serve as an indicator of your progress in the course.

Final project

The final project is split between two components: a paper and a poster. The project is a replication or extension of a published piece but cannot simply be a recapitulation of it. You have to add something new to the research. Your project should also involve material we cover in class or extensions of it. The project must be approved Wednesday, October 31. The final paper is due Wednesday, December 19.

Students will be assigned a partner, who will function as a co-author and provide written comments on one draft of the paper. This draft is due to both me and your partner on Friday, November 30, at 5pm. You should have your comments back to your partner by the following Monday, December 3, at 5pm.

The paper is expected to look like a draft of an empirical article to be submitted to a social science except that it should contain only the data analysis section of the paper describing the statistical model, data, results, and conclusions. Do not include an introduction, literature review, or theory section. A good summary of how to construct a paper is available here: http://gking.harvard.edu/files/paperspub.pdf

The paper should follow the style of an article in the American Political Science Review. It should be no longer than 20 pages double spaced, but a suitable paper can be shorter. Do not include your references in the page count, but do include your tables and figures. Note that a clear graph is often a better way to communicate information than a table. A good discussion of this point is available here: http://eduardoleoni.com/published/graphics.pdf

The final poster will give you an opportunity to present your research and conclusions. At the end of the semester, we will have a poster session where political science faculty and graduate students can see the work you have been doing. Your poster should be similar in format to those presented at a PolMeth poster session. Examples, guidelines and tips are given here: http://polmeth.rice.edu/poster-session/
Academic integrity

By enrolling in this course, each student assumes the responsibilities of an active participant in UW–Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to studentconduct.wiscweb.wisc.edu/academic-integrity

Accommodations for students with disabilities

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform me of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. I will work either directly with the student you or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.

Diversity and inclusion

Institutional statement on diversity

Diversity is a source of strength, creativity, and innovation for UW–Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin–Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background—people who as students, faculty, and staff serve Wisconsin and the world.

Topics and readings

The syllabus is organized around topics rather than by day. We will typically spend several classes around one topic. Topics marked with an asterisk are additional topics that we will discuss if time permits.

Introduction to likelihood inference

Faraway, chapter 1 and appendix A
**Binary data and logistic regression**
Faraway, chapter 2

**Binomial and proportional data**
Faraway, chapter 3

**Variations on logistic regression**
Faraway, chapter 4

**Missing data**

**Count data**
Faraway, chapter 5

**Nominal data**
Faraway, chapter 7.1

**Ordinal data**
Faraway, chapters 7.3 and 7.4

**Generalized linear models**
Faraway, chapter 8

**Survival data**

**Nonparametric regression**
Faraway, chapter 14

**Random effects and longitudinal data**
Faraway, chapters 10 and 11

**Mixed effects models**
Faraway, chapter 13