Topics in Political Science: Quantitative Methods
Multilevel Models for Social Science Research
PLAD 8500, University of Virginia
Spring 2017

Instructor: Constanza F. Schibber

Time and Location: Wednesday 4-6:30 PM, New Cabell Hall 594

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Office Hours: TBD

Overview

This course covers statistical modeling with explicitly defined hierarchies. Social scientists encounter multilevel data all the time: voters clustered in electoral districts, students nested within classrooms, legislators clustered in congressional periods, countries nested within regions, and so forth. Classic time-series cross-sectional (TSCS) data can also be thought as multilevel data, with observations clustered by unit and time period. In survey research, multilevel regression and poststratification (MRP) is a method to estimate public opinion across geographic units from individual-level survey data. The course will begin with a review of linear regression, logistic regression, and generalized linear models. Then it will proceed to multilevel nested models and follow with non-nested models for linear and generalized linear models. Hierarchical modeling can incorporate individual-level predictors, group-level predictors, and individual-by-group (also known as cross-level) interactions. The second half of the course will feature a Bayesian perspective on inference and computation of hierarchical models.

Grading

Your grade will be structured as follows:

- Participation: 5%
- In-Class Lab Sessions: 15%
- Assignments: 50% (the lowest grade will be dropped when computing each student's score)
- Research Paper: 20%
- Presentation of the Research Paper: 10%

Late assignments will not be accepted and no incompletes will be given for assignments or the course. Exceptions will be granted only under truly extraordinary circumstances.

The procedure to have any grade revised is as follows. Please write up a short description of your argument as to why your grade should be changed and hand it in, along with your initial assignment, within one week of receiving your grade. The instructor will respond in writing. The instructor's decisions regarding grades are final.

Evaluation

Participation & Attendance: I expect students to attend all lectures and to arrive to class on time. Students who use laptops in class must do so exclusively for the purpose of note taking. Forms of participation may include asking questions, answering questions from the instructor or from other classmates, participating in in-class group activities and class discussion, among others. Using the course email list to ask and answer questions is strongly encouraged and it will contribute to your participation evaluation

In-Class Lab Sessions: During the last 30 minutes of most classes there will be a "hand-on" lab in which each student will work on running and understanding the `R` or `Bugs` code presented during the lecture. The instructor will be available to help students complete the task and students are allowed to collaborate.

Assignments: Assignments will consist of a combination of analytical problems and data analysis. Assignments should be written in a professional fashion and also include the `R` code used to address specific problems. I recommend preparing the assignments using `RStudio` and the `R` library `knitr` (instructions will be provided separately), because it will be more efficient.

You are encouraged to work together with your fellow students. *But do not copy answers from another student, or allow your answers to be copied, or look for and copy solutions to the assignments on the internet.* There is a clear difference between collaboration on assignments and copying. Examples of cheating include copying answers from another student, directly copying computer code from another student, or allowing answers or code to be copied, or directly sharing partial or complete code with a student to be submitted as their own assignment solution. If you are unsure about the difference, please come speak to me before there are any potential problems. Copying is cheating and will be referred to the Honor Committee.

Research Paper: The main assignment is to write a paper that applies a multilevel model to data in your field of study. The end product should look like the statistical and empirical sections of a paper published in a journal (7-12 pages). There could be three types of research papers: (1) The paper is the start of a research manuscript that will eventually turn into a student's thesis, dissertation, or published work; (2) A student already has a manuscript that could be improved by reanalyzing the data with a hierarchical model; (3) The paper reanalysis the empirics of a paper published in a leading journal that could (or should) have used a multilevel model but did not.

Required Text

Gelman, Andrew and Jennifer Hill. 2007. *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Cambridge University Press.

Installing R

All students will need to download and install the latest R software. R is a free statistical programming language that we will use to fit models, simulation, computing probabilities, creating graphics, *etc.*. It may be obtained at the CRAN website. Go to http://lib.stat.cmu.edu/R/CRAN and click your choice of platform (Linux, MacOS X or Windows) for the precompiled binary distribution. Note the FAQs link to the left for additional information.

Schedule

Wednesday	
Jan 18th 1. Introduction to the Course Reading: Gelman and Hill, Chapters 1 & 2	**1**
25th 2. Linear and Generalized Linear Models Review Reading: Gelman and Hill, Chapters 3 & 4 Exercises: 3.5, 4.4, 5.9, 6.1	**2**
Feb 1st 3. Simulation of probability models and statistical inferences Reading: Gelman and Hill, Chapters 7 & 8	**3**
8th 4. Multilevel Linear Models: The Basics Reading: Gelman and Hill, Chapters 11 & 12 Exercises: 11.4, 12.2, 12.3	**4**

Wednesday	
15th 5. Multilevel Linear Models: Varying Slopes, Non-nested Models, and Other Complexities Reading: Gelman and Hill, Chapter 13 Exercises: 12.6, 13.1, 13.3	**5**
22nd 6. Multilevel Logistic Regression Reading: Gelman and Hill, Chapter 14 Exercises: 14.1, 14.5, 14.6	**6**
Mar 1st 7. Multilevel Generalized Linear Models Reading: Gelman and Hill, Chapter 15 Exercises: 15.1, 15.2	**7**
8th **Spring Break**	
15th 8. Bayesian Inference Reading: Jeff Gill, *Bayesian Methods: A Social and Behavioral Sciences Approach* (selected chapters)	**8**
22nd 9. Bayesian Inference & Multilevel Modeling in `Bugs` and `R` Reading: Gelman and Hill, Chapters 16 Exercises: 16.1, 16.2, 16.8	**9**
29th 11. Bayesian Linear Models Reading: Gelman and Hill, Chapter 17 Exercises: 17.1, 17.2, 17.3	**10**

Wednesday	
Apr 5th	**11**
13. Bayesian Generalized Linear Models Reading: Gelman and Hill, Chapter 17 Exercises: 17.4, 17.11	
12th	**12**
14. Likelihood and Bayesian inference and computation Reading: Gelman and Hill, Chapter 18 Exercises: 18.2	
19th	**13**
15. Understanding and summarizing the fitted models 16. Analysis of variance Reading: Gelman and Hill, Chapter 21 and 22 Exercises: 21.1, 21.3, 22.3	
26th	**14**
15. Model checking and comparison 16. Missing-data imputation Reading: Gelman and Hill, Chapter 24 and 25 Exercises: 24.2, 25.3	