POL 9040: Maximum Likelihood Estimation

University of Missouri

Fall 2020

W 3:00-5:30PM, Middlebush Hall 8

Laron K. Williams

Office location: 209 Professional Building
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Office hours: Zoom office hours (or by appointment): M W 1:00 - 2:00 PM (Meeting ID: 938 1058 8488; Passcode: 644658

Remote participation information: Meeting ID: 998 7061 2399; Passcode: 9040

Course Description

This course introduces you to a variety of statistical techniques relevant to political science that utilize maximum likelihood estimation. Typically, this means predicting outcomes that are binary (logit, probit, scobit), categorical (multinomial logit and multinomial probit), ordered (ordered logit), counts (negative binomial and poisson), and spatially interdependent (spatial econometric models). The objective is for you to become familiar enough with them to understand how, when and why to use them. Emphasis will therefore be on empirical applications. This class requires you to learn how to use Stata since almost all of our applications can be done using it and many of them essentially require it (unless you want to write your own code). There may be instances where we utilize other statistical programs (such as R and QGIS), but the vast majority will focus on Stata.

Required Books

- Long, J. Scott. 1997. *Regression Models for Categorical and Limited Dependent Variables.* Thousand Oaks, CA: Sage:

- Long, J. Scott and Jeremy Freese. 2006. *Regression Models for Categorical Dependent Variables Using Stata*, 2nd ed. College Station, TX: Stata Press.

- Ward, Michael D. and Kristian Skrede Gleditsch. 2008. *Spatial Regression Models*. Sage Publications.

Other required readings will be available on Canvas (`canvas.missouri.edu`) or through jstor.

Recommended Books

- Darmofal, David. 2015. *Spatial Analysis for the Social Sciences*, Cambridge University Press.

Course Requirements

Class Participation and Attendance (15%)

The quality of a graduate-level seminar in methodology depends to a large extent on the quality of the students. It is your responsibility, as well as mine, to come to class prepared to discuss the information and claims found in the readings and explore related research possibilities. If any of us shirk, we all lose. I expect no absences in the course, and I encourage you to discuss any circumstances with me that will preclude you from attending class. I also expect you to arrive on time. If you do need to miss class, please contact me ahead of time to let me know that you will not be able to attend and to make arrangements to complete an alternate assignment. A large portion of my overall evaluation of your performance in the course will depend on the quality of your seminar participation.

Grades for participation will be assigned at the end of the semester, but you may ask for feedback on your performance at any time. If you have concerns about the quality and quantity of your participation in the course, I hope you will speak to me. Remember, this is a seminar, so just showing up to class is not enough. You must come to class prepared to participate in an informed discussion of the issues raised by the week's readings. If you just show up to class every week, but never say a word, you can expect to receive a D or lower for class participation (15% of your grade).

The following general grading scale will be used for participation and preparation:

- A: The student made a very strong contribution to the course. Class discussion, comments, and presentations reflected understanding and analysis of the material, and were constructive. Constructive means that a student does not simply identify a weakness or problem. Rather, constructive comments identify a problem and offer suggestions for how to address the weakness or problem.

- B: The student contributed meaningfully to the course. Class participation and/or presentations went beyond repeating the assigned material, perhaps identifying weaknesses in the current literature, but did not make many constructive suggestions about how weaknesses might be overcome or how the literature might be usefully extended in the future.

- C: The student did not contribute meaningfully to the seminar. Class participation and/or presentations were limited to repeating the assigned material rather than making connections or extensions.

- D or lower: The student attended class, but did not participate in discussions or present meaningful questions for academic debate.

Finally, because we will engage in vigorous academic debate during class, classroom etiquette is vital. Please work to ensure that you make comments in ways that invite discussion. Our classroom contains members with various life experiences, divergent perspectives, varying levels of experience with political science research, and different strategies for defending their views. Please state your opinions constructively and respectfully, listen carefully when your colleagues are speaking, and speak to me if you are offended by something that is said in class. If you do not follow these guidelines, your participation grade will be adversely affected.

Homeworks (45%)

At various times throughout the semester, I will assign homework. This is because the best way to learn the material is to actually use the models. Homeworks must be typed and submitted (via Canvas) by the beginning of class. Late homeworks will be deducted 10% for each calendar day that they are late. Homeworks must be completed in LaTeX.

Research Reports (40%)

At 4 points throughout the semester, students will prepare research reports. I will provide more description and requirements for these research reports in class.

The paper will be graded on the quality of the empirical analysis, proper interpretation, and exploration of the results in the best manner to test the hypotheses. These papers will be expected to conform to the submission standards of the *American Journal of Political Science* and research reports must be completed in LaTeX.

Grammatical mistakes in any of the assignments will NOT be tolerated. Any student turning in an assignment with grammatical mistakes will have the assignment returned without a grade. The student will have one opportunity to improve and resubmit the work with a grade penalty in a time frame decided by me.

Final class grades will be assigned with the following grading scale:

A+ = 97.0 - 100
A = 90.0 - 96.99
B+ = 87.0 - 89.99
B = 80.0 - 86.99
C+ = 77.0 - 79.99
C = 70.0 - 76.99
D+ = 67.0 - 69.99
D = 60.0 - 66.99
F = 0 - 59.99

Decreasing the Risk of COVID-19 in Classrooms and Labs

MU cares about the health and safety of its students, faculty, and staff. To provide safe, high-quality education amid COVID-19, we will follow several specific campus policies in accordance with the advice of the Center for Disease Control and Boone County health authorities. This statement will be updated as information changes.

- If you are experiencing any COVID-related symptoms, or are otherwise feeling unwell, do not attend in-person classes and contact your health care provider and/or student health immediately. COVID symptoms include: fever greater than 100.4 or chills; cough, shortness of breath or difficulty breathing; fatigue; unexplained muscle or body aches; headache; new loss of taste or smell; sore throat; congestion or runny nose; nausea or vomiting; diarrhea.

- We will all wear face coverings while in the classroom, unless you have a documented exemption due to a disability or medical condition.

- We will maintain a 6-foot distance from each other at all times (except in specific lab/studio courses with other specific guidelines for social distancing).

- We will enter the classroom and fill the room starting at the front, filing all the way across a row. When class ends, we will exit the row nearest to the door first; the instructor or TA will give the signal for the next row to exit, in the same manner.

- In any small section or lab class that requires them, additional measures will be listed in the syllabus and be mandatory for class participation.

- Online office hours will be available for all students.

- This course may be recorded <u>by the instructor</u> for the sole purpose of sharing the recording with students who can't attend class. The instructor will take care not to disclose personally identifiable information from the student education records during the recorded lesson.

Compliance with these guidelines is required for all; anyone who fails to comply will be subject to the accountability process, as stated in the University's Collected Rules and Regulations, Chapter 200 Student Code of Conduct.

If an instructor has concerns about how a student is following COVID-19 policies and protocols, please report those concerns to the Office of the Dean of Students. You can fill out a COVID Safety Measures Reporting Form here:

https://cm.maxient.com/reportingform.php?UnivofMissouriSystem&layout_id=38

By taking the above measures, we are supporting your health and that of the whole Mizzou community. Thank you in advance for joining me and your peers in adhering to these safety measures.

Other Considerations

- Out of respect for fellow students, each person will refrain from talking, whispering, eating, making offensive remarks, newspaper reading, and other disruptive behavior during lecture. Cell phones and laptops must be turned off and may not be used during class time. Inappropriate classroom behavior may result in the student being requested to leave the classroom. **I will discuss my electronics policy in-depth the first day of class.**

- The University of Missouri is committed to supporting student well-being through an integrated network of care, with a wide range of services to help students succeed. The MU Counseling Center offers professional mental health care, and can help you find the best approach to treatment based on your needs. Call to make an appointment at 573-882-6601. Any student in crisis may call or go to the MU Counseling Center between 8:00 – 5:00 M-F. After hours phone support is available at 573-882-6601.

  Visit our website at https://wellbeing.missouri.edu to take an online mental health screening, find out about workshops and resources that can help you thrive, or learn how to support a friend. Download Sanvello, a phone app that teaches skills and strategies to help you maintain good mental health. Log in with your Mizzou e-mail to unlock all the tools available through Sanvello at no cost to you.

- Academic integrity is fundamental to the activities and principles of a university. All members of the academic community must be confident that each person's work has been responsibly and honorably acquired, developed, and presented. Any effort to gain an advantage not given to all students is dishonest whether or not the effort is successful. The academic community regards breaches of the academic integrity rules as extremely serious matters. Sanctions for such a breach may include academic sanctions from the instructor, including failing the course for any violation, to disciplinary sanctions ranging from probation to expulsion. When in doubt about plagiarism, paraphrasing, quoting, collaboration, or any other form of cheating, consult the course instructor.

  Plagiarism will not be tolerated. Any student plagiarizing (or cheating on tests) will receive an automatic grade of 0 for that assignment.

- Teaching Assistant: The role of the Teaching Assistant is to serve as an assistant to me. When a student needs help or clarification, the first step is to consult their lecture notes or readings. If that doesn't clear up the misunderstanding, then the student should contact the TA.

- The Writing Center, normally located in the Student Success Center, will still offer writing support to all students at the University of Missouri during fall 2020. With socially-distant class space at a premium, we have moved all of our tutoring services online, both via synchronous Zoom sessions and the ever-present Online Writery for asynchronous submissions. Our tutors come from all majors and are familiar with a variety of writing styles and formats. Although tutors are not editors and therefore will not "fix" a student's writing, they will provide detailed feedback and revision options for any writing project at any stage of the writing process, including initial brainstorming, early drafting, major (and minor) structural revisions, and/or finishing touches on a final draft. To make an appointment, submit your work to the Online Writery, or learn what else the Writing Center has to offer, visit their website at writingcenter.missouri.edu.

  Though there may be specific times where we will request that a student meets with a Writing Center tutor before submitting an assignment, we encourage all students to use this excellent resource.

- If you anticipate barriers related to the format or requirements of this course, if you have emergency medical information to share with me, or if you need to make arrangements in case the building must be evacuated, please let me know as soon as possible.

  If disability related accommodations are necessary (for example, a note taker, extended time on exams, captioning), please establish an accommodation plan with the MU Disability Center, S5 Memorial Union, 573-882-4696, and then notify me of your eligibility for reasonable accommodations. For other MU resources for persons with disabilities, click on "Disability Resources" on the MU homepage.

- The University community welcomes intellectual diversity and respects student rights. Students who have questions or concerns regarding the atmosphere in this class (including respect for diverse opinions) may contact the departmental chair or divisional director; the Office of Academic Integrity; the MU Equity Office, or equity@missouri.edu. All students will have the opportunity to submit an anonymous evaluation of the instructor(s) at the end of the course.

- University of Missouri System Executive Order No. 38 lays out principles regarding the sanctity of classroom discussions at the university. The policy is described fully in section 200.015 of the Collected Rules and Regulations. In this class, students may not make audio or video recordings of course activity, except students permitted to record as an accommodation under section 240.040 of the Collected Rules. All other students who record and/or distribute audio or video recordings of class activity are subject to discipline in accordance with provisions of section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.

  Those students who are permitted to record are not permitted to redistribute audio or video recordings of statements or comments from the course to individuals who are not students in the course without the express permission of the faculty member and of any students who are recorded. Students found to have violated this policy are subject to discipline in accordance with provisions of section 200.020 of the Collected Rules and Regulations of the University of Missouri pertaining to student conduct matters.

Late Assignments/Missed Class

If you miss class or turn in an assignment late because of illness, send me an email. Stay home if you're not feeling well. It is preferable if students who are sick stay home and that students not take unnecessary visits to a health care provider just to get documentation for missing class.

Class Schedule:

We will spend as much time as necessary on each topic for this course. Because I am unable to predict in advance how long each topic will take, the schedule below is only a rough guideline.

August 26: Overview/Syllabus and Mathematics for Political Scientists

Recommended:

- Will H. Moore and David A. Siegel (2013) *A Mathematics Course for Political & Social Research.* Princeton University Press. Chapters 2-3, 5-8

September 2: Probability Theory & Stata Review

Announcements:

- Mathematics for MLE homework is due

Required:

- Long and Freese: Chapter 2
- Sean Gailmard (2014) *Statistical Modeling and Inference for Social Science.* Cambridge University Press. Chapter 3.
- Christopher F. Baum (2009) *An Introduction to Stata Programming.* Stata Press. Chapter 3 (all), Chapter 5.3-5.8 (p. 86-111), Chapter 7.1-7.22 (p. 139-142), Chapter 7.3 (p. 154-159), and Chapter 9-9.1 (171-177).

Recommended:

- Jeff Gill (2006) *Essential Mathematics for Political and Social Research.* Cambridge University Press. Chapters 7-8

September 9: Linear Regression Model and Maximum Likelihood Estimation

Announcements:

- Stata Programming homework is due

Required:

- Long: Chapters 1-2

Recommended:

- Gross, Justin H. 2015. "Testing What Matters (If You Must Test at All): A Context-Driven Approach to Substantive and Statistical Significance." *American Journal of Political Science.* 59.3: 775-788.

September 16: Binary Dependent Variables I: Linear Probability, Logit and Probit Models

Required:

- Long: Chapter 3.1-3.6 (p. 34-61)
- Long and Freese: Chapter 3-3.1 (p. 75-98) and Chapter 4-4.2 (p. 131-140)

Recommended:

- Beck, Nathaniel, Jonathan N. Katz and Richard Tucker. 1998. "Taking Time Seriously: Time-Series-Cross-Section Analysis with a Binary Dependent Variable." *American Journal of Political Science* 42.4: 1260-1288.
- Carter, David B. and Curtis S. Signorino. 2010. "Back to the Future: Modeling Time Dependence in Binary Data." *Political Analysis* 18: 271-292.
- Williams, Laron K. 2016. "Long-Term Effects in Models with Temporal Dependence." *Political Analysis* 24: 243-262.

Recommended (Examples):

- Fuhrmann, Matthew and Michael C. Horowitz. 2015. "When Leaders Matter: Rebel Experience and Nuclear Proliferation." *The Journal of Politics* 77.1: 72-87.

September 23: Binary Dependent Variables II: Logit and Probit Interpretation

Announcements:

- Linear Regression homework is due

Required:

- Long: Chapter 3.7-3.10 (p. 61-84)
- Long and Freese: Chapter 3.6-3.8 (p. 113-128) and Chapter 4.6-4.8 (p. 157-181)
- King, Gary, Michael Tomz and Jason Wittenberg. 2000. "Making the Most of Statistical Analyses: Improving Interpretation and Presentation." *American Journal of Political Science.* 44(2): 341-355.

Recommended:

- King, Gary and Langche Zeng. 2006. "The Dangers of Extreme Counterfactuals." *Political Analysis.* 14: 131-159.
- Berry, William D., Jacqueline H. R. DeMerritt. 2010. "Testing for Interaction in Binary Logit and Probit Models: Is a Product Term Essential?" *American Journal of Political Science* 54.1: 248-266.
- Hanmer, Michael J. and Kerem Ozan Kalkan. 2013. "Behind the Curve: Clarifying the Best Approach to Calculating Predicted Probabilities and Marginal Effects from Limited Dependent Variable Models." *American Journal of Political Science* 57.1: 263-277.
- Williams, Laron K. *Forthcoming.* "Temporal Dependence and the Sensitivity of Quantities of Interest: A Solution for a Common Problem." *International Studies Quarterly.*

September 30: Binary Dependent Variables III-IV: Hypothesis Testing and Model Fit & Extensions

Required:

- Long: Chapter 4

- Long and Freese: Chapter 3.5 (p. 104-113) and 4.3-4.5 (p. 140-157)

Recommended:

- Herron, Michael C. 1999. "Postestimation Uncertainty in Limited Dependent Variable Models." *Political Analysis* 8.1: 83-98.

- Greenhill, Brian, Michael D. Ward and Audrey Sacks. 2011. "The Separation Plot: A New Visual Method for Evaluating the Fit of Binary Models." *American Journal of Political Science* 55.4: 991-1003.

- Ward, Michael D., Brian D. Greenhill and Kristin M. Bakke. 2010. "The Perils of Policy by p-Value: Predicting Civil Conflicts." *Journal of Peace Research* 47.4: 363-375.

October 7: Ordinal Dependent Variables: Ordered Logit and Probit

Announcements:

- Logit/Probit homework is due

Required:

- Long: Chapter 5

- Long and Freese: Chapter 5

Recommended (Examples):

- Duch, Raymond M. and Harvey D. Palmer. 2004. "It's Not Whether You Win or Lose, but How You Play the Game: Self-Interest, Social Justice, and Mass Attitudes toward Market Transition." *American Political Science Review.* 98(3): 437-452.

October 14: Nominal Dependent Variables: Multinomial Logit and Probit

Announcements:

- Ordered Models homework is due

Required:

- Long: Chapter 6.1-6.6 (p. 148-178)

- Long and Freese: Chapter 6-6.7 (p. 223-276)

Recommended (Example):

- Whitten, Guy D. and Harvey Palmer. 1996. "Heightening Comparativists' Concern for Model Choice: Voting Behavior in Great Britain and the Netherlands." *American Journal of Political Science*. 40(1): 231-260.

October 21: Count Models: Poisson and Negative Binomial Models

Announcements:

- **Research Report #1 is Due**

Required:

- Long: Chapter 8
- Long and Freese: Chapter 8-8.3.5 (p. 349-381) and Chapter 8.6-8.8 (p. 394-414)
- King, Gary. 1988. "Statistical Models for Political Science Event Counts: Bias in Conventional Procedures and Evidence for the Exponential Poisson Regression Model." *American Journal of Political Science*. 32(2): 838-863.

Spatial Econometrics

October 28: Spatial Dependence in Theory and Practice

Announcements:

- Categorical Models homework is due

Required:

- Ward and Gleditsch: pages 1-13

November 4: Identifying Neighbors

Announcements:

- **Research Report #2 is Due**

Required:

- Ward and Gleditsch: pages 14-19
- Neumayer, Eric and Thomas Plumper. 2016. "W". *Political Science and Research Methods*. 4.1: 175-193.

Recommended:

- Zhukov, Yuri M. and Brandon M. Stewart. 2013. "Choosing Your Neighbors: Networks of Diffusion in International Relations." *International Studies Quarterly*. 57: 271-287.

- Plumper, Thomas and Eric Neumayer. 2010. "Model Specification in the Analysis of Spatial Dependence." *European Journal of Political Research*. 49: 418-422.

Examples (Recommended):

- Kayser, Mark Andreas and Michael Peress. 2012. "Benchmarking across Borders: Electoral Accountability and the Necessity of Comparison." *American Political Science Review*. 106.3: 661-684.

- Fortunato, David, Clint S. Swift and Laron K. Williams. *forthcoming* "All Economics Is Local: Spatial Aggregations of Economic Information." *Political Science Research and Methods*.

- Beck, Nathaniel, Kristian Skrede Gleditsch and Kyle Beardsley. 2006. "Space Is More than Geography: Using Spatial Econometrics in the Study of Political Economy." *International Studies Quarterly*. 50: 27-44.

November 11: Model Specification

Required:

- Ward and Gleditsch: pages 19-34

Recommended:

- Vega, Solmaria Halleck and J. Paul Elhorst. 2015. "The SLX Model." *Journal of Regional Science*. 55.3: 339-363. **Only read pages 339-344.**

November 18: Estimating Spatial Econometric Models

Required:

- Ward and Gleditsch: pages 35-44 and 65-76

- Franzese, Robert J. and Jude C. Hays. 2007. "Spatial Econometric Models of Cross-Sectional Interdependence in Political Science Panel and Time-Series-Cross-Section Data." *Political Analysis*. 15: 140-164.

Recommended:

- Vega, Solmaria Halleck and J. Paul Elhorst. 2015. "The SLX Model." *Journal of Regional Science*. 55.3: 339-363. **Only read pages 345-363.**

- Williams, Laron K. 2015. "It's All Relative: Spatial Positioning of Parties and Ideological Shifts." *European Journal of Political Research*. 54: 141-159.

Recommended (Examples):

- Williams, Laron K. and Guy D. Whitten. 2015. "Don't Stand So Close to Me: Spatial Contagion Effects and Party Competition." *American Journal of Political Science*. 59.2: 309-325. **Only read pages 309-317.**

- Williams, Laron K., Katsunori Seki and Guy D. Whitten. 2016. "You've Got Some Explaining to Do: The Influence of Economic Conditions and Spatial Competition on Party Strategy." *Political Science Research and Methods*. 4.1: 47-63. **Only read 47-56**.

November 25: Thanksgiving Break (No Class)

December 2: Visualizing and Depicting Spatial Dependence

Announcements:

- **Research Report #3 is Due**

Required:

- Ward and Gleditsch: pages 44-64

Recommended (Examples):

- Williams, Laron K. and Guy D. Whitten. 2015. "Don't Stand So Close to Me: Spatial Contagion Effects and Party Competition." *American Journal of Political Science*. 59.2: 309-325. **Only read pages 318-325.**

- Williams, Laron K., Katsunori Seki and Guy D. Whitten. 2016. "You've Got Some Explaining to Do: The Influence of Economic Conditions and Spatial Competition on Party Strategy." *Political Science Research and Methods*. 4.1: 47-63. **Only read 57-63**.

- Whitten, Guy D., Laron K. Williams and Cameron Wimpy. *Forthcoming*. "Interpretation: The Final Spatial Frontier." *Political Science Research and Methods*.

December 9: Clean Up

December 16

Announcements:

- **Research Report #4 is Due**