
PSC 505
MLE (+ Other Topics)

Fall 2020
Mon/Wed 10:30-12, online

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COURSE DESCRIPTION: This course builds upon the analytical and applied foundations of PSC 404, taking the classical linear model as its point of departure. Because the classical linear regression model is inappropriate for data that arises in many interesting areas of political science, students need additional statistical tools in order to conduct rigorous empirical research. In this course, students will learn methods to analyze models and data for event counts, durations, censoring, truncation, selection, multinomial ordered/unordered categories, and strategic choices – in other words, all the other data out there. From time to time, we will also venture into semi-parametric methods, nonparametric methods, and machine learning, especially when those topics complement the MLE techniques we are studying.

A major goal of the course will be to teach students how to develop new models and techniques for analyzing issues they encounter in their own research. “Canned” statistical routines are often not appropriate for most of the micro-level models we develop as political science researchers. Students will therefore be required to program their own statistical routines (primarily in R).

PREREQUISITES: PSC 404 or the equivalent. Calculus. Matrix algebra.

COURSE REQUIREMENTS: Course grades will be based on a series of homeworks (55%), a course paper (40%), and participation (5%). The homeworks will consist of a mix of analytical problems, programming, and data analysis. For homeworks, students are encouraged to work in groups of any size, so long as that size is no greater than two. The course paper must be the sole work of the student. Coauthored papers are not allowed. Papers submitted for another course this semester are acceptable (so long as the other instructor agrees as well). However, the research, statistical analysis, and writing must have been conducted *this semester*.

COURSE CREDITS: This is a four credit course, consisting of in-class lecture (3 credit hours), a section (1 credit hour), and out-of-class student time spent on reading and homeworks.

READINGS: Students are responsible for keeping up with the reading each week. I post my lecture notes and will provide links or copies of articles from time to time. In addition, students should read the appropriate chapters in the following, many of which are available in H315:

- **Yudi Pawitan. 2013. *In All Likelihood: Statistical Modeling and Inference Using Likelihood*.**

- **W. John Braun & Duncan J. Murdoch.** *A First Course in Statistical Programming with R.**
- Gary King. 1998. *Unifying Political Methodology.*
- A. Colin Cameron & Pavin K. Trivedi. *Microeconometrics.**
- William H. Greene. 1997. *Econometric Analysis.**
- Patrick Burns. 2011. *The R Inferno.**
- The star lab introduction to R. <http://www.sas.rochester.edu/psc/thestarlab/resources.php>

* PDF available on course blackboard page under Course Materials > Texts.

COURSE OUTLINE:

1. R Programming and Monte Carlo Simulation

- W. John Braun & Duncan J. Murdoch. *A First Course in Statistical Programming with R.*
- Burns, Patrick. 2011. *The R Inferno.*

2. Maximum Likelihood Estimation

- Pawitan, 2013. *In All Likelihood.* Chapters 1-3, 6.1.
- King, Gary. 1998. *Unifying Political Methodology.* Chapters 1-4.
- Zivot, E. 2009. "Maximum Likelihood Estimation." Notes.

3. Binary Data and Count Data

- Pawitan, 2013. *In All Likelihood.* Chapters 4.1-4.8. (Bernoulli, Binomial, Poisson)
- Pawitan, 2013. *In All Likelihood.* Chapter 6.2-6.3. (Logistic & Poisson Regression)
- King, Gary. 1998. *Unifying Political Methodology.* Chapters 5.6-5.10.

Recommended

- King, Gary and Curtis S. Signorino. 1996. "The Generalization in the Generalized Event Count Model, with Comments on Achen, Amato and Londegren." *Political Analysis* 6: 225-252.
- Prentice, R. L. 1986. "Binary Regression Using an Extended Beta-Binomial Distribution, With Discussion of Correlation Induced by Covariate Measurement Errors." *Journal of the American Statistical Association* 81: 321-327.

4. Standard Errors and Confidence Intervals: Delta Method and Bootstrap

- Pawitan, 2013. *In All Likelihood.* Chapter 5.
- King, Gary. 1991. "Calculating Standard Errors of Predicted Values based on Nonlinear Functional Forms." *The Political Methodologist* 4(2).
- Efron, Bradley and Gail Gong. 1983. "A Leisurely Look at the Bootstrap, the Jackknife, and Cross-Validation." *The American Statistician.* 37(1):36-48.

5. Interaction Terms in Nonlinear Models

- Norton, Edward C., Hua Wang, and Chunrong Ai. "Computing Interaction Effects and Standard Errors in Logit and Probit Models." *The Stata Journal* 4: 103-116.

- Ai, Chunrong and Edward C. Norton. 2003. "Interaction Terms in Logit and Probit Models." *Economics Letters* 80:123-129.
- Braumoeller, Bear F. 2004. "Hypothesis Testing and Multiplicative Interaction Terms." *International Organization* 58: 807-820.
- Brambor, Thomas, William Clark, and Matt Golder. 2006. "Understanding Interaction Models: Improving Empirical Analyses." *Political Analysis*. 14:63-82.

6. Duration Models

6.1 Parametric Models

- Pawitan, 2013. *In All Likelihood*. Chapters 4.9, 11.5-11.6.
- Box-Steffensmeier, Janet and Bradford S. Jones. 2004. *Event History Modeling: A Guide for Social Scientists*. Chapters 2 – 8.
- King, Gary, James E. Alt, Nancy Elizabeth Burns, and Michael Laver. 1990. "A Unified Model of Cabinet Dissolution in Parliamentary Democracies." *American Journal of Political Science* 34: 846-871.

Recommended

- Alt, James E., Gary King, and Curtis S. Signorino. 2001. "Aggregation among Binary, Count, and Duration Models: Estimating the Same Quantities from Different Levels of Data." *Political Analysis* 9: 1-24.

6.2 Cox Proportional Hazard Models

- Pawitan, 2013. *In All Likelihood*. Chapter 11.7.
- Box-Steffensmeier, Janet and Bradford S. Jones. 2004. *Event History Modeling: A Guide for Social Scientists*. Chapter .
- Box-Steffensmeier, Janet M. and Christopher J. W. Zorn. 2001. "Duration Models and Proportional Hazards in Political Science." *American Journal of Political Science* 45: 972-988.

Recommended

- Blossfeld, Hans-Peter and Gotz Rohwer. 2001. *Techniques of Event History Modeling: A New Approach to Causal Analysis*. Chapters 1, 3, 8 – 10.
- Kalbfleisch, J. D. and R. L. Prentice. 1980. *The Statistical Analysis of Failure Time Data*. Chapter 4.

6.3 Grouped Binary Duration Data

- 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: 1260-1288.
- Carter, David B. and Curtis S. Signorino. 2009. "Back to the Future: Modeling Time Dependence in Binary Data." *Political Analysis*. 18(3):271-292.
- Oneal, John R. and Bruce M. Russett. 1997. "The Classical Liberals Were Right: Democracy, Interdependence, and Conflict, 1950-1985." *International Studies Quarterly* 41:267-293.

Supplemental Reading on Splines

- Ruppert, David, M. P. Wand, and R. J. Carroll. 2003. *Semiparametric Regression*. Chapter 3.
- Ridgeway, Greg. “Splines.”
- Fox, John. 2000. *Nonparametric Simple Regression: Smoothing Scatterplots*. Chapter 6.

7. Censoring and Truncation

- Sigelman, Lee and Langche Zeng. 1999. “Analyzing Censored and Sample-Selected Data with Tobit and Heckit Models.” *Political Analysis* 8. Read pages 167-177.
- King, Gary. 1998. *Unifying Political Methodology*. Chapter 9.
- Krehbiel, Keith and Douglas Rivers. 1988. “The Analysis of Committee Power: An Application to Senate Voting on the Minimum Wage.” *American Journal of Political Science* 32: 1151—1174.
- Smith, Alastair. 1999. “Testing Theories of Strategic Choice: The Example of Crisis Escalation.” *American Journal of Political Science* 43: 1254--1283.

Recommended

- Amemiya, Takeshi. 1984. “Tobit Models: A Survey.” *Journal of Econometrics* 24: 3-60.
- Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. Chapter 5.

8. Selection Models

- Sigelman, Lee and Langche Zeng. 1999. “Analyzing Censored and Sample-Selected Data with Tobit and Heckit Models.” *Political Analysis* 8: 167-182.
- Heckman, James J. 1979. “Sample Selection Bias as a Specification Error.” *Econometrica* 47: 153-162.
- Reed, William. 2000. “A Unified Statistical Model of Conflict Onset and Escalation.” *American Journal of Political Science* 44: 84—93.

Recommended:

- Heckman, James J. 1976. “The Common Structure of Statistical Models of Truncation, Sample Selection and Limited Dependent Variables and a Simple Estimator for Such Models.” *Annals of Economic and Social Measurement* 5: 475-492.
- Dubin, Jeffrey A. and Douglas Rivers. 1989. “Selection Bias in Linear Regression, Logit, and Probit Models.” *Sociological Methods and Research*. 18:360-390.
- Meng, Chun-Lo and Peter Schmidt. 1985. “On the Cost of Partial Observability in the Bivariate Probit Model.” *International Economic Review*. 26(1):71-85.

9. Categorical Data and Random Utility Models

- King, Gary. 1998. *Unifying Political Methodology*. Chapter 5, Section 4.
- Amemiya, Takeshi. 1981. “Qualitative Response Models: A Survey.” *Journal of Economic Literature*. 19(4):1483-1536.
- Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. Chapter 5.

Recommended

- So, Ying. “A Tutorial on Logistic Regression.” SAS Institute, Inc.

10. Strategic Models, part I

10.1 Bounded Rationality and the Quantal Response Equilibrium (QRE)

- McKelvey, Richard D. and Thomas R. Palfrey. 1996. “A Statistical Theory of Equilibrium in Games.” *The Japanese Economic Review* 47: 186-209.
- McKelvey, Richard D. and Thomas R. Palfrey. 1998. “Quantal Response Equilibria for Extensive Form Games.” *Experimental Economics* 1: 9-41.
- Fey, Mark, Richard D. McKelvey, and Thomas Palfrey. 1996. “An Experimental Study of the Constant-Sum Centipede Game.” *International Journal of Game Theory* 25: 269—287.

10.2 Private Information, Regression, and Misspecification

- Signorino, Curtis S. 1999. “Strategic Interaction and the Statistical Analysis of International Conflict.” *American Political Science Review* 93: 279—297.
- Signorino, Curtis S. 2003. “Structure and Uncertainty in Discrete Choice Models.” *Political Analysis* 11:316—344.
- Signorino, Curtis S. and Kuzey Yilmaz. 2003. “Strategic Misspecification in Regression Models.” *American Journal of Political Science* 47: 551—566.
- Bas, Muhammet, Curtis S. Signorino, and Robert W. Walker. 2008. “Statistical Backwards Induction: A Simple Method for Estimating Strategic Models.” *Political Analysis* 16: 21—40.

Recommended:

- Signorino, Curtis S. 2002. “Strategy and Selection in International Relations.” *International Interactions* 28: 93—115.
- Signorino, Curtis S. and Ahmer Tarar. 2006. “A Unified Theory and Test of Extended Immediate Deterrence.” *American Journal of Political Science* 50: 586—605.
- Plaxina, Elena. 2003. “An Evaluation of the Effectiveness of Financial Transfer Institutions for the Environment: The Global Environment Facility of the World Bank.” University of Rochester. Working Paper.

11. Model Comparison and Model Discrimination

- Pawitan, 2013. *In All Likelihood*. Chapters 13.5-13.6.
- Clarke, Kevin A. 2001. “Testing Nonnested Models of International Relations: Reevaluating Realism.” *American Journal of Political Science* 45: 724-744.
- Clarke, Kevin A. 2003. “Nonparametric Model Discrimination in International Relations.” *Journal of Conflict Resolution* 47: 72-93.
- Clarke, Kevin A. and Curtis S. Signorino. 2010. “Discriminating Methods: Tests for Non-nested Discrete Choice Models.” *Political Studies* 58: 368—388.

12. Strategic Models, part II

12.1 Signaling Models

- Lewis, Jeffrey B. and Kenneth A. Schultz. 2003. “Revealing Preferences: Empirical Estimation of a Crisis Bargaining Game with Incomplete Information.” *Political Analysis* 11: 345—367.
- Wand, Jonathan. 2005. “Comparing Models of Strategic Choice: The Role of Uncertainty and Signaling.” *Political Analysis* 14: 101—120.
- Bas, Muhammet, Curtis S. Signorino and Taehee Whang. 2013. “Knowing One’s Future Preferences: A Correlated Agent Model with Bayesian Updating.” *Journal of Theoretical Politics*.

13. Machine Learning & Flexible Functional Form Estimation

- Penalized Estimators: Ridge Regression, LASSO, Adaptive LASSO
- Kenkel & Signorino working papers.
- Das, Mitali, Whitney K. Newey, & Francis Vella. “Nonparametric Estimation of Sample Selection Models.” *Review of Economic Studies*. 70:33–58.

14. Introduction to Bayesian Estimation

IMPORTANT DATES

Labor Day 9/7

Fall Break None this year

Topic and Data OK’d 11/4 (One paragraph. Research question. Main hypothesis. Dataset.)

Thanksgiving Break 11/25 - 11/29

Rough Draft Due 11/23

Comments Returned 11/30

Class Presentations 12/7 & 12/9

Final Paper Due 5pm, Wed 12/16

ACADEMIC HONESTY

Students are expected to abide by the College’s policy on academic honesty. Please review the policy at <https://www.rochester.edu/college/honesty/graduates.html>
When in doubt, please ask the professor for guidance concerning the policy and how it applies to homeworks and papers in this course.

In particular,

- You are not allowed to consult material from previous years that other PSC 505 students have kept or archived.
- All R code should be written by you. I will provide you with many examples throughout the semester. Sometimes it will make sense to use the same variable names and techniques. However, you should never simply copy and paste my R code for use in your homework or final paper.

- If you have never written a research paper, please consult with your Director of Graduate Studies for information on plagiarism and academic honesty.
- You should not post or share course material (e.g., lectures and homeworks) online without first obtaining the permission of the instructor.

UNIVERSITY COVID-19 STATEMENT

The University is committed to protecting the health and safety of the entire community – students, faculty and staff. For this reason, it is mandatory that everyone wear a mask in University buildings and observe appropriate social distancing, including classrooms. Masks have been provided to students, faculty and staff and classrooms have been specifically assigned to allow for social distancing to support these requirements. You must wear a mask appropriately (e.g. over nose and mouth) if you are attending class in person, and you must do this for every class session and for the entire duration of each class session. If you fail to do this, you will be politely reminded of the requirement and then asked to leave if you do not comply.

If you do not want to wear a mask, you may consider taking the course remotely (online). This may require you to complete a set of online requirements different from the in-person requirements, although these will be equivalent in their learning objectives.

Students who refuse to adhere to requirement for mask wearing or social distancing the course will be in violation of the COVID-19 Community Commitment and will be referred to the Student Conduct system through a COVID-19 Concern Report. Such referrals will lead to student conduct hearings and may result in disciplinary action.

Students who feel unable to wear a mask may contact the Office of Disability Resources to explore options for accommodations. Students requiring accommodations may be asked to participate in the course through synchronous or asynchronous learning as part of this accommodat