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# PSC 505

## Maximum Likelihood Estimation

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Fall 2008  
2:00-3:15 MW, Hark 329

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**COURSE DESCRIPTION:** This course builds upon the analytical and applied foundations of PSC 404 and 405, taking the latter's emphasis on 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, strategic choices, and time series – in other words, all the other data out there.

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 and 405, or the equivalent.

**COURSE REQUIREMENTS:** Course grades will be based on a series of problem sets (20%), a midterm exam (40%), and a final exam (40%). The exercises will consist of a combination of analytical problems and data analysis. Students are encouraged to work in groups of any size, so long as that size is two.

**READINGS:** Students are responsible for keeping up with the reading each week. I will hand out 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 the star lab:

- **William H. Greene. 1997. *Econometric Analysis*. 5<sup>th</sup> edition. Prentice Hall.**
- **Gary King. 1998. *Unifying Political Methodology*. Michigan.**
- **G.S. Maddala. *Limited-Dependent and Qualitative Variables in Econometrics*. Cambridge.**
- Peter Kennedy. 1998. *A Guide to Econometrics*. 4<sup>th</sup> edition. MIT.
- W.N. Venables and B.D. Ripley. *Modern Applied Statistics with S*. Springer.

## COURSE OUTLINE:

### 1. Maximum Likelihood Estimation

- King, Gary. 1998. *Unifying Political Methodology*. Chapters 1-4.
- Greene, William H. 1997. *Econometric Analysis*. Chapter 17.
- Rodriguez, G. 2001. "Appendix A: Review of Likelihood Theory."

### 2. Count Models

#### General Information

- King, Gary. 1998. *Unifying Political Methodology*. Chapter 5, Sections 6-10.
- Greene, William H. 1997. *Econometric Analysis*. Chapter 21, Section 9.
- 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.
- King, Gary. 1991. "Calculating Standard Errors of Predicted Values based on Nonlinear Functional Forms." *The Political Methodologist* 4(2).

#### 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.

#### Homework Reading

- Martin, Lisa. 1992. *Coercive Cooperation*. Chapters 2 – 4.
- Chang, Eric C. C. 2005. "Electoral Incentives for Political Corruption under Open-List Proportional Representation." *Journal of Politics* 87: 716-730.

### 3. Duration Models

#### Parametric Models

- Greene, William H. 1997. *Econometric Analysis*. Chapter 22, Section 5.
- 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.
- 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.

#### Cox Proportional Hazard Models

- 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.
- 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.

#### 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. 2007. "Back to the Future: Modeling Time Dependence in Binary Data." University of Rochester Working Paper.
- 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.

#### **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.

#### **4. Categorical Data Models**

- King, Gary. 1998. *Unifying Political Methodology*. Chapter 5, Section 4.
- Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. Chapter 5.
- So, Ying. "A Tutorial on Logistic Regression." SAS Institute, Inc.
- Jackman, Simon. 2000. "Models for Unordered Outcomes."

#### **5. Censoring, Truncation, and Selection Models**

- Greene, William H. 1997. *Econometric Analysis*. Chapter 22, Sections 1-4.
- King, Gary. 1998. *Unifying Political Methodology*. Chapter 9.
- Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics*. Chapter 5.
- Heckman, James J. 1979. "Sample Selection Bias as a Specification Error." *Econometrica* 47: 153-162.
- 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.
- Sigelman, Lee and Langche Zeng. 1999. "Analyzing Censored and Sample-Selected Data with Tobit and Heckit Models." *Political Analysis* 8: 167-182.
- Amemiya, Takeshi. 1984. "Tobit Models: A Survey." *Journal of Econometrics* 24: 3-60.

#### **6. Strategic Models**

##### **General Information**

- Signorino, Curtis S. and Kuzey Yilmaz. 2003. "Strategic Misspecification in Regression Models." *American Journal of Political Science* 47: 551-566.
- Bas, Muhammet Ali, Curtis S. Signorino, and Robert W. Walker. 2007. "Statistical Backwards Induction: A Simple Method for Estimating Recursive Strategic Models." *Political Analysis* 16: 21-40.
- Signorino, Curtis S. 2003. "Structure and Uncertainty in Discrete Choice Models." *Political Analysis* 11: 316-344.
- Signorino, Curtis S. 2002. "Strategy and Selection in International Relations." *International Interactions* 28: 93-115.
- Signorino, Curtis S. 2007. "On Formal Theory and Statistical Methods: A Response to Carrubba, Yuen and Zorn." *Political Analysis* 15: 483-501.
- Carrubba, Clifford J., Amy Yuen, and Christopher Zorn. 2007. "In Defense of Comparative Statics: Specifying Empirical Tests of Models of Strategic Interaction." *Political Analysis* 15: 465-482.

##### **Quantal Response Equilibria**

- Signorino, Curtis S. 1999. "Strategic Interaction and the Statistical Analysis of International Conflict." *American Political Science Review* 93: 279-297.

- 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.

#### **Signaling**

- Signorino, Curtis S. and Taehee Whang. 2006. "Uncertainty and Learning in Statistical Strategic Models." University of Rochester Working Paper.
- 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.

#### **Bargaining**

- Ramsay, Kristopher W. and Curtis S. Signorino. 2005. "Bargaining and Society: A Statistical Model of the Ultimatum Game." University of Rochester Working Paper.

#### **Deterrence**

- Signorino, Curtis S. and Ahmer Tarar. 2006. "A Unified Theory and Test of Extended Immediate Deterrence." *American Journal of Political Science* 50: 586-605.

#### **IPE**

- 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.

### **7. Comparative Model Testing**

- 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. 2006. "Discriminating Methods: Tests for Nonnested Discrete Choice Models." University of Rochester Working Paper.

### **8. Time Series**

- King, Gary. 1998. *Unifying Political Methodology*. Chapter 7.
- Greene, William H. 1997. *Econometric Analysis*. Chapter 20.