

POLS571: Longitudinal Data Analysis

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1 Description

This course is designed as an introduction to statistics for longitudinal data – that is, data with repeated measurements on the same units over time. Such data have become increasingly widespread in political science, particularly in comparative politics and international relations. Longitudinal data offer both challenges and opportunities for the applied researcher. The current course is divided more or less in half. In the first half of the class, we’ll discuss and apply what are commonly referred to as “time series” models: models for data consisting of long series of observations on relatively few (i.e., one) unit(s). Some topics that will be covered include ARIMA models; regression analysis of time series; unit roots, integration and cointegration, error correction models; exogeneity tests; non-normal time series; vector autoregression models; and ARCH/GARCH models. In the second part of the course, we’ll address methods for data which varies both across units and over time; these include models for “panel” data, “time-series cross-sectional” data, and the like. Topics will include fixed- and random-effects models, GLS-based approaches to panel data, GEE models, random coefficient models and dynamic models with lagged dependent variables. Along the way, we’ll try, to the extent possible, to include methods for “ugly” (i.e., discrete) dependent variables. Except for a very few instances, however, we will not discuss duration/survival models; those models are presented in the *Maximum Likelihood* course taught in alternating years.

Much of the material in this course is fairly technical. While I have chosen readings that present the models as clearly and with as little jargon as possible, most of the readings will still require several readings to fully comprehend. POLS585M (The Linear Model) is a prerequisite for this class. Additionally, students are expected to have a nodding acquaintance with basic differential and integral calculus and distribution theory. Additionally, it is impossible to learn statistics by reading books or articles and attending lectures. Because of this incontrovertible fact, students will be required to complete six lab exercises over the course of the semester, typically receiving the exercise on Thursday and turning it in the following Tuesday. Most of these exercises will be computer-based and use the Stata 7.0 statistical software in the lab and data I will provide; some will replicate recent published work.

2 Grading

Grading will be based on several lab exercises and a final project, as follows:

- Lab exercises: Six worth 10 percent each.
- Final Project: 40 percent.

3 Part I: Time Series Analysis

3.1 Reference Works

There are lots and lots of good reference works on time series analysis. A few of the more comprehensive ones include:

- Box, George E. P., Gwilym M. Jenkins and Gregory C. Reinsel. 1994. *Time Series Analysis: Forecasting Control*, 3rd Ed. New York: Prentice-Hall.
- Enders, Walter, Ed. 1994. *Applied Econometric Times Series*. New York: Wiley.
- Hamilton, James D. 1994. *Time Series Analysis*. Princeton: Princeton University Press.
- Harvey, A. C. 1993. *Time Series Models*. Cambridge: MIT Press.
- Maddala, G. S. and In-Moo Kim. 1999. *Unit Roots, Cointegration, and Structural Change*. New York: Cambridge University Press.
- Mills, Terence C. 1990. *Time Series Techniques for Economists*. New York: Cambridge University Press.
- Mills, Terence C. 1999. *The Econometric Modelling of Financial Time Series*, 2nd Ed. New York: Cambridge University Press.
- Patterson, K. D. 2000. *An Introduction to Applied Econometrics : A Time Series Approach*. New York: Palgrave.

3.2 Sept. 4-6: ARIMA Models

- Hamilton, James D. 1994. *Time Series Analysis*. Chapter 3.
- Li, R. P. and W. R. Thompson. 1978. "The Stochastic Process of Alliance Formation Behavior." *American Political Science Review* 72:1288-1303.
- Quinn, D. P. and R. Jacobson. 1989. "Industrial Policy Through Restrictions on Capital Flows." *American Journal of Political Science* 33:700-36.

3.3 Sept. 11-13: Unit Roots and Integration

- Dickey, D. and W. A. Fuller. 1979. "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." *Journal of the American Statistical Association* 74:427-31.
- Phillips, P. C. B. and P. Perron. 1988. "Testing for a Unit Root in Time Series Regression." *Biometrika* 75:335-346.
- Kwiatkowski, Denis, P.C.B. Phillips, Peter Schmidt and Yongcheol Shin. 1992. "Testing the Null Hypothesis of Stationarity against the Alternative of a Unit Root." *Journal of Econometrics* 54:159-78.
- Sims, Christopher A. 1988. "Bayesian Skepticism on Unit Root Econometrics." *Journal of Economic Dynamics and Control* 12:463-74.

3.4 Sept. 18-20: Causality

Theory:

- Granger, Clive W. J. and Paul Newbold. 1974. "Spurious Regressions in Econometrics." *Journal of Econometrics* 2:111-20.
- Hibbs, D. 1974. "Problems of Statistical Estimation and Causal Inference in Time-Series Regression Models." *Sociological Methodology* 137-79.
- Freeman, James R. 1983. "Granger Causality and the Time Series Analysis of Political Relationships." *American Journal of Political Science* 27:327-58.

- Granato, James and Renee M. Smith. 1994. "Exogeneity, Inference, and Granger Causality: Part 1, The Stationary Case." *The Political Methodologist* 5:24-28.
- Granato, James and Renee M. Smith. 1994b. "Exogeneity, Inference, and Granger Causality: Part 2, The Case of Integrated Regressors." *The Political Methodologist* 6:23-26.

Application:

- Reuveny, R. and H. Kang. 1996. "International Trade, Political Conflict/Cooperation, and Granger Causality." *American Journal of Political Science* 40:943-70.

3.5 Sept. 25-27: Intervention Analysis and Distributed Lag Models

Theory:

- Box, G. E. P. and G. C. Tiao. 1975. "Intervention Analysis with Applications to Economic and Environmental Problems." *Journal of the American Statistical Association* 70:70-79.
- Gujarati, Damodar. 1995. *Basic Econometrics*, 3rd Ed. Chapter 17: "Autoregressive and Distributed Lag Models".
- Hibbs, Douglas. 1977. "On Analyzing the Effects of Policy Interventions: Box-Jenkins and Box-Tiao vs. Structural Equation Models." *Sociological Methodology* 252-307.

Applications:

- Alt, James. 1986. "Political Parties, World Demand, and Unemployment." *American Political Science Review* 79:1016-40.
- Rasler, Karen and William Thompson. 1985. "War and the Economic Growth of the Major Powers." *American Journal of Political Science* 29:513-38.

- Whitely, Paul F. 1988. "The Causal Relationships Between Issues, Candidate Evaluations, Party Identification, and Vote Choice – The View From 'Rolling Thunder'." *Journal of Politics* 50:961-84.
- Wood, B. Dan and Richard W. Waterman. 1991. "The Dynamics of Control of Bureaucracy." *American Political Science Review* 85:801-28.

3.6 Oct. 2-4: Cointegration and Error-Correction Models

Theory:

- Murray, Michael P. 1994. "A Drunk and Her Dog: An Illustration of Cointegration and Error Correction." *The American Statistician* 48(February):37-39.
- Engle, Robert F. and Clive W. J. Granger. 1987. "Co-integration and Error Correction: Representation, Estimation and Testing." *Econometrica* 55:251-76.
- Engle, R. F. and B. S. Yoo. 1991. "Cointegrated Economic Time Series: An Overview with New Results." In *Long-Run Economic Relationships: Readings in Cointegration*, Engle R. F. and C. W. J. Granger, eds. New York: Oxford University Press.
- Durr, Robert. 1993. "An Essay on Cointegration and Error Correction Models." *Political Analysis* 5:185-228, and discussion by Williams, Beck and Smith.
- Beck, Nathaniel. 1991. "Comparing Dynamic Specifications: The Case of Presidential Approval." *Political Analysis* 3:51-87.

Applications:

- Caldeira, Gregory A. and Christopher J. W. Zorn. 1998. "Of Time and Consensual Norms in the Supreme Court." *American Journal of Political Science* 42:874-902.

- Ostrom, Charles and Renee Smith. 1993. "Error Correction, Attitude Persistence, and Executive Rewards and Punishments: A Behavioral Theory of Presidential Approval." *Political Analysis* 5:127-83.

3.7 Oct. 9-11: VAR and ARCH Models

3.7.1 Vector Autoregression Models

- Hamilton, J. D. 1994. *Time Series Analysis*. Chapter 11.
- Freeman, John R., John T. Williams and Tse-min Lin. 1989. "Vector Autoregression and the Study of Politics." *American Journal of Political Science* 33:842-77.
- Freeman, John, Daniel Houser, Paul Kellstedt, and John Williams. 1998. "Long-Memored Processes, Unit Roots, and Causal Inference in Political Science." *American Journal of Political Science* 42:1261-88.
- Williams, John T. and B. K. Collins. 1997. "The Political Economy of Corporate Taxation." *American Journal of Political Science* 41:208-44.
- Enders, Walter and Todd Sandler. 1993. "The Effectiveness of Antiterrorism Policies: A Vector-Autoregression-Intervention Analysis." *American Political Science Review* 87:829-44.

3.7.2 ARCH/GARCH Models

- Engle, Robert F. 1982. "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of U.K. Inflation." *Econometrica* 50:978-1008.
- Bollerslev, Tim. 1986. "Generalized Autoregressive Conditional Heteroskedasticity." *Journal of Econometrics* 31:307-27.
- Maestas, Cherie and Robert R. Preuhs. 2000. "Modeling Volatility in Political Time Series." *Electoral Studies* 19:95-110.
- Beck, Nathaniel. 1983. "Time-Varying Parameter Regression Models." *American Journal of Political Science* 27:557-600.

- Brehm, John and Paul Gronke. 2001. "History, Heterogeneity, and Presidential Approval: A Modified ARCH Approach." *Electoral Studies*: forthcoming.

3.8 Oct. 18: Time Series Models for Event Counts

- Brandt, Patrick T., John T. Williams, Richard Fordham and Brian Pollins. 2000. "Dynamic Modelling For Persistent Event-Count Time Series." *American Journal of Political Science* 44:823-43.
- Brandt, Patrick and John Williams. 2001. "A Linear Poisson Autoregressive Model: The Poisson AR(p) Model." *Political Analysis* 9:164-84.
- Schwartz, J., Spix, C., Touloumi, G., et al. 1996. "Methodological Issues in Studies of Air Pollution and Daily Counts of Deaths or Hospital Admissions." *Journal of Epidemiology and Community Health* 50(Suppl. 1): S3-S18.

4 Part Two: Panel and TSCS Data Analysis

4.1 Reference Works

- Baltagi, B. 2001. *Econometric Analysis of Panel Data*, 2nd Ed. New York: Wiley.
- Diggle, P. K-Y Liang and S. Zeger. 1994. *Analysis of Longitudinal Data*. Oxford: Oxford University Press.
- Finkel, Stephen E. 1995. *Causal Analysis With Panel Data*. Thousand Oaks, CA: Sage Publications.
- Hand, David and Martin Crowder. 1996. *Practical Longitudinal Data Analysis*. London: Chapman and Hall.
- Hsiao, Cheng. 1986. *The Analysis of Panel Data*. Cambridge University Press.
- Judge, George G., W. E. Griffiths, R. Carter Hill, Helmut Lutkepohl, and Tsoung-Chao Lee. 1985. *The Theory and Practice of Econometrics*, 2nd Ed. New York: Wiley. Chapter 13.

- Markus, Gregory B. 1980. *Analyzing Panel Data*. Newbury Park, CA: Sage Publications.
- Mátyás, László and Patrick Sevestre, eds. 1996. *The Econometrics of Panel Data: A Handbook of the Theory with Applications*. 2nd Revised Ed. Dordrecht: Kluwer Academic Publishers.
- Wooldridge, Jeffrey M. 2001. *Econometric Analysis of Cross Section and Panel Data*. Cambridge: MIT Press.

4.2 Oct. 23-25, 30: Introduction and Fixed- and Random-Effects Models

- Hsiao, Cheng. 1986. *The Analysis of Panel Data*. Cambridge University Press. Chapters 1 and 3.
- Stimson, James. 1985. "Regression in Space and Time: A Statistical Essay." *American Journal of Political Science* 29:914-47.
- Finkel, Steven E. and Edward N. Muller. 1998. "Rational Choice and the Dynamics of Political Action: Evaluating Alternative Models with Panel Data." *American Political Science Review* 92(March):37-50.
- Wawro, Gregory. 2001. "Let's Not Be Laggard When Estimating Dynamic Panel Data Models in Political Science." Manuscript: Columbia University.

4.3 Nov. 1,6,8: GLS-based Models

4.3.1 GLS-ARMA Models

Theory:

- Beck, Nathaniel and Jonathan N. Katz. 1995. "What To Do (And Not To Do) With Time-Series Cross-Section Data." *American Political Science Review* 89(September):634-47.
- Beck, Nathaniel and Jonathan N. Katz. 1996. "Nuisance vs. Substance: Specifying and Estimating Time-Series-Cross-Section Models." *Political*

Analysis. 6:1-36.

- Beck, Nathaniel. 2001. "Time-Series Cross-Section Data: What Have We Learned in the Past Few Years?" *Annual Review of Political Science*. 4:271-93.

Applications:

- Blais, Andre, Donald Blake and Stephane Dion. 1996. "Do Parties Make a Difference: A Reappraisal," *American Journal of Political Science* 40:514-20.
- Burkhart, Ross E. and Michael S. Lewis-Beck. 1994. "Comparative Democracy: The Economic Development Thesis." *American Political Science Review* 88:903-10.

4.3.2 Between- and Within-Unit Effects

- Neuhaus, J. M., J. D. Kalbfleisch and W. W. Hauck. 1991. "A Comparison of Cluster-Specific and Population-Averaged Approaches for Analyzing Correlated Binary Data." *International Statistical Review* 59(1):25-35.
- Kaufman, Robert L. 1993. "Decomposing Longitudinal from Cross-Unit Effects in Panel and Pooled Cross-Sectional Designs." *Sociological Methods and Research* 21:482-504.
- Neuhaus, J. M. and J. D. Kalbfleisch. 1998. "Between- and Within-Cluster Covariate Effects in the Analysis of Clustered Data." *Biometrics* 54:638-45.
- Zorn, Christopher. 2002. "Estimating Between- and Within-Cluster Covariate Effects, with an Application to Models of International Disputes." *International Interactions* 28(4):forthcoming.

4.4 Nov. 13-15: Random-Coefficient Models and Time-Varying Parameters

- Longford, Nicholas. 1995. "Random Coefficient Models." In Arminger, et al., *Handbook of Statistical Modeling for the Social and Behavioral Sciences*. Plenum Press.

- Western, Bruce. 1998. "Causal Heterogeneity in Comparative Research: A Bayesian Hierarchical Modelling Approach." *American Journal of Political Science* 42:1233-59.
- Beck, Nathaniel and Jonathan Katz. 2001. "Random Coefficient Models in the Time-Series Cross-Section Context." Paper presented at the Political Methodology Meeting.
- Jackson, John E. 1991. "Estimation of Models with Variable Coefficients." *Political Analysis* 3:27-49.
- Wood, B. Dan. 2000. "Weak Theories and Parameter Instability: Using Flexible Least Squares to Take Time-Varying Relationships Seriously." *American Journal of Political Science*. 44:603-18.

4.5 Nov. 20,27-29; Dec. 4-6: Non-Normal Dependent Variables

4.5.1 Fixed- and Random-Effects Models

- 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(October):1260-88.
- Green, Donald P., Soo Yeon Kim, and David Yoon. 2001. "Dirty Pool." *International Organization*, 55:441-68.
- Wawro, Gregory. 2001. "A Panel Probit Analysis of Campaign Contributions and Roll Call Votes." *American Journal of Political Science* 45(July):563-79.
- Cameron, A. Colin and Pravin K. Trivedi. 1998. *Regression Analysis of Count Data*. New York: Cambridge University Press. Chapter 9.

4.5.2 GEE Models

- Zorn, Christopher. 2001. "Generalized Estimating Equation Models for Correlated Data: A Review with Applications." *American Journal of Political Science* 45:470-90.

- Caldeira, Gregory A., John R. Wright and Christopher J. W. Zorn. 1999. "Strategic Voting and Gatekeeping in the Supreme Court." *Journal of Law, Economics and Organization* 15(3):549-72.
- Leeds, Brett Ashley and David R. Davis. 1997. "Domestic Political Vulnerability and International Disputes." *Journal of Conflict Resolution* 41(December):814-34.

4.6 Dec. 11: Wrapping Up

- Beck, Nathaniel, 2000 "Time-Series Cross-Section Data: What Have We Learned in the Last Few Years?" Manuscript: University of California - San Diego.
- Granato, Jim. 1991. "An Agenda for Econometric Model Building." *Political Analysis* 3:123-54.