

ICPSR 2012 – Spatial Econometrics: Statistical Models of Interdependence – 4-8 June 2012

Instructor: Robert (Rob) J. Franzese, Jr. (franzese@umich.edu; www.umich.edu/~franzese)

Description & Objectives: Spatial interdependence is ubiquitous across the social sciences. The likelihood and outcomes of demonstrations, riots, coups, and revolutions in one country almost certainly depend in substantively crucial ways on such occurrences in other countries (e.g., through demonstration effects or snowballing). Election outcomes and candidate qualities or strategies in some contests surely depend on those in others, and representatives' votes in legislatures certainly depend on others' votes or expected votes. In micro-behavioral research, long-standing and recently surging interest in contextual or network effects often refers to effects on each individual's behavior or opinion from sets of other individuals' opinions or behaviors; e.g., a respondent's opinion on some policy likely depends on the opinions of her state, district, community, or social group. In international relations, states' entry decisions in wars, alliances, and organizations, e.g., heavily depend on how many and who else enters and how. In comparative and international political economy, globalization, i.e., international economic integration, implies strategic (and non-strategic) interdependence in national-level macroeconomic policymaking. This course introduces spatial and spatiotemporal econometric models for continuous and limited dependent variables that can address such interdependence, with an emphasis on social-science applications.

The main objective of this course is to teach students how to incorporate the interdependence implied by most social scientific theories into their empirical analysis. Students will learn *inter alia* how to 1) diagnose spatial patterns in their data, 2) estimate the structural parameters of spatial and spatiotemporal regression models, 3) calculate and present spatial and spatiotemporal effects, 4) use spatial modeling to discriminate between the multiple sources of spatial correlation—common exposure, interdependence, and selection—and, when it exists, to evaluate the nature of the interdependence (e.g., strategic free-riding behavior, learning, coercion) among units of observation.

Daily Schedule: Our morning sessions will *start around 9:30am* (after continental breakfast courtesy of ICPSR, enrollments permitting). We will break for *lunch around 11:30am*, resuming with our *afternoon session around 1pm*. We will take a *15-30 minute break around 3:00pm* (also with catered refreshments, enrollments permitting), and resume for *lab 3:30-5:00*.

Prerequisites & Background: Students should have understandings of basic matrix algebra, calculus, probability, statistics, and regression analysis at levels commensurate with successful completion of a second graduate course in empirical methods in the social sciences, as well as some familiarity with a software package that can be used for spatial analysis (e.g., *Stata*, *R*, or *MatLab*).

Course Materials: We do not use a textbook, but Anselin (2006) and Franzese & Hays (2008) overview most topics covered. Ward & Gleditsch (2008) provides good introductory textbook overview; LeSage & Pace (2009) is a good fuller, and more intermediate to advanced textbook.

Anselin, L. 2006. Spatial Econometrics. In T.C. Mills & K. Patterson, eds., *Palgrave Handbook of Econometrics: Volume 1, Econometrics Theory*. Basingstoke: Palgrave, pp. 901-941.

Franzese, R., Hays, J. 2008. [Empirical Models of Spatial Interdependence](#). In J. Box-Steffensmeier, H. Brady, D. Collier, eds., *Oxford Handbook of Political Methodology*, Oxford UP, pp. 570-604. (Use the hyperlinked version; it corrects an error in the published.)

LeSage, J., Pace, K. 2009. *Introduction to Spatial Econometrics*. Boca Raton: CRC Press, Taylor & Francis Grp.

Ward, M.D. and K.S. Gleditsch. 2008. *Spatial Regression Models*. Thousand Oaks, CA: Sage.

Course Outline with Readings and Lab Plans

Session 1 (Monday, June 4th, Morning):

Introductory Stuff, Theoretical and Empirical Models of “Spatial” Interdependence

Ross, M. and E. Homer. 1976. “Galton’s Problem in Cross-National Research.” *World Politics* 29(1):1-28.

Brueckner, J. 2003. “Strategic Interaction Among Governments: An Overview of Empirical Studies.” *International Regional Science Review* 26(2): 175-188.

Franzese, R., Hays, J. 2008. “Contagion, Common Exposure, and Selection: Empirical Modeling of the Theories and Substance of Interdependence in Political Science,” *Concepts & Methods: Newsletter of the International Political Science Association* 4(2):3-9.

Simmons, B., Dobbin, F., Garrett, G. 2006. “The International Diffusion of Liberalism.” *International Organization* 60(4):781-810.

Session 2 (Monday, June 4th, Afternoon):

Diagnosing Spatial Association in Raw Data and/or in OLS Residuals

Anselin, L. 1995. “Local Indicators of Spatial Association – LISA.” *Geographical Analysis* 27: 93-115.

Buse, A. 1982. “The Likelihood Ratio, Wald, and LM Tests: An Expository Note.” *The American Statistician* 36(3): 153-157.

Anselin, L., Bera, A., Florax, R.J., Yoon, M. 1996. “Simple Diagnostic Tests for Spatial Dependence.” *Regional Science and Urban Economics*, 26: 77-104.

Suggested: Cho, W.T., Rudolph, T. 2007. “Emanating Political Participation: Untangling the Spatial Structure behind Participation.” *British Journal of Political Science* 38(2): 273-289.

***** **Lab 1 Exercises: Measures & Diagnostics*******

Session 3 (Tuesday, June 5th, Morning):

Spatial Lag, Error, and Mixed Models I: A Typology of Structural Models

Beck, N., Gleditsch, K., Beardsley, K. 2006. “Space is More than Geography: Using Spatial Econometrics in the Study of Political Economy.” *International Studies Quarterly* 50: 27-44.

Plümper, T., Neumayer, E. 2010. “Model Specification in the Analysis of Spatial Dependence,” *European Journal of Political Research* 49(3):418-42.

Suggested: Neumayer, E., Plümper, T. 2010. “Spatial Effects in Dyadic Data.” *International Organization* 64(1):145-66.

Neumayer, E., Plümper, T. 2010. “Making Spatial Analysis Operational: Commands for Generating Spatial-Effect Variables in Monadic & Dyadic Data.” *The Stata Journal* 10(4):585-605.

Session 4 (Tuesday, June 5th, Afternoon):

Spatial Lag, Error, and Mixed Models II: Estimation

Doreian, P. 1981. "Estimating Linear Models with Spatially Distributed Data." *Sociological Methodology* Vol. 12: 359-388.

Land, K., Deane, G. 1992. "On the Large-Sample Estimation of Regression Models with Spatial or Network-Effects Terms: A Two-Stage Least Squares Approach." *Sociological Methodology*, Vol. 22, pp. 221-248.

*******Lab 2 Exercises: SAR & STAR Models*******

Session 5 (Wednesday, June 6th, Morning):

Spatial Lag, Error, and Mixed Models III: Calculating and Presenting Spatial Effects

Franzese, R., Hays, J. 2007. "Spatial-Econometric Models of Cross-Sectional Interdependence in Political Science Panel and Time-Series-Cross-Section Data." *Political Analysis* 15(2): 140-164.

Elhorst, J.P. 2001. "Dynamic Models in Space and Time." *Geographical Analysis* 33:119-140.

Session 6 (Wednesday, June 6th, Afternoon):

Spatiotemporal Models: Estimation & Interpretation

Repeat: Elhorst, J.P. 2001. "Dynamic Models in Space and Time." *Geographical Analysis* 33:119-140.

Repeat: Franzese, R., Hays, J. 2007. "Spatial-Econometric Models of Cross-Sectional Interdependence in Political Science Panel and Time-Series-Cross-Section Data." *Political Analysis* 15(2): 140-164.

Elhorst, J.P. 2010. "Spatial Panel-Data Models." In M.M. Fischer & A. Getis, eds., *Handbook of Applied Spatial Analysis*. Berlin: Springer, pp. 377-407.

Franzese, R., Hays, J. 2008. [Empirical Models of Spatial Interdependence](#). In J. Box-Steffensmeier, H. Brady, D. Collier, eds., *Oxford Handbook of Political Methodology*, Oxford UP, pp. 570-604. (Use the hyperlinked version; it corrects an error in the printed version.)

*******Lab 3 Exercises: More SAR & STAR Models*******

Session 7 (Thursday, June 7th, Morning):

Limited Dependent Variables I: Spatial-Probit Model

Beron, K., Murdoch, J., Vijverberg, W. 2003. "Why Cooperate? Public Goods, Economic Power, and the Montreal Protocol." *Review of Economics and Statistics* 85(2): 286-297.

Franzese, R., Hays, J., Schaffer, L. 2010. "[Spatial, Temporal, and Spatiotemporal Autoregressive Probit Models of Binary Outcomes: Estimation, Interpretation, and Presentation](#)," APSA 2010 (September).

*******Lab 4 Exercises: Spatial Probit*******

Session 8 (Thursday, June 7th, Afternoon):

Limited Dependent Variables II: Spatial-Duration and Spatial-Count Models

Hays, J. 2009. "[Bucking the System: Using Simulation Methods to Estimate and Analyze Systems of Equations with Qualitative and Limited Dependent Variables](#)," SLAMM (St. Louis Area Methods Meetings), Washington University in St. Louis.

Franzese, R., Hays, J. 2009. "[A Comparison of the Small-Sample Properties of Several Estimators for Spatial-Lag Count-Models](#)," Political Methodology Society Annual Meetings.

Suggested: Griffith, D., Haining, R. 2006. "Beyond Mule Kicks: The Poisson Distribution in Geographical Analysis." *Geographical Analysis* 38: 123-139.

Hays, J., Kachi, A. 2009. "[Interdependent Duration Models in Political Science](#)," American Political Science Association Annual Meetings.

Darmofal, D. 2009. "Bayesian Spatial Survival Models for Political Event Processes," *American Journal of Political Science* 53(1):241-57.

******Lab 5 Exercises: Spatial-Duration & Count******

Session 9 (Friday, June 8th, Morning):

Multiparametric Spatial-Lag Models and Network-Behavior Coevolution

Hays, J., Kachi, A., Franzese, R. 2010. "[A Spatial Model Incorporating Dynamic, Endogenous Network Interdependence: A Political Science Application](#)," *Statistical Methodology* 7(3): 406-28.

******Lab 6 Exercises: m-STAR Model******

Session 10 (Friday, June 8th, Afternoon):

Network and Spatial-Econometric Models of Network-Behavior Coevolution

Franzese, R., Hays, J., Kachi, A. 2012. "[Modeling History Dependence in Network-Behavior Coevolution](#)" *Political Analysis* 20(2):175-90.