

# ICPSR 2013 – Spatial Regression for Contagion, Diffusion, and Interdependent Processes 12-16 August 2013

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**Description & Objectives:** Spatial interdependence is ubiquitous across the social sciences (and beyond). For examples: 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 directly 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, where applicable, to evaluate the behavioral source of the interdependence (strategic responses, free-riding, learning, coercion, etc.) among units of observation.

**Daily Schedule:** Our morning sessions will *start around 9:30am* (after morning light-refreshments courtesy of ICPSR). We will break for *lunch around 11:30am*, resuming with our *afternoon session around 1pm*. We will take a *15-30 minute break around 2:45pm* (also with catered refreshments, enrollments permitting), and resume for *lab around 3:00-4:30*.

**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* for instance).

**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 (& Bayesian) 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.
- Anselin, L., Murray, A. T., & Rey, S. 2013. "Spatial Analysis." Ch. 8 in *The Oxford Handbook of Quantitative Methods in Psychology: Vol. 2: Statistical Analysis*, pp. 154-74.
- 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, August 12<sup>th</sup>, 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, August 12<sup>th</sup>, 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.

Griffith, D. 2000. “A linear regression solution to the spatial autocorrelation problem.” *Journal of Geographical Systems* 2:141-156.

Franzese, R., Hays, J. 2013. “[Testing for Spatial-Autoregressive Lag versus \(Unobserved\) Spatially Correlated Error-Components](#).” Presented at the European Political Science Association (EPSA 2013).

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

**Session 3 (Tuesday, August 13<sup>th</sup>, 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, August 13<sup>th</sup>, 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, August 14<sup>th</sup>, 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.

LeSage, J., Pace, K. 2009. *Introduction to Spatial Econometrics*. Boca Raton: CRC Press, Taylor & Francis Grp, Chapter 2, pp. 25-42.

**Session 6 (Wednesday, August 14<sup>th</sup>, 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, August 15<sup>th</sup>, 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., Cook, S. 2013. "Spatial-, Temporal-, and Spatiotemporal-Autoregressive Probit Models of Interdependent Binary Outcomes: Estimation and Interpretation." Two Versions: [Spatial Models of Politics Conference \(February, Texas A&M\)](#); [Political Science Research & Method submission \(August\)](#).

LeSage, J., Pace, K. 2009. *Introduction to Spatial Econometrics*. Boca Raton: CRC Press, Taylor & Francis Grp, Chapter 10, pp. 279-322.

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

**Session 8 (Thursday, August 15<sup>th</sup>, 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.

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

Hays, J., Schilling, E., Boehmke, F. 2013. "[Accounting for Right Censoring in Interdependent Duration Analysis](#)," Political Methodology Society Annual Meeting

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

**Session 9 (Friday, August 16<sup>th</sup>, 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, August 16<sup>th</sup>, 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.