Community & Environmental Sociology/Sociology 977
Spatial Data Analysis

Spring 2012
Class Meeting: 301 Ag Hall, Labs 3218 SS
Class Hours: Thursdays, 1:20-3:15P
Office Hours: Thursdays, 3:30-4:30P

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Course Objectives.
This course is a graduate-level seminar on conceptual motivations and technical approaches for analyzing spatially arrayed data for social science research. There are two joint objectives to this course: to gain a conceptual understanding of the role of space in sociological processes and to become technically proficient with various methods used to analyze spatial processes.

The seminar focuses largely on methods of analyzing and modeling variables measured over an irregular configuration of areal units. Other important classes of spatially-referenced data, such as point patterns, flows and continuous fields, and methods of analysis specific to them are addressed less thoroughly. This course is not a seminar in spatial econometrics, per se, although we will draw from this work. Further, this course is not a seminar in geographic information systems/science (GIS), per se, although we will become familiar with GIS tools and software in the course.

Prerequisites.
Some prior experience with census data and with GIS software is useful, but neither is a prerequisite. What *is* a prerequisite for this course is a solid understanding of multivariate statistics and some experience with advanced regression analysis. It also is important that you have some familiarity with matrix notation and matrix algebra. If you suspect that you do not have a sufficient grounding in statistics, it is your responsibility to gain the necessary knowledge outside of the course.

Course Format & Requirements.
Class meetings will be organized around three rotating activities: lecture, discussion and lab. All students are expected to actively participate. Students must be present to actively participate.

Students are required to submit a one-paragraph (no more than 250 words) reflecting on the week's readings. Reflections can include points that were particularly interesting or aspects that were confusing and require further clarification. The reflections must be submitted to me via email (kcurtis@ssc.wisc.edu) at least 24 hours before the class meeting (1:20P on Wednesday).

Students are required to complete four homework assignments during the semester. The assignments correspond to the material covered in the in-class labs. I will provide example data to be used in the labs and in the homework assignments. Students are welcome (encouraged!) to use their own data on their own, but not to complete the labs and homework assignments. Collaboration of ideas among seminar participants is appropriate and encouraged, but the assignments must be executed independently. Evidence to the contrary will result in the full loss of credit on the assignment. All assignments must be submitted to me via email (kcurtis@ssc.wisc.edu) before the class meeting of the date identified on the course schedule below. Late assignments will not be accepted.

Homework assignments will be graded on the quality and clarity of content, which includes clear and accessible communication and format. Please use 11 or 12 point font, 1 inch margins, and single spacing.

There is no page limit on the homework assignments given varying needs to incorporate figures, tables, and/or citations. However, students are expected to approach the homework assignments as brief reports that summarize the main analytical strategy and findings; organization, brevity and conciseness are highly valued.

As a final assignment, students are required to complete a research proposal that follows the National Science Foundation (NSF) dissertation fellowship format. Rather than submitting a full proposal, complete with budget and biosketch, students will prepare the *Project Description* portion of the larger packet one would submit to NSF. Details on the format and expectations can be found at (see especially page II-8): http://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpgprint.pdf

The 10-page limit is firm. References must be included but will not count toward the page limit. Proposals must use 11 or 12 point font, 1 inch margins, and a full space between paragraphs. Single-spacing is the norm for grant proposals and will be used in this assignment. Please submit the proposals as a *.doc or *.pdf file. The final assignment must be submitted to me via email (kcurtis@ssc.wisc.edu) by 5P on 14 May. Like a real submission, late proposals will not be accepted.

Proposals will be graded on the same principles as those used by NSF—intellectual merit and broader impacts—in addition to the quality and clarity of content. Avoid jargon. Please carefully review the proposal description (link given above) and follow up with me on any questions. Do not wait until the last minute or even the last two weeks to begin the proposal writing process. Brief (250 words) project summaries are due before class on 19 April. Students should consider exchanging drafts of proposals with peers to improve readability. As with the homework assignments, discussing ideas is acceptable and encouraged, but the work must be executed independently. Evidence to the contrary will result in the full loss of credit on the assignment.

A note on sending documents via email: please copy yourself on the message you submit to me with your attached document to confirm that the email was successfully sent.

Course grades will be based on the following percentage distribution:

Reading Reflections	10%
Homework Assignments	50%
Research Proposal	40%

Course Etiquette.
Come prepared. Be respectful. Turn off your cell phones.

Course Outline & Reading List.
There is one required text. The text is available for purchase through no specific vendor; it can be purchased through a number of on-line vendors.

> Ward, Michael D. and Kristian Skrede Gleditsch. 2008. *Spatial Regression Models*. London: Sage. (a draft form is available at http://www.duke.edu/web/methods/pdfs/SRMbook.pdf)

In addition to the text, there are several required journal articles and book chapters. All required readings are available online at my faculty website (http://www.drs.wisc.edu/faculty/curtis/cesoc-977.php). Please be in touch if you have any problems accessing the articles.

Course Schedule.
All lectures and discussions will meet in 301 Ag Hall. All labs will meet in 3218 Social Sciences.

Week 1 (26 January). Lecture: Orientation to Spatial Data
No readings

Week 2 (2 February). Discussion: Spatial Data & Spatial Thinking

1. Anselin, Luc. 2010. "Thirty Years of Spatial Econometrics." *Papers in Regional Science* 89(1):3-25.
2. Voss, Paul R., Katherine J. Curtis White, and Roger B. Hammer. 2006. "Explorations in Spatial Demography." Pp. 407-429 in William Kandel and David L. Brown (eds.), *Population Change and Rural Society: Demographic Research for a New Century*. Dordrecht, The Netherlands: Springer. *[A gentle introduction to the concepts surrounding spatial data analysis aimed at demographers]*
3. Loftin, Colin, and Sally K. Ward. 1983. "A Spatial Autocorrelation Model of the Effects of Population Density on Fertility." *American Sociological Review*, 48(1):121-128. *[Together with the following reading, a classic motivational example]*
4. Galle, Omer R., Walter R. Gove, and J. Miller McPherson. 1972. "Population Density and Pathology: What Are the Relations for Man?" *Science* (new series) 176:23-30.

Week 3 (9 Februrary). Lab: Orientation to Example Data, GeoDa & R

1. Voss, Paul R., David D. Long, Roger B. Hammer, and Samantha Friedman. 2006. "County Child Poverty Rates in the U.S.: A Spatial Regression Approach." *Population Research and Policy Review* 25:369-391. *[An introduction to the example data used throughout the semester]*
2. GeoDa Workbook, Chapters 2, 3 and 7-10

Week 4 (16 February). Lecture: ESDA & Spatial Autocorrelation
Homework #1 due before class

1. Anselin, Luc. 1996. "The Moran Scatterplot as an ESDA Tool to Assess Local Instability in Spatial Association." Pp. 111-125 in Fischer, Manfred, Henk J. Scholten, and David Unwin (eds.) *Spatial Analytical Perspectives on GIS: GISDATA 4* (London: Taylor & Francis). *[Introduction to a key diagnostic tool in spatial data analysis]*
2. Anselin, Luc. 1995. "Local Indicators of Spatial Association – LISA." *Geographical Analysis* 27(2):93-115. *[The foundational reading for LISA statistics]*
3. Ward and Gleditsch, Chapter 1 *[A recent and accessible introduction to spatial data analysis aimed at social scientists]*

Week 5 (23 February). Discussion: Spatial Autocorrelation

1. Messner, Steven F., Luc Anselin, Robert D. Baller, Darnell F. Hawkins, Glenn Deane, and Stewart E. Tolnay. 1999. "The Spatial Patterning of County Homicide Rates: An Application of Exploratory Spatial Data Analysis." *Journal of Quantitative Criminology* 15(4):423-450. *[A clear example of ESDA]*
2. Tobler, Waldo R. 1970. "A Computer Movie Simulating Urban Growth in the Detroit Region." *Economic Geography* 46(June):234-240. *[The piece to which positive spatial autocorrelation is attributed]*
3. Getis, Arthur. 2008. "A History of the Concept of Spatial Autocorrelation: A Geographer's Perspective." *Geographical Analysis* 40:297-309. *[A review essay by a*

quantitative geographer who has contributed much to the spatial autocorrelation literature]

4. Tolnay, Stewart E., Glenn Deane, and E.M. Beck. 1996. "Vicarious Violence: Spatial Effects on Southern Lynchings, 1890-1919." *American Journal of Sociology* 102(3):788-815. *[A classic piece on negative spatial autocorrelation]*

Week 6 (1 March). Lab: ESDA & Spatial Autocorrelation in GeoDa & R

1. GeoDa Workbook, Chapters 11, 12, 15-19, and 21

Week 7 (8 March). Lecture: Spatial Processes

Homework #2 due before class

1. Anselin, Luc, and Anil Bera. 1998. "Spatial Dependence in Linear Regression Models with an Introduction to Spatial Econometrics." Chapter 7 (pp. 237-289) in Aman Ullah and David Giles (eds.) *Handbook of Applied Economic Statistics* (New York: Marcel Dekker). *[A strong, foundational reading]*
2. Anselin, Luc. 2002. "Under the Hood: Issues in the Specification and Interpretation of Spatial Regression Models." *Agricultural Economics* 27(3):247-267. *[An overview of spatial economic regression models]*
3. Ward and Gleditsch, Chapters 2 and 3 *[A gentle orientation to spatial regression models]*

Week 8 (15 March). Discussion: Spatial Dependence & Spatial Heterogeneity

1. Baller, Robert D., and Kelly K. Richardson. 2002. "Social Integration, Imitation, and the Geographic Patterning of Suicide." *American Sociological Review* 67(6):873-888. *[A terrific example of theoretically grounded spatial data analysis]*
2. Beggs, John T., Wayne J. Villemez, and Ruth Arnold. 1997. "Black Population Concentration and Black-White Inequality: Expanding the Consideration of Place and Space Effects." *Social Forces* 76(1):65-91. *[A piece that sets out to conceptually and analytically address both processes]*
3. Crowder, Kyle and Scott J. South. 2008. "Spatial Dynamics of White Flight: The Effects of Local and Extralocal Racial Conditions on Neighborhood Out-Migration." *American Sociological Review* 73(5):792-812. *[A theoretically motivated study incorporating space as a cross-regressive process]*
4. Sparks, Patrice Johnelle and Corey S. Sparks. 2010. "An Application of Spatially Autoregressive Models to the Study of US County Mortality Rates." *Population, Space and Place* 16:465-481. *[A nice example of sticking with your theory despite diagnostics to the contrary]*

Week 9 (22 March). Lab: Traditional & Spatial Linear Regression in GeoDa & R

1. GeoDa Workbook, Chapters 22-25

Week 10 (29 March). Guest Lecture. Jun Zhu

Homework #3 due before class

Readings to be announced

Week 11 (5 April). No Class, Spring Recess

Week 12 (12 April). Lecture: Spatial Heterogeneity, Part 2

1. Fotheringham, A. Stewart, and Chris Brunsdon. 1999. "Local forms of Spatial Analysis." *Geographical Analysis* 31(4):340-358. *[A strong review of local variation in relationships]*
2. Brunsdon, Chris, A. Stewart Fotheringham, and Martin Charlton. 1999. "Some Notes on Parametric Significance Tests for Geographically Weighted Regression." *Journal of Regional Science* 39(3):497-524. *[A user-friendly discussion and application of GWR]*
3. Wheeler, David, and Michael Tiefelsdorf. 2005. "Multicollinearity and Correlation among Local Regression Coefficients in Geographically Weighted Regression." *Journal of Geographical Systems* 7:161-187. *[Criticisms of GWR]*

Week 13 (17 April—NOTE: Tuesday, 354 Ag Hall). Discussion: Relationship Heterogeneity
Research project summary due before class

1. O'Loughlin, John, Colin Flint, and Luc Anselin. 1994. "The Geography of the Nazi Vote: Context, Confession, and Class in the Reichstag Election of 1930." *Annals of the Association of American Geographers* 84(3):351-380. *[An excellent example of spatial regime analysis]*
2. Curtis, Katherine J., Paul R. Voss, and David Long. 2012. "Spatial Variation in Poverty-Generating Processes: Child Poverty in the United States." *Social Science Research* 41(1):146-159. *[A sociological application of spatial regime analysis]*
3. Fotheringham, A. Stewart, Martin E. Charlton, and Chris Brunsdon. 2001. "Spatial Variations in School Performance: A Local Analysis Using Geographically Weighted Regression." *Geographical & Environmental Modelling* 5(1):43-66. *[An application of GWR by the originators]*
4. Cahill, Meagan, & Gordon Mulligan. 2007. "Using Geographically Weighted Regression to Explore Local Crime Patterns." *Social Science Computer Review* 25(2):174-193. *[Another empirical application of GWR with theoretical motives]*

Week 14 (26 April). Lab: GWR & Spatial Regime Analysis in R

1. Anselin, Luc. 2007. "Spatial Regimes." Pp. 107-115 in *Spatial Regression Analysis in R: A workbook*. (CSISS) *[How to for R]*

Week 15 (3 May). No Class, Writing Day
Homework #4 due before regular class meeting time

Week 16 (11 May—NOTE: Friday, 301 Ag Hall). Course Wrap-up

14 May. Research Proposals Due (5P)