

Syllabus for
Sociology 8243
SPATIAL ANALYSIS OF SOCIAL DATA

Summer First Term, 2011
Class hours: 1–2:50pm, Monday–Friday
Office hours: 3:30–4pm, Monday–Thursday
Classroom: 270 Bowen Hall

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Course Description

Spatial data analysis has recently received increasing attention in social studies. However, it remains a difficult subject to learn for practitioners due to its complexity and various unresolved issues. This course aims to help students 1) develop a spatial view on the social phenomena of their interests and 2) master basic geographic information techniques and spatial statistical methods, which are essential for materializing this spatial view in their research.

This course covers the basics of geographic information systems (GIS), exploratory spatial data analysis, and spatial regression/econometric models. By the end of the semester, students will be able to facilitate their research by using software including ArcView, ArcGIS, GeoDa, and R to create and visualize their own geographically referenced data, diagnose potential spatial autocorrelation, and specify appropriate spatial regression/econometric models.

This course is especially suitable for students who are interested in the spatial dimensions of sociology, anthropology, social work, political science, human geography, agricultural economics, public health, public administration, and education. This course focuses on lattice data (also known as *areal* or *aggregated* data) analysis. Students who are interested in spatial point data analysis and geostatistics, which will not be covered in this course, are encouraged to take ST4313/6313, Introduction to Spatial Statistics, and FO8313, Spatial Statistics for Natural Resource Management.

Course Structure

The class meetings are composed of three parts: discussions, lectures, and lab sessions. Each class meeting begins with discussions of one or two readings, from which students develop their spatial view and learn to effectively apply spatial analysis techniques to their research. During the lectures, the concepts and methods of spatial statistics and analysis are taught. Students then practice the use of GIS and spatial statistical software in the lab sessions. No required textbooks are assigned to this class; the reading materials include journal articles and book chapters that are electronically available.

Prerequisites

Students do not need to have any GIS background. This course will introduce basic GIS concepts and tools. However, students should have taken at least one multiple/econometric regression course; those who have not may take the class with the consent of the instructor.

Homework Assignments

There will be four homework assignments. Each assignment will cover one topic of this course. Ideally, students will develop their term papers based on the homework assignments.

Assignment 1: Introduce your research question and data (due date: June 7)

Assignment 2: Geo-visualizing the data (due date: to be announced)

Assignment 3: Explanatory spatial data analysis (due date: to be announced)

Assignment 4: Spatial regression modeling (due date: to be announced)

Term Paper

Students are also expected to apply GIS and spatial statistical methods to the research of their own interests for a term paper. Ideally, the term paper will serve as the preliminary analysis for a thesis or dissertation and/or as a manuscript ready for submission to a journal. The term paper should cite the readings appropriately. Students will present their work to the class in the last two class meetings. The final paper is due on June 30.

Final Grade

The grade for this course will be determined as follows:

Participation in discussions	15%
Homework assignments	30%
Presentation of term paper	15%
Written term paper	40%

Homework assignments and the term paper are expected to be turned in on time. For each day after the due date, a 10% penalty will be applied.

Academic Misconduct and Dishonesty

Mississippi State University has an approved Honor Code that applies to all students. The code is as follows: "As a Mississippi State University student I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do." Any occurrence of academic misconduct and dishonesty will be treated according to the University policies and procedures (<http://www.msstate.edu/web/security.html>).

Course Outline

Note: The schedule below represents an imprecise guess of what components we will cover and how long we will spend on each component. The schedule will likely change as we go along.

Session 1. Introduction

The syllabus
Spatial data and spatial data analysis
The topics to cover in this course
Textbooks, journals, and software
Spatial thinking and theories

Sessions 2-4. GIS

Session 2. Introduction to GIS

Definitions of GIS
Software components of GIS
Types of spatial data
Geographical data structures and formats
Geographic coordinate systems
Map projections

Readings:

Discuss (spatial thinking). Goodchild, Michael F., Luc Anselin, Richard P. Applebaum, and Barbara Herr Harthorn. 2000. "Toward Spatially Integrated Social Science." *International Regional Science Review* 23:139-159.

Read. Anselin, Luc. 1999. "The Future of Spatial Analysis in the Social Sciences." *Geographic Information Sciences* 5(2):67-76.

Read (spatial thinking). Rogerson, P.A. and D. Kim. 2005. "Population Distribution and Redistribution of the Baby-Boom Cohort in the United States: Recent Trends and Implications." *Proceedings of the National Academy of Sciences* 102(43):15319-15324.

Weeks, John R. 2004. "The Role of Spatial Analysis in Demographic Research." Pp. 381-399 in Michael F. Goodchild and Donald G. Janelle (eds.) *Spatially Integrated Social Science*. (Oxford: Oxford University Press).

Brewer, Cynthia A and Trudy A Suchan. 2001. *Mapping Census 2000: The Geography of U.S. Diversity*. Redlands, CA: ESRI.

Peters, Alan and Heather MacDonald. 2004. *Unlocking the Census with GIS*. Redlands, CA: ESRI Press. Chapter 1

Session 3. Spatial Analysis

Geocoding
Buffering
Geoprocessing analysis: dissolve, merge, overlay, and intersect
Application of GIS to social sciences: examples, privacy

Readings:

- Discuss.** Chi, Guangqing. 2010. "Land Developability: Developing an Index of Land Use and Development for Population Research." *Journal of Maps* 2010: 609–617.
- Read.** Anselin, L. 2000. "Computing Environments for Spatial Data Analysis." *Journal of Geographical Systems* 2:201-220.
- Read.** Reibel, Michael. 2007. "Geographic Information Systems and Spatial Data Processing in Demography: A Review." *Population Research and Policy Review* 26:601-618.
- Read (spatial thinking).** Voss, Paul R. 2007. "Demography as a Spatial Social Science." *Population Research and Policy Review* 26:457-476.
- Maguire, David J, Michael Batty, and Michael F Goodchild. 2005. "GIS, Spatial Analysis, and Modeling: Current Status and Future." Pp. 445-455 in *GIS, Spatial Analysis, and Modeling*, edited by D. J. Maguire, M. Batty, and M. F. Goodchild. Redlands, CA: ESRI.

Session 4. Mapping and Cartography

Map-making tools

Map elements

Data classification

Symbolizing aggregate data

Type on maps

Color on maps

Special maps

Finishing your map

Readings:

- Discuss.** Entwisle, Barbara, Ronald R. Rindfuss, Stephen J. Walsh, Tom P. Evans, and Sara R. Curran. 1997. "Geographic Information Systems, Spatial Network Analysis, and Contraceptive Choice." *Demography* 34(2):171-187.
- Discuss.** VanWey, Leah K, Ronald R Rindfuss, Myron P Gutmann, Barbara Entwisle, and Deborah Balk. 2005. "Confidentiality and Spatially Explicit Data: Concerns and Challenges." *Proceedings of the National Academy of Sciences* 102:15337-15342.
- Read (spatial thinking).** Ellis, M. and R. Wright. 2005. "Assimilation and Differences between the Settlement Patterns of Individual Immigrants and Immigrant Households." *Proceedings of the National Academy of Sciences* 102(43):15325-15330.
- Anselin, Luc. 2005. "Spatial Statistical Modeling in a GIS Environment." Pp. 93-112 in *GIS, Spatial Analysis, and Modeling*, edited by D. J. Maguire, M. Batty, and M. F. Goodchild. Redlands, CA: ESRI.
- Entwisle, Barbara, Ronald R. Rindfuss, David K. Guilkey, Aphichat Chamrathirong, Sara R. Curran, and Yothin Sawangdee." 1996. "Community and Contraceptive Choice in Rural Thailand: A Case Study of Nang Rong." *Demography* 33(1):1-11.
- Peters, Alan, and Heather MacDonald. 2004. *Unlocking the Census with GIS*. (Redlands, CA: ESRI Press).
- Rindfuss, Ronald R., and Paul C. Stern. 1998. "Linking Remote Sensing and Social Science: The Need and the Challenges." Pp. 1-27 in Diana Liverman, et al. (editors) *People and Pixels: Linking Remote Sensing and Social Science* (Washington, DC: National Academy Press).

Sessions 5-7. Explanatory Spatial Data Analysis

Session 5. Concepts and Issues of ESDA

Concepts of ESDA

Types of spatial data analysis

Methods of spatial data analysis

Issues in spatial data analysis

Sampling perspectives

Readings:

Discuss. Wrigley, Neil, Tim Holt, David Steel, and Mark Tranmer. 1996. "Analysing, Modelling, and Resolving the Ecological Fallacy." Pp. 23-40 in *Spatial Analysis: Modelling in a GIS Environment*, edited by P. Longley and M. Batty. Cambridge, MA: GeoInformation International.

Discuss. Robinson, W. S. 1950. "Ecological Correlations and the Behavior of Individuals." *American Sociological Review* 15:351-357.

Read (spatial thinking). Voss, P.R., K.J.C. White, and R.B. Hammer. 2006. "Explorations in spatial demography." Pp. 407-429 in *Population Change and Rural Society*, edited by W. A. Kandel and D. L. Brown. Dordrecht: Springer.

Read. 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. [Read parts I through IIa.]

Green, Mick and Robin Flowerdew. 1996. "New Evidence on the Modifiable Areal Unit Problem." Pp. 41-54 in *Spatial Analysis: Modelling in a GIS Environment*, edited by P. Longley and M. Batty. Cambridge, UK: GeoInformation International.

Fotheringham, A. Stewart and David W.S. Wong. 1991. "The Modifiable Areal Unit Problem in Multivariate Statistical Analysis." *Environment and Planning A* 23:1025-1034.

Langford, Mitchel and David J. Unwin. 1994. "Generating and Mapping Population Density Surfaces Within a Geographical Information System." *The Cartographic Journal* 31:21-26.

Openshaw, S. and P. J. Taylor. 1981. "The Modifiable Areal Unit Problem." Pp. 60-70 in *Quantitative Geography: A British View*, edited by N. Wrigley and R. J. Bennett. London: Routledge.

Session 6. Spatial Weight Matrix and Neighborhood Structure

The need to impose neighborhood structure

Spatial weight matrix

Assumptions of neighborhood structure and spatial weight matrix

Readings:

Discuss. Baller, R.D., L. Anselin, S.F. Messner, G. Deane, and D.F. Hawkins. 2001. "Structural Covariates of U.S. County Homicide Rates: Incorporating Spatial Effects." *Criminology* 39(3):561-590.

- Read (spatial thinking).** Castro, Marcia Caldas de. 2007. "Spatial Demography: An Opportunity to Improve Policy Making at Diverse Decision Levels." *Population Research and Policy Review* 26:477-509.
- Read.** 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. [Read parts IIb-c.]
- Getis, Arthur, and Daniel A. Griffith. 2002. "Comparative Spatial Filtering in Regression Analysis." *Geographical Analysis* 34(2):130-140.
- Getis, Arthur, and J. K. Ord. 1992. "The Analysis of Spatial Association by Use of Distance Statistics." *Geographical Analysis* 24(3):189-206.

Session 7. Spatial Autocorrelation

Spatial heterogeneity and spatial dependence
 Concepts of spatial autocorrelation
 Moran's I, Geary's c, and Getis' G statistic
 LISA (local indicators of spatial association)
 Moran scatterplot

Readings:

- Discuss.** Pacheco, Andrada I., and Timothy J. Tyrrell. 2002. "Testing Spatial Patterns and Growth Spillover Effects in Clusters of Cities." *Journal of Geographical Systems* 4:275-285. [Nice application of the Moran scatterplot.]
- Read.** Wheeler, Christopher H. 2001. "A Note on the Spatial Correlation Structure of County-Level Growth in the U.S." *Journal of Regional Science* 41(3):433-449.
- Read.** 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).
- Read (spatial thinking).** Entwisle, Barbara. 2007. "Putting People into Place." *Demography* 44:687-703.
- Miron, John. 1984. "Spatial Autocorrelation in Regression Analysis: A Beginner's Guide." Pp. 201-222 in Gary L. Gaile and Cort J. Willmott (eds.) *Spatial Statistics and Models* (Dordrecht, Holland: D. Reidel Publishing Co.).
- Anselin, Luc. 1995. "Local Indicators of Spatial Association – LISA." *Geographical Analysis* 27(2):93-115.
- Fotheringham, A. Stewart, and Chris Brunsdon. 1999. "Local forms of Spatial Analysis." *Geographical Analysis* 31(4):340-358.
- Logan, John R., and Wenquan Zhang. 2004. "Identifying Ethnic Neighborhoods with Census Data: Group Concentration and Spatial Clustering." Pp. 113-126 in Michael F. Goodchild and Donald G. Janelle (eds.) *Spatially Integrated Social Science*. (Oxford: Oxford University Press).
- Getis, Arthur, and J. Keith Ord. 1996. "Local Spatial Statistics: An Overview." Pp. 261-277 in Paul Longley and Michael Batty (eds.) *Spatial Analysis: Modelling in a GIS Environment* (GeoInformation International).

Sessions 8-10. Spatial Regression Models

Session 8. Spatial Model Specification

Issues in spatial dependence
Specifying spatial covariance
Spatial stochastic processes
SAR, CAR and SMA processes

Readings:

- Discuss.** 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.
- Read.** 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. [Read part III.]
- Read.** 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.
- Read (spatial thinking).** Hanson, S. 2005. "Perspectives on the Geographic Stability and Mobility of People in Cities." *Proceedings of the National Academy of Sciences* 102(43):15301-15306.
- Fossett, M. 2005. "Urban and Spatial Demography." Pp. 479-524 in *Handbook of Population*, edited by D. L. Poston and M. Micklin. New York, NY: Springer.

Session 9. Spatial Regression Models

Maximum likelihood (ML) basic principles
Spatial lag model
Spatial error model
Spatially autoregressive moving average (SARMA) Model
Spatial cross-regressive model

Readings:

- Discuss.** Chi, Guangqing. 2010. "The Impacts of Highway Expansion on Population Change: An Integrated Spatial Approach." *Rural Sociology* 75(1): 58–89.
- Read.** Anselin, Luc. 2002. "Under the Hood: Issues in the Specification and Interpretation of Spatial Regression Models." *Agricultural Economics* 27(3):247-267.
- Read.** 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. [Read parts IId-f.]
- Read.** 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.

- Voss, Paul R. and Guangqing Chi. 2006. "Highways and Population Change." *Rural Sociology* 71:33-58.
- Florax, R.J.G.M. and Henk Folmer. 1992. "Specification and Estimation of Spatial Linear Regression Models." *Regional Science and Urban Economics* 22:405-432.
- Anselin, Luc. 2003. "Spatial Externalities, Spatial Multipliers, and Spatial Econometrics." *International Regional Science Review* 26:153-166.
- Fingleton, Bernard and Enrique Lopez-Bazo. 2006. "Empirical Growth Models with Spatial Effects." *Papers in Regional Science* 85:177-198.

Session 10. Model Evaluation

Model selection criteria

Diagnostics: heteroskedasticity, spatial lag and error dependence, and multicollinearity problem

General steps of spatial regression modeling

General guidelines of modeling

Readings:

- Discuss.** Chi, Guangqing and Jun Zhu. 2008. "Spatial Regression Models for Demographic Analysis." *Population Research and Policy Review* 27:17-42.
- Read.** 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. [Read parts IV-V.]
- Read.** Doreian, Patrick. 1980. "Linear Models with Spatially Distributed Data: Spatial Disturbances or Spatial Effects?" *Sociological Methods & Research* 9(1):29-60.
- Read (spatial thinking).** Clark, W.A.V. 2005. "Intervening in the Residential Mobility Process: Neighborhood Outcomes for Low-Income Populations." *Proceedings of the National Academy of Sciences* 102(43):15307-15312.
- De Graaff, Thomas, Raymond G.G.M. Florax, and Peter Nijkamp. 2001. "A General Misspecification Test for Spatial Regression Models: Dependence, Heterogeneity, and Nonlinearity." *Journal of Regional Science* 41(2):255-276.
- Bivand, Roger S., and Boris A. Portnov. 2004. Exploring Spatial Data Analysis Techniques Using R: The Case of Observations with No Neighbors." Pp. 121-142 in Anselin, Luc, Raymond J.G.M. Florax, and Sergio J. Rey (eds.) *Advances in Spatial Econometrics: Methodology, Tools and Applications* (Berlin: Springer).
- Tita, George, and Jacqueline Cohen. 2004. "Measuring Spatial Diffusion of Shots Fired Activity across City Neighborhoods." Pp. 171-204 in Michael F. Goodchild and Donald G. Janelle (eds.) *Spatially Integrated Social Science*. (Oxford: Oxford University Press).
- Messner, Steven F., and Luc Anselin. 2004. "Spatial Analyses of Homicide with Areal Data." Pp. 127-144 in Michael F. Goodchild and Donald G. Janelle (eds.) *Spatially Integrated Social Science*. (Oxford: Oxford University Press).
- Lacombe, Donald J. 2004. "Does Econometric Methodology Matter? An Analysis of Public Policy Using Spatial Econometric Techniques." *Geographical Analysis* 36(2):105-118.
- Kelejian, Harry H., and Ingmar R. Prucha. 1997. "Estimation of Spatial Regression Models with Autoregressive Errors by Two-Stage Least Squares Procedures: A Serious Problem." *International Regional Science Review* 20:103-111.

- Ord, J. Keith. 1975. "Estimation Methods for Models of Spatial Interaction." *Journal of the American Statistical Association* 70:120-126.
- Rey, Sergio J. 2004 (2001). "Spatial Analysis of Regional Income Inequality." Pp. 280-299 in Michael F. Goodchild and Donald G. Janelle (eds.) *Spatially Integrated Social Science*. (Oxford: Oxford University Press).
- Sampson, Robert J., and Jeffrey D. Morenoff. 2004. "Spatial (Dis)Advantage and Homicide in Chicago Neighborhoods." Pp. 145-170 in Michael F. Goodchild and Donald G. Janelle (eds.) *Spatially Integrated Social Science*. (Oxford: Oxford University Press).

Sessions 11-12. Other Spatial Statistical Models

Session 11. Advanced Spatial Econometric Models

Hierarchical linear model (HLM)
 Geographically weighted regression (GWR)
 Spatial logistic model
 Spatio-temporal regression models
 Gravity models
 Bayesian estimation

Readings:

- Discuss.** Mennis, Jeremy L. and Lisa Jordan. 2005. "The Distribution of Environmental Equity: Exploring Spatial Nonstationarity in Multivariate Models of Air Toxic Releases." *Annals of Association of American Geographers* 95:249-268. [GWR]
- Read (spatial thinking).** Plane, D.A., C.J. Henrle, and M.J. Perry. 2005. "Migration up and down the Urban Hierarchy and across the Life Course." *Proceedings of the National Academy of Sciences* 102(43):15313-15318.
- Read.** Pace, R.H., R. Barry, J.M. Clapp, and M. Rodriguez. 1998. "Spatiotemporal Autoregressive Models of Neighborhood Effects." *Journal of Real Estate Finance and Economics* 17(1):15-33.
- Fleming, Mark M. 2004. "Techniques for Estimating Spatially Dependent Discrete Choice Models." Pp. 145-168 in *Advances in Spatial Economics*, edited by L. Anselin, R. J. G. M. Florax, and S. Rey. Berlin: Springer. [spatial logistic model]
- Fotheringham, A. Stewart, Tomoki Nakaya, Keiji Yano, Stan Openshaw and Yoshitaka Ishikawa. 2001. "Hierarchical Destination Choice and Spatial Interaction Modelling: A Simulation Experiment." *Environment and Planning A* 33:901-920. [HLM]
- Fotheringham, A. Stewart, Chris Brunsdon & Martin Charlton. 2002. *Geographically Weighted Regression* (West Sussex: John Wiley & Sons, Ltd.). [GWR]
- Parent, O and S Riou. 2005. "Bayesian Analysis of Knowledge Spillovers in European Regions." *Journal of Regional Science* 45:747-775. [spatial logistic model]
- Holloway, Garth, Bhavani Shankar, and Sanzidur Rahman. 2002. "Bayesian Spatial Probit Estimation: A Primer and an Application to HYV Rice Adoption." *Agricultural Economics* 27:383-402. [spatial logistic model]
- Law, Jane, and Robert Haining. 2004. "A Bayesian Approach to Modeling Binary Data: The Case of High-Intensity Crime Areas." *Geographical Analysis* 36(3):197-216. [Bayesian estimation]

Borgoni, Riccardo, and Francesco C. Billari. 2003. "Bayesian Spatial Analysis of Demographic Survey Data: An Application to Contraceptive Use at First Sexual Intercourse." *Demographic Research* 8(3):61-92. [Bayesian estimation]

Session 12. Three More Components of Spatial Statistics

Spatial point data analysis

Geostatistics

Spatial interaction models

Readings:

Discuss. Baller, Robert D., and Kelly K. Richardson. 2002. "Social Integration, Imitation, and the Geographic Patterning of Suicide." *American Sociological Review* 67:873-888.

Read. Sampson, R.J., J.D. Morenoff, and F. Earls. 1999. "Beyond Social Capital: Spatial Dynamics of Collective Efficacy for Children." *American Sociological Review* 64(5):633-660. [HLM]

Read. Elhorst, J. Paul. 2001. "Dynamic Models in Space and Time." *Geographical Analysis* 33:119-140. [spatio-temporal regression model]

Read (spatial thinking). Miller, H. 2007. "Place-Based versus People-Based Geographic Information Science." *Geography Compass* 1(1):1-33.

Longley, Paul A. and Carolina Tobon. 2004 "Spatial Dependence and Heterogeneity in Patterns of Hardship: An Intra-Urban Analysis." *Annals of the Association of American Geographers* 94(3):503-519.

Guldmann, Jean-Michel. 2004. Spatial Interaction Models of International Telecommunication Flows." Pp. 400-419 in Michael F. Goodchild and Donald G. Janelle (eds.) *Spatially Integrated Social Science*. (Oxford: Oxford University Press).

Session 13. Student Paper Presentations

Labs

1. Introduction to ArcView and ArcGIS
2. Basic spatial analysis
3. Mapping and cartography
4. Introduction to GeoDa
5. Basic Exploratory Data Analysis (EDA)
6. Create spatial weight matrix
7. Global spatial autocorrelation
8. Local Indicator of Spatial Autocorrelation (LISA)
9. Ordinary Least Square (OLS) and diagnostics
10. Spatial lag model and spatial error model
11. Spatially Autoregressive Moving Average (SARMA) model
12. Introduction to SpaceStat
13. Introduction to R
14. Introduction to spatial point data analysis and geostatistics

Recommended Textbooks

- Anselin, Luc. 1988. *Spatial Econometrics: Methods and Models*. Dordrecht, Netherlands: Kluwer Academic Publishers.
- Bailey, Trevor C. and Anthony C. Gatrell. 1995. *Interactive Spatial Data Analysis*. Harlow, England: Longman Scientific & Technical.
- Burrough, Peter A. and Rachael A. McDonnell. 1998. *Principles of Geographical Information Systems*. New York, NY: Oxford University Press.
- Cliff, Andrew D and Keith J Ord. 1973. *Spatial Autocorrelation*. London: Pion Limited.
- . 1981. *Spatial Processes: Models and Applications*. London: Pion Limited.
- Cressie, Noel. 1993. *Statistics for Spatial Data, Revised Edition*. New York: Wiley.
- Fotheringham, A. Stewart, Chris Brunsdon, and Martin Charlton. 2000. *Quantitative Geography: Perspectives on Spatial Data Analysis*. London: Sage Publications.
- . 2002. *Geographically Weighted Regression*. West Sussex: John Wiley & Sons, Ltd.
- Goodchild, Michael F and Donald G Janelle. 2004. *Spatially Integrated Social Science*. Oxford: Oxford University Press.
- Liverman, Diana, Emilio F. Moran, Ronald R. Rindfuss, and Paul C. Stern (eds.). 1998. *People and Pixels: Linking Remote Sensing and Social Science*. Washington, DC: National Academic Press.
- Ward, Michael D. and Kristian S. Gleditsch. 2008. *Spatial Regression Models*. SAGE Series: Quantitative Applications in the Social Sciences. Los Angeles, CA: SAGE Publications.

Reference Textbooks

- Anselin, Luc and Raymond JGM Florax. 1995. *New Directions in Spatial Econometrics*. Berlin: Springer.
- Anselin, Luc, Raymond JGM Florax, and Sergio J Rey. 2004. *Advances in Spatial Econometrics: Methodology, Tools and Applications*. Berlin: Springer.
- Arlinghaus, Sandra Lach and Daniel A Griffith. 1996. *Practical Handbook of Spatial Statistics*. Boca Raton: CRC Press.
- Banerjee, S., B.P. Carlin, and A.E. Gelfand. 2003. *Hierarchical modeling and analysis for spatial data*. Boca Raton, FL: Chapman & Hall/CRC.
- Bolstad, William M. 2004. *Introduction to Bayesian Statistics*. Hoboken, NJ: John Wiley & Sons.
- Burrough, P. A. 1986. *Principles of Geographical Information Systems for Land Resources Assessment*. Oxford: Clarendon Press.
- Chou, Yue-Hong. 1997. *Exploring Spatial Analysis in Geographic Information Systems*. Santa Fe: OnWord Press.
- Dent, Borden D. 1999. *Cartography: Thematic Map Design*. Dubuque, IA: Wm. C. Brown Publishers.
- Diggle, PJ. 1983. *Statistical Analysis of Spatial Point Patterns*. New York, NY: Academic.
- Fischer, Manfred M and Peter Nijkamp. 1993. *Geographic Information Systems, Spatial Modelling and Policy Evaluation*. Berlin: Springer.
- Fotheringham, A. Stewart and Peter Rogerson. 1994. *Spatial Analysis and GIS*. London: Taylor & Francis.
- Gaile, Gary L and Cort J Willmott. 1984. *Spatial Statistics and Models*. Dordrecht, Holland: D. Reidel Publishing Co.

- Griffith, Daniel A. 1987. *Spatial Autocorrelation: A Primer*. Washington, DC: Association of American Geographers.
- . 1988. *Advanced Spatial Statistics*. Dordrecht: Kluwer Academic Publishers.
- . 2003. *Spatial Autocorrelation and Spatial Filtering*. New York, NY: Springer.
- Griffith, Daniel A and Carl G Amrhein. 1991. *Statistical Analysis for Geographers*. Upper Saddle River, NJ: Prentice Hall.
- . 1997. *Multivariate Statistical Analysis for Geographers*. Upper Saddle River, NJ: Prentice Hall.
- Griffith, Daniel A and Larry J Layne. 1999. *A Casebook for Spatial Statistical Data Analysis*. New York, NY: Oxford University Press.
- Haining, Robert. 1990. *Spatial Data Analysis in the Social and Environmental Sciences*. Cambridge, England: Cambridge University Press.
- . 2003. *Spatial Data Analysis: Theory and Practice*. New York, NY: Cambridge University Press.
- Isaaks, EH and RM Srivastava. 1989. *An Introduction to Applied Geostatistics*. New York, NY: Oxford University Press.
- Koop, Gary. 2003. *Bayesian Econometrics*. Chichester: John Wiley & Sons Ltd.
- Longley, Paul A, Michael F Goodchild, David J Maguire, and David W Rhind. 1999. *Geographical Information Systems: Principles, Techniques, Management and Applications*. New York, NY: Wiley.
- . 2001. *Geographical Information Systems and Science*. New York, NY: Wiley.
- Maguire, David J, MF Goodchild, and DW Rhind. 1991. *Geographical Information Systems: Principles and Applications*. New York, NY: Longman Scientific & Technical.
- Martin, David. 1996. *Geographic Information Systems: Socioeconomic Applications*. London: Routledge.
- O'Sullivan, David and David Unwin. 2003. *Geographic Information Analysis*. Hoboken, NJ: John Wiley & Sons.
- Peters, Alan and Heather MacDonald. 2004. *Unlocking the Census with GIS*. Redlands, CA: ESRI Press.
- Peuquet, Donna J. 2002. *Representations of Space and Time*. New York, NY: Guilford Press.
- Ripley, Brian D. 1981. *Spatial Statistics*. New York, NY: John Wiley Sons.
- Schabenberger, O. and C.A. Gotway. 2005. *Statistical methods for spatial data analysis*. Boca Raton, FL: Chapman & Hall/CRC Press.
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