

USC Dornsife

Dana and David Dornsife
College of Letters, Arts and Sciences
Spatial Sciences Institute

SSCI 599 Special Topics: Spatial Econometrics

Syllabus

Units: 4

Term – Day – Time: Spring 2020, Mondays 12-1:50 p.m. & Wednesdays, 12-1:50 p.m.

Location: THH 105

Instructor: An-Min Wu, PhD

Office: AHF B55B

Office Hours: Mondays, 3-4 p.m. and Tuesdays, 11:30 a.m.–12:30 p.m.

Contact Info: anminwu@usc.edu, 213-740-2876 (office), <http://bluejeans.com/anminwu>

Library Help: Andy Rutkowski

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Contact Info: arutkows@usc.edu, 213-740-6390 (office), <http://bit.ly/andyhangout>

IT Help: Richard Tsung

Office: AHF B57E

Regular Office Hours: By appointment

Contact Info: ctsung@usc.edu, 213-821-4415 (office)

Course Scope and Purpose

This course explores the theoretical foundations, methods, techniques, and software systems for spatial econometrics. The course aims to provide students with the knowledge and skills necessary to investigate socioeconomic problems, with the consideration of the effects of spatial dependence and spatial heterogeneity. Essential concepts of spatial econometrics are presented, including the fundamental spatial concepts and the core components of spatial regression models for both cross-sectional and panel (time series) data. The latest research in a variety of topics using spatial econometric models is also examined. Students will gain an in-depth understanding and hands-on experience to explore a variety of applications through a combination of homework, presentations, and projects. Students will learn about the variety of geospatial data and techniques available for solving socioeconomic challenges and problems.

This course serves as a required course for the Spatial Economics and Data Analysis M.S. Program and an elective course in the Geographic Information Science and Technology M.S. and Graduate Certificate Programs. Anyone wishing to pursue a career in solving social and built environment problems using spatial data analysis should gain an understanding of spatial regression models and therefore will be benefiting from this course.

Learning Outcomes

When you have completed this course, you will be able to:

- Describe the roles played by spatial dependence and spatial heterogeneity in solving social and economic problems.
- Articulate the key theoretical concepts of spatial econometrics
- Analyze cross-sectional and panel data using spatial regression models in ArcGIS Pro and the GeoDa and R software environments
- Enhance written and oral communication skills that are essential for today's workforce.

Prerequisite(s): SSCI 583 or by permission of the instructor

Co-Requisite(s): None

Course Structure

This is a four-credit course that meets twice per week. The course will be delivered using multiple methods, including lectures, class presentations and hands-on practice. Exercises utilize unpublished and published tutorial materials using ArcGIS Pro, GeoDa, and R, and a final project allows students to demonstrate their ability to apply spatial statistical and econometric methods in an appropriate, informed manner. Student participation is encouraged through reading discussions, hands-on practices, homework assignments, and class presentations.

This is a graduate-level course, so you should expect this class to be intellectually challenging. As this is a four-credit course, students should expect to spend 10-15 hours per week completing the work in this course. As a graduate student, you are expected to engage with the information you are learning and to explore the ideas, opinion, and analysis that describe our collective effort to thoroughly interrogate the subject at hand. Learning arises from active

engagement with the knowledge found in our reading materials and with one another. As in any graduate class, the instructor's role is that of a guide who keeps you on this path of discovery.

Technological Requirements

The course will be focused on using ArcGIS Pro as well as GeoDa and R for course assignments and hands-on practices in class. The latter two software platforms are free, open source software. Another important program that might be useful is RStudio, an integrated development environment (IDE) for R.

Students can download the abovementioned free and open source software online, and all three of these software platforms using the remote Spatial Sciences Institute Server (SSI Server). If you are unable to connect to the server or experience any type of technical issues, send an email using your USC account to Tech Support at spatial_support@usc.edu, make sure to copy (c.c.) you instructor on the email. Questions pertaining to specific assignments should be directed to your instructor.

The hands-on practices in class may be completed on a laptop computer. If a student does not have access to any of these, please speak with the instructor at the start of the semester to establish a workaround.

Required Readings and Supplementary Materials

The required textbook for this course is:

- Chi, Guangqing, and Jun Zhu. 2019. *Spatial Regression Models for the Social Sciences*. Thousand Oaks, CA: SAGE Publications.

Supplementary readings will be assigned from various sources including:

- Anselin, Luc. 2019. "The Moran scatterplot as an ESDA tool to assess local instability in spatial association." In *Spatial Analytical Perspectives on GIS*, pp. 111-126. Edited by Manfred Fischer, Henk J Scholten, and David Unwin. London: Routledge.
- Anselin, Luc, Ibnu Syabri, and Youngihn Kho. 2006. "GeoDa: an introduction to spatial data analysis." *Geographical Analysis* 38(1): 5-22.
- Anselin, Luc. 2003. "Spatial externalities, spatial multipliers, and spatial econometrics." *International Regional Science Review* 26(2): 153-166.
- Anselin, Luc. 2002. "Under the hood issues in the specification and interpretation of spatial regression models." *Agricultural Economics* 27(3): 247-267.
- Anselin, Luc. 2001. "Spatial econometrics". In *A Companion to Theoretical Econometrics*. Edited by Badi H. Baltagi, pp. 310-330. Blackwell Publishing. .
- Baltagi, Badi H., and Dong Li. 2004. "Prediction in the panel data model with spatial correlation." In *Advances in Spatial Econometrics: Methodology, Tools and Applications*, pp. 283-295. Edited by Luc Anselin, R.J.G.M Florax, Sergio J. Rey. Springer: Berlin.

- Celebioglu, Fatih, & Sandy Dall'erba. 2010. "Spatial disparities across the regions of Turkey: an exploratory spatial data analysis." *Annals of Regional Science* 45(2): 379-400.
- Elhorst, J. Paul. 2014. "Spatial panel data models." In *Spatial Econometrics from Cross-Sectional Data to Spatial Panels*, pp. 37-93. Springer: Berlin, Heidelberg.
- Elhorst, J. Paul. 2010. "Applied spatial econometrics: raising the bar." *Spatial Economic Analysis* 5(1): 9-28.
- Gibbons, Stephen, & Henry G. Overman. 2012. "Mostly pointless spatial econometrics?" *Journal of Regional Science* 52(2): 172-191.
- Harris, Nancy L., Elizabeth Goldman, Christopher Gabris, Jon Nordling, Susan Minnemeyer, Stephen Ansari, Michael Lippmann et al. 2017. "Using spatial statistics to identify emerging hot spots of forest loss." *Environmental Research Letters* 12(2): 024012.
- Matthews, Stephen A., & Tse-Chuan Yang. 2012. "Mapping the results of local statistics: Using geographically weighted regression." *Demographic Research* 26: 151.
- Millo, Giovanni, & Gianfranco Piras. 2012. "splm: Spatial panel data models in R." *Journal of Statistical Software* 47(1): 1-38.
- Partridge, Mark D., Marlon Boarnet, Steven Brakman, & Gianmarco Ottaviano. 2012. "Introduction: whither spatial econometrics?" *Journal of Regional Science* 52(2): 167-171.
- Sparks, Patrice J., & Corey S. Sparks. 2010. "An application of spatially autoregressive models to the study of US county mortality rates." *Population, Space & Place* 16(6): 465-481.
- Stowell, Sarah, & Larry Pace. 2014. *Using R for statistics*. New York, NY: Apress.
- Tian, Lei, H. Holly Wang, & Yongjun Chen. 2010. "Spatial externalities in China regional economic growth." *China Economic Review* 21: S20-S31.
- Wu, An-Min, & Karen K. Kemp. 2019. "Global measures of spatial association." *The Geographic Information Science & Technology Body of Knowledge* (1st Quarter 2019 Edition), John P. Wilson (Ed.)

Description and Assessment of Assignments

Students must prepare a lecture, participate in a team project, participate in class discussion, take weekly quizzes, and turn in homework assignments. Your grade in this course will be determined based on the basis of several different assessments.

Resume Assignment – 1 worth a total of 2 points. We require all current students to post and maintain a public resume, short biography and recent photo on our shared SSI Student Community Blackboard site. Please prepare your resume in the SSI template that will be provided to you. Unless you opt out, your resume will be included in the Spatial Sciences

Institute Graduate Programs Resume Book. This resume book is compiled annually and, along with our web presence, is used to promote our programs, and more importantly, your skills, experience and professional aspirations.

Lead Class Discussion – 4 worth a total of 16 points. These will focus on the theory portion of the course as presented in the weekly readings. Each student will be responsible for leading several class discussions on the assigned readings. The objective is to help you evaluate and integrate the information you have acquired from the course readings and develop public presentation skills. You are strongly recommended to read all material outlined for each week before the class session, but you will conduct 15-20 minutes presentations about the readings and prepare 2-3 questions for class discussion on the assigned weeks.

Quizzes – 5 worth a total of 15 points. There would be quizzes on the lectures and readings from the previous week. The top 5 score would be counted toward the final grade. There is no final, so the quizzes are the assessment of how well the students have learned the material during the semester.

Homework Assignments – 4 worth a total of 28 points. Students will be assigned four homework during the course. The assignments include hands-on practices on spatial techniques explored in theory in the texts as well as practical job search and application skills to prepare students for the job market.

In-Class Work - 12 worth a total of 12 points. An in-class engagement grade for the semester will be assigned based upon student engagement in the class sessions. The activities of in-class engagement can be, but not limited to, one-minute writing, group discussion, or hands-on practices. Failure to participate in in-class engagement activities will receive no grade for that week.

Final Project

In the second half of the course, students will work in teams on projects determined in consultation with the instructor. The team will propose their own projects based on the topics covered in class. The grades for the final project will be spread across three components as follows. Peer evaluation would be considered in the final grades to ensure individual responsibility and reliability in the team project.

Written Proposal – 5 points. A proposal document developed from the project idea discussion and the feedback received.

Final presentation – 10 points. A final presentation during the final week of the class session.

Final report – 12 points. A written report in the format of a research paper on your final project methodology and outcomes.

Grading Breakdown

Assessment	Number	Points Each	Total Points
Weekly Assignments			
Resume Assignment	1	3	2
Lead Class Discussions	4	4	16
Quizzes	5	3	15
Homework Assignments	4	7	28
In-class Work	12	1	12
Team Project Components			
Written Proposal	1	5	5
Final Presentation	1	10	10
Final Report	1	12	12
Total	29	-	100

Assignment Submission Policy

Unless otherwise noted, assignments must be submitted via Blackboard by the due dates specified in the Course Schedule below and on the assignment instructions. Unless otherwise noted, all Reading Assignments and Tutorials are *due by 11:59 pm Pacific Time (PT) on the due date*. Project components have different due dates as indicated on the Course Schedule below. Your attention to on-time assignment submission is essential.

Strict penalties apply for late assignments as follows:

- All assignments will be penalized 2 points up to FOUR days late. No points will be given for submissions more than FOUR days late. Note that all assignments worth 2 points will receive 0 points if submitted late.
- Additionally, no written work will be accepted for grading after 5 pm PT on the last day of classes.

Course Schedule: A Weekly Breakdown

	Topics	Readings and Assignments	Deliverables/Dues
<i>Module 1: Basics of Spatial Econometrics</i>			
Week 1 1/13	Introduction to course	Resume Assignment Anselin (2001)	Resume Assignment: due Friday, 1/17

1/15	Introduction to spatial econometrics		
Week 2 1/23* *Monday, 1/20 is a university holiday	Why is spatial data special?	Chi & Zhu (2019) Ch.1 Homework Assignment 1	Sign-up for lead class discussion
Week 3 1/27 1/29	Spatial statistics concept framework Using R for statistics and mapping	Chi & Zhu (2019) Ch.2 pp. 21-33 Stowell & Pace (2014)	In-class quiz
<i>Module 2: Spatial Autocorrelation</i>			
Week 4 2/3 2/5	Spatial autocorrelation I: Global measures Spatial weights matrix	Chi & Zhu (2019) Ch.2 pp. 33-46 & Ch8 pp. 195-196 Wu & Kemp (2019) Bivand (2002)	In-class quiz Submit Homework Assignment 1 on the Blackboard no later than 11:59 p.m. on Mon., 2/3
Week 5 2/10* *Class to be rescheduled due to CalGIS 2/12	Spatial autocorrelation II: Local Indicators of Spatial Association (LISA) Getis-Ord G statistics	Chi & Zhu (2019) Ch.2 pp.47-53 Anselin (2019) Harris et al. (2017) Celebioglu & Dall'erba (2010) Homework Assignment #2	
Week 6 2/19* 2/17 is a university holiday	Local spatial autocorrelation in GeoDa	Anselin et al. (2006)	In-class quiz
<i>Module 3: Spatial Regression Methods</i>			

Week 7 2/24	Regression in GIS	Chi & Zhu (2019) Ch3 pp.55-65	In-class quiz
2/26	Regression analysis of areal data using R	Chi & Zhu (2019) Ch8 pp.183-195 Homework assignment #3	Submit Homework Assignment 2 on the Blackboard no later than 11:59 p.m. on Monday, 2/24
Week 8 3/2	Spatial regression I: Spatial dependency Spatial Lag Models	Chi and Zhu (2019) Ch3 pp.65 – 83 Anselin (2003) Elhorst (2010)	In-class quiz
3/4	Spatial Error Models		
Week 9 3/9	Spatial regression II: Spatial heterogeneity Aspatial regression, spatial regime models	Chi & Zhu (2019) Ch5 Matthew & Yang (2012)	In-class quiz Final project idea discussion in-class on 3/9
3/11	Geographically weighted regression		Submit Homework Assignment 3 on the Blackboard no later than 11:59 p.m. on Friday, 3/13
3/15-3/22	<i>Spring Recess</i>		
<i>Module 4: Advanced Spatial Regression Methods</i>			
Week 10 3/23	Dealing with both spatial dependency and spatial heterogeneity (Spatial regime models)	Chi and Zhu (2019) Ch6	In-class quiz
3/25	Spatial regime models (cont'd)		Submit project proposal on the Blackboard no later than 11:59 p.m. on Wednesday, 3/25
Week 11 3/30	Spatio-temporal analysis I: Introduction to spatial panel models	Chi & Zhu (2019) Ch7 pp.155-167 Baltagi & Li (2004) Elhorst (2014) pp.37-53	In-class quiz
4/1	Spatio-temporal analysis in ArcGIS	Homework Assignment #4	
Week 12 4/6*	Spatio-temporal analysis II: Spatial panel model selections	Elhorst (2014) pp.53-93 Milo & Piras (2012)	

4/8 *AAG week; schedule might change			
<i>Module 5: Practical Aspects of Spatial Econometrics</i>			
Week 13 4/13 4/15	Problems and critiques of spatial econometric models Team project work	Anselin (2002) Gibbons & Overman (2012) Patridge et al. (2012)	In-class quiz Submit Homework Assignment 4 on the Blackboard no later than 11:59 p.m. on Mon., 4/13
Week 14 4/20 4/22	Practical applications of spatial econometric models Team project work	Sparks & Sparks (2010) Baller & Richardson (2002) Tian et al. (2010)	In-class quiz
Week 15 4/27* 4/29 *Friday, 5/1 is the last day of class	Team project work & summative discussion Final presentations	Final presentations	Final presentations in-class on 4/29
FINAL 5/6-5/13	Final project completion		Submit final report on the Blackboard no later than 11:59 pm on Friday, 5/8

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Support Systems

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call

engemannshc.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline – 1 (800) 273-8255 – 24/7 on call

www.suicidepreventionlifeline.org

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call

engemannshc.usc.edu/rsvp

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086

equity.usc.edu, titleix.usc.edu

Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support – (213) 740-2421

studentaffairs.usc.edu/bias-assessment-response-support

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs – (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

Student Support and Advocacy – (213) 821-4710

studentaffairs.usc.edu/ssa

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC – (213) 740-2101

diversity.usc.edu

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

dps.usc.edu, emergency.usc.edu

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety – - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

Resources for Online Students

The Course Blackboard page and the GIST Community Blackboard page have many resources available for distance students enrolled in our graduate programs. In addition, all registered students can access electronic library resources through the link <https://libraries.usc.edu/>. Also, the USC Libraries have many important resources available for distance students through the link: <https://libraries.usc.edu/faculty-students/distance-learners>. These include instructional videos, remote access to university resources, and other key contact information for distance students.