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

SSCI 583, Spatial Analysis

Syllabus

Units: 4

Term - Day - Time: Spring 2022, Mondays and Wednesdays, 1 -2:50 pm PT

Location: Physical room TBD and DEN@Dornsife

Instructor: Elisabeth Sedano, JD, PhD
Office: AHF B57C
Office Hours: Mondays 12-1 pm and Thursdays 1-2 pm PT. Also available by appointment via email.
Contact Info: sedano@usc.edu

Library Help: Andy Rutkowski
Office: VKC 36B
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Contact Info: arutkows@usc.edu, see contact page on Blackboard for Zoom Room

IT Help: Richard Tsung
Office: AHF 145D
Office Hours: By appointment
Contact Info: spatial_support@usc.edu, 213-821-4415

Course Scope and Purpose

Spatial analysis is key to the successful application of GIS to today's difficult and critical environmental and social challenges. While digital mapping technologies such as Google Maps are in widespread general use, GIS only reaches its full potential when the power of spatial analysis is engaged. Consumer-oriented mapping tools are simple and intuitive for most people to use, yet competent spatial analysis requires a deep awareness of the underlying assumptions and methods. In fact, the easy access to advanced spatial analytical tools in today's GIS is deceptive: It is fairly simple to walk through wizards and push buttons in a GIS to perform a complicated analysis, using any collection of data and parameters one likes. However, choosing the proper data, methods, and settings for the analysis such that a valid, defensible result is produced is a different matter. Helping you become an informed spatial analyst is the goal of this course.

This course aims to provide students with the knowledge and skills necessary to investigate the spatial patterns which result from social and physical processes operating on or near the Earth's surface. Essential theoretical concepts of quantitative geography are examined, including measures of geographical distribution (including point and areal pattern analysis) and spatial autocorrelation, interpolation, and network connectivity. The focus is on understanding the theory and context of spatial analysis so that you are equipped to find and apply the best analytical tool for your problem and to correctly and appropriately interpret and present your results. Since proficient spatial analysis requires imaginative application of a myriad of available tools, there are far more tools and techniques available than we can possibly cover in a single course. Therefore, practical assignments in this course are not intended to provide comprehensive training in any of the wide range of available tools, but rather to develop skills that will help you find, understand, and use the multitude of tools and, importantly, the related learning resources when you need them in the future. Of the wide range of software programs available, we will focus on the ArcGIS ecosystem, NetLogo, and Maxent programs.

By necessity and design, this course serves several different audiences. It is a required course for students in the GeoHealth track in the Master of Public Health program or pursuing the M.S. in Spatial Data Science or M.S. in Spatial Economics and Data Analysis. It is an elective for students pursuing the M.S. in Geographic Information Science and Technology, M.S. in Homeland Security and Geospatial Intelligence, or Graduate Certificates in GIST, Geospatial Intelligence, or Geospatial Leadership. To address this diverse range of student interests, this course focuses on common principles and tools.

Learning Outcomes

On completion of this course, students should be able to:

- Explain the conceptual bases for and results of the main spatial analysis methodologies, such as weighted and fuzzy overlay, accessibility assessments, cluster and hot spot analyses, geographically weighted regression, and interpolation.
- Distinguish the utility of the main spatial analysis methodologies in a variety of settings.

- Execute commonly requested spatial analyses using ArcGIS.
- Outline the geographic concepts of distance, adjacency, interaction, and neighborhood, and discuss how these are fundamental in performing spatial analysis.
- Outline the central role that spatial autocorrelation plays in spatial analysis and explain how it helps and hinders the use of current tools.
- Explain the utility of agent-based modeling and the parameter choices for building an agent-based model.
- Build a basic agent-based model using NetLogo.
- Explain the utility of machine learning for building spatial models and the common parameter choices for building a spatial model using machine learning.
- Build a basic model with machine learning using Maxent.
- Critically assess the results of spatial analyses.

Students may vary in their competency levels on these abilities. You can expect to acquire these abilities only if you honor all course policies, attend classes regularly, complete all assigned work in good faith and on time, and meet all other course expectations of you as a student.

Prerequisite(s): SSCI 581 or permission of the instructor
Co-Requisite(s): None

Class Conduct

Harassment, sexual misconduct, interpersonal violence, and stalking are not tolerated by the university. All faculty and most staff are considered Responsible Employees by the university and must forward all information they receive about these types of situations to the Title IX Coordinator. The Title IX Coordinator is responsible for assisting students with supportive accommodations, including academic accommodations, as well as investigating these incidents if the reporting student wants an investigation. The Title IX office is also responsible for coordinating supportive measures for transgender and nonbinary students such as faculty notifications, and more. If you need supportive accommodations you may contact the Title IX Coordinator directly (titleix@usc.edu or 213-821-8298) without sharing any personal information with me. If you would like to speak with a confidential counselor, Relationship and Sexual Violence Prevention Services (RSVP) provides 24/7 confidential support for students (213-740-9355 (WELL); press 0 after hours).

SSI Server and Tech Support

ArcGIS and other software is provided online via the SSI Server; hence, you do not need to install them on your own computer. Instead, every student must have the following technology requirements:

- A computer with a fast Internet connection.
- A functional webcam and a microphone in the event that the student attends class virtually.

- An up-to-date web browser to access the SSI Server.

If a student does not have access to any of these, please speak with the instructor at the start of the semester. Also, see the USC ITS Student Toolkit here: https://keepteaching.usc.edu/students/student-toolkit/

Workload

This is a four credit, one semester course. Students should expect to spend 10-15 hours per week completing the work in this course.

Required Readings and Supplementary Materials

The required textbook for this course is:

- O'Sullivan, D. and D.J. Unwin. 2010. *Geographic Information Analysis*, 2nd edition. New York: John Wiley & Sons. (Available online through the USC Libraries.)

Supplementary readings will be assigned from various sources including but not limited to:

- Bryant Jr, J. and Delamater, P.L. 2019. Examination of spatial accessibility at micro-and macro-levels using the enhanced two-step floating catchment area (E2SFCA) method. *Annals of GIS*, 25(3), pp.219-229.
- Crooks, A., Malleson, N., Manley, E. and Heppenstall, A. 2018. *Agent-Based Modelling and Geographical Information Systems: A Practical Primer*. London: SAGE Publications Ltd.
- Jun, H.J. and Namgung, M. 2018. Gender difference and spatial heterogeneity in local obesity. *International Journal of Environmental Research and Public Health*, 15(2), p.311.
- Kalinski, C. 2019. *Building Better Species Distribution Models with Machine Learning: Assessing the Role of Covariate Scale and Tuning in Maxent Models*. University of Southern California (Master's Thesis).
- Klaas, B.A., Moloney, K.A. and Danielson, B.J. 2000. The tempo and mode of gopher mound production in a tallgrass prairie remnant. *Ecography*, 23:246-256.
- Luo, W. and Wang, F. 2003. Measures of spatial accessibility to health care in a GIS environment: synthesis and a case study in the Chicago region. *Environment and Planning B: Planning and Design*, 30(6), pp.865-884.
- Mierzwiak, M. and Calka, B. 2017. Multi-criteria analysis for solar farm location suitability. *Reports on Geodesy and Geoinformatics*, 104(1), pp.20-32.
- Phillips, S.J., Anderson, R.P. and Schapire, R.E. 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modelling*, 190(3-4), pp.231-259.
- Sawyer, S.C., Epps, C.W. and Brashares, J.S. 2011. Placing linkages among fragmented habitats: Do least-cost models reflect how animals use landscapes? *Journal of Applied Ecology*, 48(3), pp.668-678.
- Weir, R. 2019. Using geographically weighted regression to explore neighborhood-level predictors of domestic abuse in the UK. *Transactions in GIS*, 23(6), pp.1232-1250.

- Wilson, J.P. 2018. *Environmental Applications of Digital Terrain Modeling*. Oxford: John Wiley and Sons, Ltd.

As well, for several of the assignments in this course, you will conduct online library research to find articles that apply specific techniques in an application area of your choice.

Description and Assessment of Assignments

This course includes a diversity of assessments that allow students to gain knowledge and experience and to show their mastery of the material in a variety of ways. The different types of assessments are described below and their overalls point value are summarized in the following Grading Breakdown section.

Resume Assignment 1 - 1 worth 1 point. 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 which 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.

Resume Assignment 2 - 1 worth 2 points. At the end of the term, the SSI requires students to update their resumes to reflect the knowledge and experience gained through the course.

Projects - 5 worth a total of 71 points. These assignments – completed in pairs – require students to complete the basic types of analyses asked of professional spatial analysts in real-world settings. Prompts will list helpful information, such as software tutorials, for becoming familiar with ways that concepts learned in the course are implemented in various software packages. Each project has two deliverables: a workflow diagram and a final report that describes the student's goals, methods, data, and results for the project. The workflow diagram is due one week prior to the final deliverable and is workshopped in an online forum and during a synchronous class session with classmates and the instructor.

Reading and Research Discussions - 5 worth a total of 26 points. These assignments call on students to identify relevant research case studies employing the methodologies and concepts we cover in class and to discuss them with the instructor and their classmates during course meetings and in online discussion forums. For one of the five, students take a lead in the discussion, posing questions and presenting case studies, and they receive greater course credit.

Grading Breakdown

The table below shows the breakdown of the assessments and their weight in the final grade.

Assessment	Number	Points Each	Total Points
Resume Assignment 1	1	1	1
Resume Assignment 2	1	2	2
Reading and Research Discussions			
Discussion Posts	4	4	16
Discussion Leaders	1	10	10
Projects			
Workflow Reviews	5	3	15
Projects 1-3 Reports	3	12	36
Projects 4-5 Reports	2	10	20
Total	17	-	100 points

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.

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.
- No work will be accepted for grading after 5 pm on the last day of classes, except for Project 5, which is due May 1, 11:59pm.

Schedule

Date	Class Topic/Activity	Readings and Assignments	Deliverables: Due Dates
Weeks 1 - 4: Module 1 | Spatial Analysis Foundations: Overlay and MCDA			
1/10	Introduction to the Course and Spatial Analysis	Resume Assignment 1 Reading & Research Discussion (RRD)1 Project 1 Mierzwiak and Calka (by 1/12) O&U, Chs. 1, 2, 11 (by 1/19) O&U, Chs. 3, 4 (by 1/24)	Resume Assignment 1: 1/14 RRD1 Forum Posts: See Prompt Project 1 Workflow: 1/31, 1pm Project 1 Report: 2/6, 11:59pm PT
1/12	Overlay and Multiple Criteria Decision Analyses		
1/19* *1/17 is a university holiday	Intro to Project 1 and Tech		
1/24	Benefits and Complications of Spatial Analysis		
1/26	MCDA Case Study		
1/31	Project 1 Workflow Reviews		

Date	Class Topic/Activity	Readings and Assignments	Deliverables: Due Dates
2/2	RRD1 Discussion		
Weeks 5 - 7: Module 2 | Distance-Based Analysis and Accessibility			
2/7	Networks and Accessibility Analyses	RRD2 Project 2 Luo and Wang (by 2/9) Bryant and Delamater (by 2/9)	RRD2 Forum Posts: See Prompt Project 2 Workflow: 2/16, 1pm PT Project 2 Report: 2/27, 11:59pm PT
2/9	Intro to Project 2 and Tech		
2/14	Accessibility Case Study		
2/16	Project 2 Workflow Reviews		
2/23* *2/21 is a university holiday	RRD2 Discussion		
Weeks 8 - 9: Module 3 | Point Pattern and Spatial Autocorrelation Analyses			
2/28	Lecture: Point-Pattern Analysis and Spatial Autocorrelation	RRD3 Project 3 O&U, Chs. 5 ,6 (by 3/2) Klaas et al. (by 3/2) O&U, Chs. 7, 8 (by 3/7) Jun and Namgung (by 3/7)	RRD3 Forum Posts: See Prompt Project 3 Workflow: 3/7, 1pm PT Project 3 Report: 3/20, 11:59pm PT
3/2	Intro to Project 3 and Tech		
3/7	Project 3 Workflow Reviews		
3/9	RRD3 Discussion		
Weeks 10 - 13: Module 4 | Introduction to Spatial Modeling			
3/21	Spatial Modeling Overview and Spatial Regression	RRD4 RRD5 Project 4 O&U, Ch. 12 (341-354,360-368) (by 3/23) Weir (by 3/23) Kalinski (by 4/4) Philips et al. (by 4/4) Crooks, Ch. 1-3 (by 4/6)	RRD4 Forum Posts: See Prompt RRD5 Forum Posts: See Prompt Project 4 Workflow: 4/10, 1pm PT Project 4 Report: 4/17, 11:59pm PT
3/23	Geographically Weighted Regression		
3/28	Intro to Project 4 and Tech		
3/30	RRD4 Discussion		
4/4	Species Distribution Modeling with Maxent		
4/6	Agent-Based Modeling		

Date	Class Topic/Activity	Readings and Assignments	Deliverables: Due Dates
4/10	Project 4 Workflow Reviews		
4/12	RRD5 Discussion		
Weeks 14 - 15: Module 5 | Fields and Surfaces			
4/18	Interpolation and the Analysis of and Surfaces	Project 5 O&U, Ch. 9, 10 (by 4/20) Wilson, Ch. 3.1.3, 3.1.4 (by 4/25)	Project 5 Workflow: 4/27, 1pm PT Resume Assignment 2: 4/29 11:59 pm PT Project 5 Report: 5/1 11:59pm PT
4/20	Intro to Project 5 and Tech		
4/25	Terrain Analysis		
4/27	Project 5 Workflow Reviews		

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 Research and Scholarship Misconduct.

Students and Disability Accommodations

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu

Support Systems

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.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
suicidepreventionlifeline.org
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) 740-9355(WELL), press "0" after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
eeotix.usc.edu
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
osas.usc.edu
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.
USC Campus Support and Intervention - (213) 821-4710
campussupport.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity, and Inclusion - (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

Emergency assistance and avenue to report a crime. Latest updates regarding safety, 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.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
ombuds.usc.edu
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

*Occupational Therapy Faculty Practice - (323) 442-33*40 or otfp@med.usc.edu
chan.usc.edu/otfp
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.

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.