

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: Fall 2020, Mondays and Wednesdays,
2 -3:50 pm PT

Location: Online; Zoom links shared via course Blackboard

Instructor: Elisabeth Sedano, JD, PhD

Office: Zoom link shared via course Blackboard

Office Hours: Tuesdays and Thursdays 2-3 pm PT. Also
available by appointment via email.

Contact Info: sedano@usc.edu

Please contact Instructor via email in advance of attending
office hours. Instructor is also available by appointment.

Library Help: Andy Rutkowski

Office: VKC 36B

Office Hours: Tue 10 am-12 pm and Thu 4:30-5:30 pm PT

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

IT Help: Richard Tsung

Office: AHF 146

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, Maxent, and WhiteBox programs.

By both 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 key methods of digital terrain analysis and various algorithms for assess the flow of water over land.
- Perform and compare terrain analyses in ArcGIS and WhiteBox.
- 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.

Prerequisite(s): SSCI 581 or permission of the instructor

Co-Requisite(s): None

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

This course utilizes the SSI Server which is a virtual desktop giving access to many different professional software programs. If you are unable to connect to the server or experience any type of technical issue, send an email using your USC account to SSI Tech Support at spatial_support@usc.edu, making sure to copy (cc) your instructor on the email.

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 textbooks for this course are:

- Crooks, A., Malleon, N., Manley, E. and Heppenstall, A. 2018. *Agent-Based Modelling and Geographical Information Systems: A Practical Primer*. London: SAGE Publications Ltd.
- 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:

- 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).
- 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.
- 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.
- Shi, X., Alford-Teaster, J., Onega, T. and Wang, D. 2012. Spatial access and local demand for major cancer care facilities in the United States. *Annals of the Association of American Geographers*, 102(5), pp.1125-1134.
- 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 to 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, we require students to update the Skills section of their resumes to reflect the knowledge and experience gained through the course.

Projects - 7 worth a total of 70 points. These assignments 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 during a synchronous class session with classmates and the instructor.

Reading and Research Discussions - 7 worth a total of 27 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 two of the seven, 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. The emphasis is on regularly completing a number of short assignments as well as solid performance on the final examination.

Assessment	Number	Points Each	Total Points
Resume Assignment 1	1	1	1
Resume Assignment 2	1	2	2
Reading and Research Discussions			
Discussion Posts	5	3	15
Discussion Leads	2	6	12
Projects			
Workflow Reviews	7	2	14
Reports	7	8	56
Total	23	-	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.

Weekly Course Breakdown

Date	Class Topic/Activity	Assignments	Deliverables: Due Dates
Weeks 1 & 2: Module 1 Spatial Analysis Foundations			
8/24	Lecture: Introduction to Spatial Analysis; Overlay Analyses	Resume Assignment Reading & Research Discussion (RRD)1 Project 1 O&U, Chs. 1, 2, 11 (by 8/26) Chang Ch. 17 (by 8/26)	Resume Assignment: 8/31 Project 1 Workflow: 8/31 12pm PT RRD1 Forum Posts: 9/2 12pm PT RRD1 Synchronous Discussion: 9/2 2pm PT Project 1 Report: 9/6 11:59pm PT
8/26	Intro to Project 1 and Tech		
8/31	Project 1 Workflow Reviews		
9/2	RRD1 Discussion		
Weeks 3 & 4: Module 2 Point Pattern Analysis			
9/9* *9/7 is a university holiday	Lecture: Complete Spatial Randomness and Spatial Clusters; Intro to Project 2 and Tech	RRD2 Project 2 O&U, Chs. 3 (68-71), 4 (93-119); 5, 6 (by 9/9)	Project 2 Workflow: 9/14 12pm PT RRD2 Forum Posts: 9/16 12pm PT RRD2 Synchronous Discussion: 9/16 2pm PT Project 2 Report: 9/20 11:59pm PT
9/14	Project 2 Workflow Reviews		
9/16	RRD2 Discussion		
Weeks 5 & 6: Module 3 Agent-Based Modeling			
9/21	Lecture: Agent-Based Modeling Methods and NetLogo Platform	RRD3 Project 3 Crooks, Chs. 1-4, 6-7 (by 9/23)	Project 3 Workflow: 9/28 12pm PT RRD3 Forum Posts: 9/30 12pm PT RRD3 Synchronous Discussion: 9/30 2pm PT Project 3 Report: 10/4 11:59pm PT
9/23	Guest Presentation: Kenan Li; Intro to Project 3 and Tech		
9/28	Project 3 Workflow Reviews		
9/30	RRD3 Discussion		
Weeks 7 & 8: Module 4 Distance-Based Analysis and Accessibility			
10/5	Lecture: Networks and Accessibility Analyses	RRD4 Project 4 Crooks, Ch. 8 (by 10/7)	Project 4 Workflow: 10/12 12pm PT RRD4 Forum Posts: 10/14

Date	Class Topic/Activity	Assignments	Deliverables: Due Dates
10/7	Guest presentation: Ada Li Sarain; Intro to Project 4 and Tech	Luo and Wang (by 10/7) Shi et al. (by 10/7)	12pm PT RRD4 Synchronous Discussion: 10/14 2pm PT Project 4 Report: 10/18 11:59pm PT
10/12	Project 4 Workflow Reviews		
10/14	RRD4 Discussion		
Weeks 9 & 10: Module 5 Spatial Autocorrelation and Geographically Weighted Regression			
10/19	Space-Time Patterns		Project 5 Workflow: 10/26 12pm PT
10/21	Guest presentation: Ruth Weir; Intro to Project 2 and Tech	RRD5 Project 5 O&U, Chs. 7, 8 (by 10/21)	RRD5 Forum Posts: 10/28 12pm PT
10/26	Project 5 Workflow Reviews	Crooks, Ch. 9 (by 10/21) Weir (by 10/21)	RRD5 Synchronous Discussion: 10/28 2pm PT
10/28	RRD5 Discussion		Project 5 Report: 11/1 11:59pm PT
Weeks 11 & 12: Module 6 Spatial Interpolation and Terrain Analysis			
11/2	Analysis of Grids and Surfaces		Project 6 Workflow: 11/9 12pm PT
11/4	Intro to Project 6 and Tech	RRD6 Project 6 O&U, Ch. 9, 10 (by 11/4)	RRD6 Forum Posts: 11/11 12pm PT
11/9	Project 6 Workflow Reviews	Wilson, Ch. 3.1.3, 3.1.4 (by 11/4)	RRD6 Synchronous Discussion: 11/11 2pm PT
11/11	RRD6 Discussion		Project 6 Report: 11/15 11:59pm PT
Weeks 13 & 14: Module 7 Spatial Modeling with Machine Learning			
11/16	Spatial Modeling with Machine Learning		Project 7 Workflow: 11/23 12pm PT
11/18	Guest Presentation: Cass Kalinski	RRD7 Project 7 Crooks, Ch. 10, 11 (by 11/18)	RRD7 Forum Posts: 11/23 12pm PT
11/23 *11/25- 11/27 is a university holiday	Project 7 Workflow Reviews; RRD7 Discussion	Kalinski (by 11/18) Philips et al. (by 11/18)	RRD7 Synchronous Discussion: 11/23 2pm PT Project 7 Report: 11/30 11:59pm PT

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) 740-9355(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 of Equity and Diversity (OED) - (213) 740-5086 | *Title IX Compliance* - (213) 821-8298
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.

Reporting Incidents of Bias or Harassment- (213) 740-5086 or (213) 821-8298
usc-advocate.symplcity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, 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.

USC Support and Advocacy - (213) 821-4710

uscsa.usc.edu

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.