SSCI 583
Spatial Analysis and Modeling

Syllabus

Units: 4

Term Day Time: Spring 2023, M and Th 11:00am-12:50pm

Location: AHF 145D and DEN@Dornsife

Instructor: Diana Ter-Ghazaryan, PhD, GISP
Office: AHF B55K
Regular Office Hours: Tue 11am-1pm PT. Also available most days and times by appointment via email.
Contact Info: terghaza@usc.edu, 213-821-1190, see contact page on D2L for Zoom Room

Library Help: Andy Rutkowski
Office: LIPA B40-A
Office Hours: Thu 10am - 12 pm or by appointment
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IT Help: Myron Medalla
Office: AHF B56B
Office Hours: By appointment via email
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, Google Earth and Microsoft's Bing Maps are now in widespread general use, GIS only reaches its full potential when the power of spatial analysis is engaged. While the consumer-oriented mapping tools are simple and intuitive for most people to use, spatial analysis requires a much deeper awareness of the underlying assumptions and methods. In fact, the easy access to very advanced spatial analytical tools in today's GIS is deceptive as it is fairly simple to walk through wizards and push buttons to perform an analysis, but much more difficult to produce a valid, defensible analytical result. 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 theories 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.

This is a required course for the GeoHealth track in the Keck School of Medicine's M.P.H. program and the M.S. in Spatial Informatics (SPIF) program and an elective for the M.S. in Geographic Information Science and Technology (GIST) program and the GIST, Geospatial Intelligence and Geospatial Leadership Graduate Certificate Programs.

Learning Outcomes

On completion of this course, students should be able to:
- Plan, design and implement a spatial analysis project demonstrating the ability to select, apply and critically interpret appropriate methods for the analysis of geographical information.
- List several different approaches to spatial analysis and differentiate between them.
- Outline the geographic concepts of distance, adjacency, interaction and neighborhood and discuss how these are fundamental in performing spatial analysis.

- Explain how point patterns, including clustering, can be identified and understood as realizations of spatial processes.
- Apply appropriate spatial references (datum and projection) to spatial data before undertaking analysis.
- Outline the central role that spatial autocorrelation plays in spatial analysis and explain how it helps and hinders the use of current tools.
- Demonstrate how different concepts about nearness and neighborhoods result in a variety of interpolation methods that produce different results.
- Outline the various ways that overlay is implemented in GIS.
- List several emerging geographical analysis techniques using temporal and 3D analysis.

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)

COVID-19 policy -- Students are expected to comply with all aspects of USC's COVID-19 policy including, but not limited to, vaccination, indoor mask mandate, and daily TrojanCheck. Failure to do so may result in removal from the class and referral to Student Judicial Affairs and Community Standards. Students are recommended to keep safe physical distancing, whenever possible, to prevent any possible transmission. Please contact your instructor if you have any safety concerns.

Diversity and Inclusion – It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource,

strength and benefit. It is my intent to present materials and activities that are respectful to everyone, and you are also expected to respect of others regardless of their race, ethnicity, gender identity and expressions, cultural beliefs, religion, sexual orientation, national origin, age, abilities, ideas and perspectives, or socioeconomic status. Your suggestions are encouraged and appreciated. Feel free to let me know ways to improve the effectiveness of the course for you personally or for other students.

Course Structure

The main theoretical concepts are provided through a directed reading of the text *Geographic Information Analysis.* The course reader will emerge as a collection of reading notes that provide the basis for an informed review of most chapters. Additional readings will be assigned to expand on the text when needed. The course will generally unfold on a biweekly basis. When possible, assignments will be given in advance, but usually they will be posted on or before Mondays. Practical exercises utilize published tutorial materials using ArcGIS and a final project allows students to demonstrate their ability to apply spatial analytical tools in an appropriate, informed manner.

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.

Technological and Communication Requirements

ArcGIS is provided online via the GIST Server; hence, you do not need to install it 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 for use whenever a presentation or meeting is scheduled.
- An up-to-date web browser to access the 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/

Desire2Learn (D2L) – This course will utilize the Desire2Learn (D2L) learning management system which allows students to access course content, upload assignments, participate in discussion forms, among other learning experiences. The D2L platform provides flexibility in the learning experience where students can participate in the course residentially or remotely, synchronously (meeting together at the same time) or asynchronously (accessing videos and course content outside of class).

SSI Server and Tech Support – This course utilizes the SSI Server which is a virtual desktop giving access to many different professional software. If you are unable to connect to the server or

experience any type of technical issues, send an email using your USC account to SSI Tech Support at spatial_support@usc.edu, making sure to copy (cc) me on the email.

Communications – All assignments given and all materials to be handed in will be submitted via D2L. The instructor will also create and monitor discussion forums through which students can discuss issues and assignments as needed. Students should read all email sent from D2L or from course instructor(s) as soon as possible. Also, students who do not regularly use their USC email accounts should double-check to be sure that mail sent from both the D2L accounts and the instructor's account (noted above) to your USC account is forwarded to an address used regularly and does not go into junk mail. The instructor will endeavor to respond to all email within 24 hours of receipt, aiming for no more than 72 hours delay. In the rare case that an instructor is off-line for an extended periodof time, an announcement will be posted to the class D2L site. Due to the synchronous and asynchronous nature of this course, it is each student's responsibility to stay informed and connected with others in our course. In addition to email, students are expectedto login to D2L regularly to check for announcements.

Discussion forums – On the D2L site, I will post a series of discussion threads relevant to various sections of the course. Discussions provide a key means for student-to-student discussion and collaboration that can replicate the face-to-face contact you may have experienced in traditional classrooms. Here students can provide support to each other while working on your assignments, sharing hints and helpful tips, as you would in a classroom laboratory. Please post your questions about assignments there, as you would ask them publicly in the classroom. I monitor the discussion threads and offer comments when necessary, but more importantly, consider the discussion board a key way to connect with your classmates and share your discoveries.

Required Readings and Supplementary Materials

The required textbooks for this course are:

- O'Sullivan, David, and David J. Unwin. 2010. *Geographic Information Analysis*, 2nd Edition. New York: John Wiley & Sons. While you may purchase this book if you wish to own a bound copy, it is available online through the USC Libraries. Sign on to the USC Libraries and search for this title.
- Mitchell, Andy. 1999. *The Esri Guide to GIS Analysis. Volume 1: Geographic Patterns and Relationships*. Redlands, CA: Esri Press.
- (Optional) Mitchell, Andy. 2005. *The Esri Guide to GIS Analysis*. *Volume 2: Spatial Measurements and Statistics.* Redlands, CA: Esri Press.
- (Optional) Mitchell, Andy. 2012. *The Esri Guide to GIS Analysis*. *Volume 3: Modeling Suitability, Movement, and Interaction.* Redlands, CA: Esri Press.

The practical Mitchell books are useful in association with the theoretical text as a means of bringing theory into a working context. Used copies of these books are widely available online, so there is no need to pay the full retail price.

Supplementary readings will be assigned from various sources including:

- de Smith, Michael J., Michael F. Goodchild and Paul A. Longley. 2013. *Geospatial Analysis: A Comprehensive Guide to Principles, Techniques and Software Tools*, 3rd Edition. Winchelsea, UK: The Winchelsea Press. Available in both print and a (free!) web version at www.spatialanalysisonline.com.
- Fisher, Peter F. and Nicholas J. Tate. 2006. Causes and consequences of error in digital elevation models. *Progress in Physical Geography* 30: 467-489.
- Kemp, Karen K., ed. 2008. *Encyclopedia of Geographic Information Science.* Thousand Oaks, CA: Sage Publications. Available online from the USC Libraries.

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 worth 3 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. This assignment is due at the end of the term, and thus should reflect the knowledge and experience gained through the course. 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.

Projects - 5 worth a total of 71 points. These assignments – completed in teams – 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

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

Assignment Submission Policy

Unless otherwise noted, assignments must be submitted via D2L 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 Sundays*. Project components have different due dates as indicated on the Course Schedule below. Your attention to on-time assignment submission is essential if I am to meet my goal to return comments on your submitted assignments before the next one is due. Sometimes this is impossible, so I will post a notice on anticipated delays if needed.

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.

Schedule

Date	Class Topic/Activity	Readings and Assignments	Deliverables: Due Dates
Weeks 1 - 3: Module 1 | Spatial Analysis Foundations: Overlay and MCDA			
1/9	Introduction to Spatial Analysis and the Course	Mierzwiak & Calka (read by 1/12) O&U, Chs. 1, 2, 11 (read by 1/12) Reading & Research Discussion (RRD)1 Project 1	RRD1 Forum Posts: See Prompt Project 1 Workflow: 1/23 11am PT RRD1 Synchronous Discussion: 1/26 11am PT Project 1 Report: 1/29 11:59pm PT
1/12	Lecture: Overlay and Multiple Criteria Decision Analyses Intro to Project 1 and Tech		
1/16* *1/16 is a university holiday			
1/19	MCDA Case Study		
1/23	Project 1 Workflow Reviews		
1/26	RRD1 Discussion		
Weeks 4 - 6: Module 2 | Finding Patterns in Spatial Data			
1/30	Lecture: Point-Pattern Analysis and Spatial Autocorrelation	O&U, Chs. 3 (68-71), 4 (93-119); 5, 6 (by 2/2) Klaas et al. (by 2/2) O&U, Chs. 7, 8 (by 2/6) Jun and Namgung (by 2/6) Weir (by 2/6) RRD2 Project 2	RRD2 Forum Posts: See Prompt Project 2 Workflow: 2/13 11am PT RRD2 Synchronous Discussion: 2/16 11 am PT Project 2 Report: 2/19 11:59pm PT
2/2	Intro to Project 2 and Tech		
2/6	Lecture: Geographically Weighted Regression		
2/9	Guest Presentation: TBD		
2/13	Project 2 Workflow Reviews		
2/16	RRD2 Discussion		

Date	Class Topic/Activity	Readings and Assignments	Deliverables: Due Dates
Weeks 7 - 9: Module 3 | Distance-Based Analysis and Accessibility			
2/20* *2/20 is a university holiday		Luo and Wang (by 2/23) Shi et al. (by 2/23) RRD3 Project 3	RRD3 Forum Posts: See Prompt Project 3 Workflow: 3/6 11am PT RRD3 Synchronous Discussion: 3/9 11am PT Project 3 Report: 3/12 11:59pm PT
2/23	Lecture: Networks and Accessibility Analyses Intro to Project 3 and Tech		
2/27	Distance-Based Analysis and Accessibility Case Study		
3/2	Guest Presentation: TBD		
3/6	Project 3 Workflow Review		
3/9	RRD3 Discussion		
Weeks 10 - 12: Module 4 | Spatial Analysis with Computational Modeling			
3/13* and 3/16* *Spring Recess		O&U, Ch. 12 (341-354,360-368) (by 3/23) Kalinski (by 3/23) Philips et al. (by 3/27) Crooks, Ch. 1-3 (by 3/27) RRD4 Project 4	RRD4 Forum Posts: See Prompt Project 4 Workflow: 4/3 11am PT RRD4 Synchronous Discussion: 4/6 11am PT Project 4 Report: 4/9 11:59pm PT
3/20	Lecture: Species Distribution Modeling with Maxent		
3/23	Lecture: Agent-Based Modeling		
3/27	Intro to Project 4 – SDM and ABM options – and Tech		
3/30	Guest Presentation: TBD		
4/3	Project 4 Workflow Reviews		

Date	Class Topic/Activity	Readings and Assignments	Deliverables: Due Dates
4/6	RRD4 Discussion		
Weeks 13 - 15: Module 5 | Creation and Analysis of Fields			
4/10	Lecture: Interpolation and the Analysis of Grids and Surfaces	Resume Assignment O&U, Ch. 9, 10 (by 4/13) Wilson, Ch. 3.1.3, 3.1.4 (by 4/17) RRD5 Project 5	Resume Assignment Due 4/17 RRD5 Forum Posts: See Prompt Project 5 Workflow: 4/20 11am PT RRD5 Synchronous Discussion: 4/24 11am PT
4/13	Intro to Project 5 and Tech		
4/17	Guest Lecture: TBD		
4/20	Project 5 Workflow Reviews		
4/24	RRD5 Discussion		
4/28	Final Presentations		
Study Days			Project 5 Report: 5/3 11am 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 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.

Last Revised on 01/04/2023

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 D2L 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.