USC Dornsife

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

SSCI 382L, Geographic Information Science: Spatial Analytics

Syllabus

Units: 4

Term Day Time: Fall 2024, M and W from 12:00-1:20pm

Location: WPH B26

Lab Section: Tu. 2:00-3:50, DMC 260

Instructor: Katherine Lester, PhD
Office: AHF B55A
Regular Office Hours: Mon and Wed 2:30-3:30 pm PT. Also available most days and times by appointment via email.
Contact Info: lesterk@usc.edu, (213) 821-0672

Lab Instructor/Teaching Assistant: TBD
Office: AHF B55A
Regular Office Hours: TBD
Contact Info: TBD

Library Help: Andy Rutkowski
Office: LIPA B40-A
Office Hours: Thu 10 am-12 pm
Contact Info: arutkows@usc.edu, see contact page on D2L for Zoom Room

IT Help: Myron Medalla
Office: AHF B56B
Office: By appointment via email
Contact Info: spatial_support@usc.edu, 213-740-4415

Course Scope and Purpose

This is the first of the two courses that provide a deeper examination of Geographic Information Science (GIScience) with a focus on database modeling, theoretical foundations of spatial statistics, and spatial data analytical methods. The course aims to provide students with the knowledge and skills necessary to manage and analyze geospatial data. As the second or third (following SSCI 301L, or SSCI 301L and SSCI381, respectively) in a four-course sequence in the SSCI 300 series about geographic information, this particular course seeks to elucidate how spatial analytics provide a gateway to the natural and social sciences via their ability to solve many of the societal and environmental problems we face in today's ever-changing world.

Learning Objectives

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

- Describe the key theoretical concepts that support spatial analytics.
- Explain how to use geodatabases and related methodologies to model the complex geographic world in digital forms.
- Analyze vector and raster datasets using relevant geospatial techniques to help solve social and environmental problems.

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 301L
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

This is a four-credit course comprised of lectures (two per week) and lab (one per week). The lecture sessions are organized into learning modules that build upon the core principles of GIScience, spatial analysis and the use of various software systems to support the exploration of these topics. The weekly lab meetings and lab assignments are designed to deepen your understanding of the available data management and geoprocessing techniques, broaden your practical experience with geographic information systems (GIS), and enhance your problem-solving skills within the framework of the scientific method. The lectures and lab sessions are designed to complement each other to provide you with sound theoretical reasoning and the technical skills to investigate various physical and/or social processes. Your weekly laboratory reports will be graded and returned via Brightspace, and the mid-term and final exams will cover both the lecture and laboratory components. It is required that you register for both the lecture and one laboratory session for this course.

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.

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 publically 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 textbook for this course is:

- Burrough, P.A., R.A. McDonnel, and C.D. Lloyd. 2015. *Principles of geographic information systems* (3rd ed.). Oxford, UK: Oxford University Press.

Supplementary readings will be assigned and provided on Blackboard from various sources including, but not limited to:

- Aljoufie, M., M. Zuidgeest, M. Brussel and M. van Maarseveen. 2013. Spatial–

temporal analysis of urban growth and transportation in Jeddah City, Saudi Arabia. *Cities*, *31*, 57- 68.

- Bagui, E. and R. Earp. 2012. Chapter 4: The basic ER diagram: A data modeling schema. In *Database Design Using Entity-Relationship Diagrams*. Auerbach Publications (available online via USC Libraries)

- Batra, R. 2018. Chapter 1: An Introduction to SQL. In *SQL Primer:* An Accelerated Introduction to SQL Basics (1st ed.). Berkeley, CA: Apress L. P. (available online via USC Libraries)

- de Smith, M.J., M.F. Goodchild, and P.A. Longley. 2020. *Geospatial analysis: A comprehensive guide to principles, techniques and software tools* (6th ed.). Winchelsea, UK: The Winchelsea Press (available online at http://www.spatialanalysisonline.com)

- Harris, N.L., E. Goldman, C. Gabris, J. Nordling, S. Minnemeyer, S. Ansari, M. Lippmann, L. Bennet, M. Raad, M. Hansen, and P. Potapob. 2017. Using spatial statistics to identify emerging hot spots of forest loss. *Environmental Research Letters* 12: 024012.

- Kim, C. 2016. Land use classification and land use change analysis using satellite images in Lombok Island, Indonesia. *Forest science and technology*, 12(4): 183-191.

- Li, W., M. Batty, and M.F. Goodchild. 2020. Real-time GIS for smart cities. *International Journal of Geographic Information Systems* 34: 311-324.

- O'Sullivan, D. and D.J. Unwin. 2010. *Geographic Information Analysis*. Wiley and Sons, Inc.

- Shi, Xun, J. Alford-Teaster, T. Onega, and D. Wang. 2012. Spatial access and local demand for major cancer care facilities in the United States. *Annals of the Association of American Geographers* 102(5): 1125-1134.

- Webster, K., J. Arroyo-Mora, O. Coomes, Y. Takasaki, and C. Abizaid. 2016. A cost path and network analysis methodology to calculate distance along a complex river network in Peruvian Amazon. *Applied Geography* 73: 13-25.

Description and Assessment of Assignments

Your grade in this class will be determined on the basis of several different assessments as follows:

Reading Reflections– 10 points total: For 11 weeks during the semester, I will ask you to identify at least three lingering questions drawing on the reading material and lectures. You will post your questions on blackboard by the end of day Fridays. You will only need to complete 10 of the 11 weeks. 1 point each week.

Discussion – 5 worth a total of 20 points: Discussion posts and responses related to course concepts and readings will be required throughout the course period via the Discussion Forum on Blackboard.

Laboratory Reports – 10 worth a total of 40 points: This course includes mandatory weekly laboratory meetings to develop technical competency with geospatial software platforms and spatial analytic techniques. The interactive laboratory sessions will run 1-2 hours and will entail discussions of the previous and the current week's lab assignments linking the technical exercises to the lecture materials (but not replicate them).

Absences from lab sessions must be requested and approved via emails by the laboratory instructor *prior to the lab session you will miss*. Excused absences from lab sections will be granted only for valid reasons via email.

Mid-Term and Final Exams – 2 exams worth 15 points each: The mid-term and final exams and will use a mix of formats and cover both lectures and lab contents. Students are expected to take the exams at the indicated times.

Grading Breakdown

Assessment	Number	Points Each	Total Points
Reading Reflections	10	1	10
Discussion Forums	5	4	20
Laboratory reports	10	4	40
Midterm exam	1	15	15
Final exam	1	15	15
Total	27	--	100

Grading Scale

Assignments in this and other SSCI courses, are graded on the letter grade scale where A is exemplary, B is very good, C is satisfactory, D is unsatisfactory, and F needs improvement. Final grades use the same letter grade scale with C being the minimum passing grade for credit at the graduate level. The grading scale follows:

A	> 93 points		B-	80-82 points		D+	67-69 points
A-	90-92 points		C+	77-79 points		D	63-66 points
B+	87-89 points		C	73-76 points		D-	60-62 points
B	83-86 points		C-	70-72 points		F	<60 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 Mondays*. 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 1 point per day up to FOUR days late. No points will be given for submissions more than FOUR days late. Note that all assignments worth 1 point will receive 0 points if submitted late.

- Additionally, no written work will be accepted for grading after 5 p.m. PT on the last day of classes.

Grading Timeline

My goal is to provide grading and feedback on each course assignment no later than one week after the assignment was submitted.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposed other than individual or group study is prohibited. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which has been distributed to students or in any way has been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. (Living our Unifying Values: The USC Student Handbook, page 13).

Learning Experience Evaluations

Please note Learning Experience Evaluations for the course take place at the end of the semester and are facilitated by the University. These evaluations provide an important review of student experiences in the course.

Course Schedule

	Topic	Readings and Assignments	Deliverables/Due Dates
Intro to Course & Review of SSCI 301L			
Week 1			

		Topic	Readings and Assignments	Deliverables/Due Dates
8/26		Introduction to the course	Burrough et al. (2015) Ch. 1, 5	No labs
8/28		Review of 301L		
Module 1. Data modeling and database management. Use case: Traffic Safety in Los Angeles				
Week 2				
9/2*		*University Holiday: No Class	Burrough et al. (2015) Ch.2 & Ch. 4 up to Sec. 4.3 (pp. 69-78)	*Lab 1*: Spatial data engineering
9/4		Spatial data engineering (ETL) & geographic data models		
Week 3				
9/9		Data modeling using Entity-relationship diagrams (ERD)	**Discussion 1** Burrough et al. (2015) Ch. 3 Burrough et al. (2015) Sec. 4.4-4.10 Batra (2018) Ch.1	*Lab 2: GDB Creation, Domains and Subtypes* *Reading Reflection 1: 9/13*
9/11		Geodatabase data integrity and standards and SQL		
Module 2. Spatial statistics: EDA, ESDA, and ESTDA. Use case: Exploration of Crime Data				
Week 4				
9/16		Statistical Conceptual Framework	Burrough et al. (2015) Ch. 6 up to Sec. 6.2 de Smith et al. (2020) Sec. 5.2	*Discussion 1 due: Tuesday, 9/17* *Lab 3*: Introduction to SQL *Reading Reflection 2: 9/20*
9/18		Exploratory Spatial Data Analysis (ESDA)		
Week 5				
9/23		Density-Based Point Analysis	Burrough et al. (2015) Sec. 6.7; de Smith et al (2020) Sec. 5.4	*Lab 4*: ESDA *Reading Reflection 3: 9/27*
9/25		Distance-Based Point Analysis		
Week 6				
9/30		Spatial autocorrelation	**Discussion 2** Burrough et al. (2015) Sec. 6.3–6.4; de Smith et al. (2020) Sec. 5.5	*Lab 5*: Cluster Detection *Reading Reflection 4: 10/4*
10/2		Hot Spot Analysis		
Week 7				
10/7		Midterm Exam	Harris et al. (2017); Aljoufie et al. (2013)	No Labs
10/9		Space-time analysis I		
Module 3. Environmental application of GIScience. Use case: Landslides susceptibility & vineyard suitability				

		Topic	Readings and Assignments	Deliverables/Due Dates
Week 8				
	10/14	Space-time analysis II	Burrough et al. (2015) Ch.10 up to Sec. 10., Sec. 10.7 & Ch 11	*Discussion 2 due: 10/15* *Lab 6*: Space-time analysis *Reading Reflection 5: 10/18*
	10/16	Grid operation I: Digital terrain analysis and focal operations		
Week 9				
	10/21	Grid operation II: More on surface and field analysis	**Discussion 3** Burrough et al. (2015) Sec. 10.6, Sec. 10.8-10.11 de Smith et al. (2020) Sec. 4.2	No Labs *Reading Reflection 6: 10/25*
	10/23	Polygon operations and map overlay I		
Week 10				
	10/28	Map overlay II: suitability analysis and weighted overlay	Burrough et al. (2015) Ch. 7, Ch. 13; O'Sullivan & Unwin (2010) Sec. 11.2-11.4	*Discussion 3 due: Tuesday, 10/29* *Lab 7*: Surface analysis and site suitability *Reading Reflection 7: 11/1*
	10/30	Map overlay III: fuzzy overlay		
Module 4. Remote sensing & spatial interpolation techniques. Use case: Climate variability				
Week 11				
	11/4	Earth observation & remote sensing	**Discussion 4** Kim (2016)	*Lab 8:* Remote sensing application for GIS *Reading Reflection 8: 11/8*
	11/6	GIScience applications		
Week 12				
	11/11*	*University Holiday-No Class	Burrough et al. (2015) Ch.8, Ch. 9	*Discussion 4 due: 11/12* *Lab 9*: Spatial interpolation *Reading Reflection 9: 11/15*
	11/13	Spatial interpolation I		
Week 13				
	11/18 (Mon)	Spatial interpolation II	Shi et al. (2012)	*Lab 10*: 2SFCA *Reading Reflection 10: 11/22*
	11/20 (Wed)	Spatial health accessibility: Two-step floating catchment area (2SFCA)		
Week 14				
	11/25 (Mon)	Network analysis and OD matrix	**Discussion 5** de Smith et al. (2020) Sec.	*Reading Reflection 11 (Bonus):*

	Topic	Readings and Assignments	Deliverables/Due Dates
11/27 (Wed)*	*Thanksgiving Holiday-No Class	4.4.1-4.4.4; Webster et al. (2016)	*11/29*
Week 15			
12/2 (Mon)	Spatial network and locational analysis	Li et al. (2020)	*Discussion 5 due: 12/6*
12/4 (Wed)	Spatiotemporal big data analytics and visualization		
Final Exam	Friday, December 13 @ 11:00am – 1:00pm PT		

Statement on Academic Conduct and Support Systems

Academic Integrity

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

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*

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

988 Suicide and Crisis Lifeline - *988 for both calls and text messages – 24/7 on call*

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - *(213) 740-9355(WELL) – 24/7 on call*

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - *(213) 740-5086*

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*

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 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) 740-0411*

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*

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*

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) 442-1200 – 24/7 on call*

Non-emergency assistance or information.

Office of the Ombuds - *(213) 821-9556 (UPC) / (323-442-0382 (HSC)*

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) 442-2850 or* otfp@med.usc.edu

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 SSI Student Hub on D2L 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.