

SSCI 583, Spatial Analysis

Syllabus

Units: 4

Term — Day — Time: Summer 2020, Online

Location: Online

Instructor: Jennifer Bernstein, PhD

Office: Remote from Colorado

Office Hours: Tuesday 11:00 to 12:00 p.m. PT and Wednesday 01:00 to 02:00 p.m. PT via Bluejeans.

Please contact the Instructor via email in advance to ensure they will be online. Instructors are also available most days and times by appointment.

Contact Info: bernstjm@usc.edu

<https://bluejeans.com/u/bernstjm>

Library Help: Andy Rutkowski

Office: VKC 36B

Office Hours: Tuesday 10:00 a.m. to 12:00 p.m. PT and Thursday 4:30 p.m. to 5:30 p.m. 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: ctsung@usc.edu, 213-821-4415

Course Scope and Purpose

Spatial analysis is key to the successful application of GIS to today's pressing environmental and social challenges. While digital mapping technologies such as Google Maps are widely used, 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 students become informed spatial analysts 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 and the R/RStudio 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, including 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 and R.
- 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.
- Critically assess the results of spatial analyses.

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

Co-Requisite(s): None

Technological and Communication Requirements

Every student must have the following technology requirements:

- A computer with a fast Internet connection.
- A functional webcam and a microphone.
- At least one up-to-date web browser.

Blackboard – A course Blackboard site is available to provide guidance as to the required administrative processes and manuscript format. Links to necessary timetables, procedures, and forms will be found here, as well as discussion boards through which students can share ideas with other thesis students. During the first week of the semester, each student should confirm that they can access the Blackboard site. All communications that are sent through it should be read promptly.

SSI server and tech support – Students in this course will utilize the Spatial Sciences Institute Server for independent thesis work as needed. If a student is unable to connect to the server or experiences technical issues, an email should be sent to SSI Tech Support at spatial_support@usc.edu and the instructor should be copied (cc). The email sent to SSI Support should be specific with respect to the problem being experienced.

BlueJeans – BlueJeans is a browser-based service that facilitates synchronous, interactive sessions with voice/video and shared desktop capabilities between two or more people. This is the primary forum for individual meetings and presentations. To use BlueJeans, each student needs a web cam on a computer with a fast internet connection. It is useful also to have a phone (mobile or landline) on hand in case there are issues with the web cam audio.

Communications – This is a distance learning course, so many interactions will be asynchronous (not at the same time). All materials to be handed in will be submitted via Blackboard or via email. Students should check to make sure that mail sent from both the USC Blackboard accounts and directly the instructors usc.edu account does not go into junk mail. Students should read as soon as possible all email sent from Blackboard or from the instructor.

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:

- Brunsdon, C. and L. Comber. 2019. *An Introduction to R for Spatial Analysis and Mapping*. London: Sage.
- Lloyd, C. 2010. *Spatial Data Analysis: An Introduction for GIS Users*, 2nd edition. Oxford University Press.

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

- 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 print and (free) online at www.spatialanalysisonline.com.
- Greene, R., R. Devillers, J.E. Luther, and B.G. Eddy. 2011. GIS-based multiple-criteria decision analysis. *Geography Compass*, 5(6), pp.412-432.
- Luo, W. and Y. Qi. 2009. An enhanced two-step floating catchment area (E2SFCA) method for measuring spatial accessibility to primary care physicians. *Health & Place*, 15(4), pp.1100-1107.
- Mitchell, A. 1999. *The Esri Guide to GIS Analysis. Volume 1: Geographic Patterns and Relationships*. Redlands, CA: Esri Press.
- Openshaw, S. and P.J. Taylor. 1979. A million or so correlation coefficients, three experiments on the modifiable areal unit problem. In *Statistical Applications in the Spatial Sciences*, pp.127-144. London: Pion.
- O'Sullivan, D. and D.J. Unwin. 2010. *Geographic Information Analysis*, 2nd edition. New York, NY: John Wiley & Sons. (Available online through 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 to are summarized in the following Grading Breakdown section.

Resume Assignment - 1 worth 2 points. We require all current students to post and maintain a public resume, short biography and recent photo on our shared SSI Student Community Blackboard site. Please prepare your resume in the SSI template 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.

Projects - 5 worth a total of 39 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 Esri and R tutorials, for becoming familiar with ways that concepts learned in course are implemented in various GIS software packages, but the deliverables will be final written summaries of the students' goals, methods, data, and results for each project.

Reading and Research Discussions - 10 worth a total of 30 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. For each assignment, students will be assigned either to identify a case study in the relevant literature, analyze it, and lead a critical discussion on it with their classmates OR to critically read the identified case study and discuss it in class. Thus, even when students are not presenting, their active participation in the class discussion is required for full credit.

Wiki Contributions - Ongoing contributions worth a total of 7 points. The class will collectively build out a course Wiki for sharing important concepts and definitions as well as answers to R programming exercises. Full credit will be awarded for all students who meaningfully contribute throughout the semester. Partial credit will be awarded as appropriate.

Module Quizzes - 4 worth a total of 12 points. The module quizzes will cover material learned in the first four modules of the course. They will take place during lecture periods as indicated on the syllabus. They may be mixed format and may consist of multiple choice, short answer, and simple problem questions. Students are expected to take the quizzes at the indicated times.

Final Exam - 1 worth 10 points. The final exam will cover material learned throughout the duration of the semester. It may be mixed format and may consist of multiple choice, short answer, and simple problem questions. Students are expected to take the exam at the indicated time.

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	2	2
Reading and Research Discussions	10	3	30
Wiki	1	7	7
Projects 1, 4, 5	3	7	21
Project 2, 3	2	9	18
Module Quizzes	4	3	12
Final Exam	1	10	10
Total	22	-	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

Week	Topic	Assignments	Deliverables: Due Dates
Module 1 Spatial Analysis Foundations			
Week 1 5/20	Introduction to Course and to Spatial Analysis	Resume Assignment Reading & Research Discussion (RRD) 1 - Choice of case study	RRD1 - Choice of case study: 5/26

Week	Topic	Assignments	Deliverables: Due Dates
Week 2 5/26* *Monday, 5/25 is university holiday	Overlay and Multiple- Criteria Decision Analysis	RRD1 - Discussion RRD2 - Choice of case study Wiki contribution Project 1 is assigned	RRD1 - Discussion: Original Post Due 5/26 RRD1 – Discussion: Response to classmates due 5/28 Resume Assignment: 5/28 RRD2 – Written response: 5/29
Week 3 6/1	Spatial Data and the Modifiable Areal Unit Problem	RRD2 - Discussion Wiki contribution	RRD2 – Original discussion post: 6/2 RRD2 – Discussion: Response to classmates due 6/4 Module 1 Quiz: 6/4
Module 2 Distance-Based Analysis and Accessibility			
Week 4 6/8	Network and Least- Cost Path Analysis	RRD3 - Choice of case study Wiki contribution RRD3 - Discussion	RRD3 - Choice of case study: 6/13 Project 1: 6/11
Week 5 6/15	Accessibility	RRD4 - Choice of case study Wiki contribution Project 2 is assigned	RRD3 - Discussion: 6/16 RRD4 - Choice of case study: 6/18
Week 6 6/22	Accessibility cont.	RRD4 - Discussion Wiki contribution	RRD4 - Discussion: 6/25 Module 2 Quiz: 6/26
Module 3 Spatial Patterns in Data			
Week 7 6/29* *Friday, 7/3 is university holiday	Clustering and Hot Spots	RRD5 - Choice of case study Wiki contribution	RRD5 - Choice of case study: 6/30 RRD5 - Discussion: 7/2
7/6	Autocorrelation	RRD5 - Discussion RRD6 - Choice of case study Wiki contribution	RRD6 - Choice of case study: 7/7 Project 2: 7/9
Week 8 7/13	Geographically Weighted Regression	RRD6 - Discussion RRD7 - Choice of case study Wiki contribution Project 3 is assigned	RRD6 - Discussion: 7/14 RRD7 - Choice of case study: 7/14

Week	Topic	Assignments	Deliverables: Due Dates
Week 9 7/20	Geographically Weighted Regression cont.	RRD7 - Discussion Wiki contribution	RRD7 - Discussion: 7/21 Module 3 Quiz: 7/23 Project 3: 7/24
Module 4 Analysis of Fields			
Week 10 7/27	Interpolation	RRD8 - Choice of case study Wiki contribution Project 4 is assigned	RRD8 - Choice of case study: 7/28
Week 11 8/3	Analysis of Grids and Surfaces	RRD8 – Discussion Wiki contribution RRD9 - Choice of case study Wiki contribution Project 5 is assigned	RRD8 – Discussion: 8/4 RRD9 - Discussion: 8/6 Project 4: 8/7
Module 5 Spatial Modeling and The Future of Spatial Analysis			
Week 13 8/10	Introduction to Spatial Models Maximum Entropy Models; 3D and Other New Developments in Spatial Analysis	RRD9 – Discussion Wiki contribution RRD – 10 Choice of Case Study and Discussion Wiki contribution	RRD10 - Choice of case study: 8/11 RRD10 - Discussion: 8/13 Project 5: 8/14

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, policy.usc.edu/scientific-misconduct.

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 of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298

equity.usc.edu, titleix.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 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 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 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

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.