SSCI 683: Principles of Spatial Data Analysis

Units: 4

Term—Day—Time: Spring 2021, Thursdays 11 a.m. – 1:50 p.m.

Location: Online (See the Blackboard course site for the zoom link)

Instructor: An-Min Wu, Ph.D.
Office: AHF B55B
Office Hours: Tuesdays 11:30 a.m.–12:30 p.m. and Thursdays 3-4 p.m. Pacific Time via zoom – please contact me via email in advance to ensure I will be online. Also available most days between 9 a.m. – 6 p.m. by appointment via email.
Contact Info: anminwu@usc.edu

Library Help: Andrzej (Andy) Rutkowski
Office: VKC Library 36B
Office Hours: By appointment
Contact Info: arutkows@usc.edu

IT Help: Richard Tsung
Office: AHF B57E
Office Hours: By appointment
Contact Info: ctsung@usc.edu
Course Description
This course explores theoretical foundations, methods, techniques, and software systems for spatial data analysis. The course aims to provide students with the fundamental knowledge and hands-on skills necessary to investigate research questions, with a focus on population and health problems, using spatial analysis approaches. Including fundamental spatial concepts and the core components of geospatial data analysis techniques, this course intends to explore a broad range of principle spatial data analysis methods, from exploratory spatial data analysis and surface analysis, remote sensing to spatial statistics to network and locational analysis. The latest research in a variety of topics related to population, health, and place that are central to spatial analysis are also examined. Students will gain an in-depth understanding and hands-on experience in the ways to explore a variety of applications through a combination of homework, presentations and projects. Students will learn about the wide variety of geospatial data and analytical tools available, including how to find relevant data and transform it as needed so that it can be used for solving specific socio-economic challenges and problems.

This course will be offered in a hybrid format. Lectures will be offered in person and streamed for remote access.

Learning Objectives
On completion of this course, students will be able to:

- Describe key theoretical concepts of spatial analysis approaches.
- Evaluate spatial analysis approaches and techniques for working on research that investigate places and their roles in shaping environmental exposures, health-related impacts and outcomes, and the efficacy of health care delivery systems.
- Analyze spatial problems by applying appropriate and relevant spatial analysis techniques.

Prerequisite(s): None.
Co-Requisite(s): Students must be enrolled in an existing USC PhD program
Concurrent Enrollment: None
Recommended Preparation: Some experience in GIS software or GIS coursework (e.g. SSCI 581) is strongly recommended; contact the instructor if you have no prior experience in GIS.

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)

Course Structure

The course will be delivered with multiple methods including lectures, class discussion, presentations and hands-on practice. During the first half of each class session, the instructor will present the core topics and students will give presentations on the selective subtopics. The remaining time in the class will be group discussions on the readings or hands-on practices related to the lecture topics covered. Student participation is encouraged through reading discussions, hands-on practices, homework assignments, and class presentations.

Throughout the semester, hands-on practice and homework assignments provide students first-hand experience in spatial analysis using the software R and ArcGIS Pro, and reading assignments help students evaluate and integrate the information acquired from the weekly readings. Students will design and conduct final projects to learn more in-depth spatial analysis approaches in a specific topic of research interest and demonstrate their ability to apply appropriate spatial analysis methods in resolving problems related to population, health and place.

Technological Requirements

The course will be focused on using R and ArcGIS Pro. Students can access the software for course assignments using computing resources provided by the Spatial Sciences Institute. Students will be given login credentials and instructions to sign-in to the remote Spatial Sciences Institute Server for the required software.

Required Readings and Supplementary Materials

The required textbooks for this course are:


Supplementary readings will be assigned from various sources and will be accessed via the USC Library's electronic collections and/or provided by the instructor via Blackboard, including:


• Nilsson, Pia. 2014. “Natural amenities in urban space – A geographically weighted regression approach.” Landscape and Urban Planning 121: 45-54.


**Description and Assessment of Assignments**

There are several different types of assignments due nearly each week in our course that make up a significant part of your final grade. These different types of assignments are described below.

*In-Class Engagement - 12 worth a total of 12%.* An in-class engagement grade for the semester will be assigned based upon student engagement in the class sessions. The activities of in-class engagement can be, but not limited to, one-minute writing, quiz, group discussion, or hands-on practice. Failure to participate in in-class engagement activities will receive no grade for that week.

*Reading Assignments – 6 worth a total of 12%.* These will focus on the theory portion of the course as presented in the weekly readings. The objective is to help you evaluate and integrate the information you have acquired from the course readings. You are strongly recommended to read all material outlined for each week before the class session, but are free to choose to submit any six of the 13 subsequent assignments. You must
complete and submit them for grading in the weeks specified in the Course Schedule at the end of this syllabus.

**Homework Assignments -- 3, worth a total of 24%**: Students will be assigned a total of 4 homework assignments in this course. These hands-on assignments are to practice spatial analysis techniques explored in theory in the texts. You will analyze the data of your own choice using ArcGIS and/or R scripts, and write a short report to answer the questions in each assignment.

**Class Lead Discussion - 1 worth a total of 12%**: Students will conduct a 30-minute class presentation based on the specific subtopic areas of the chosen week determined in consultation with the instructor. Students will be expected to present the selected subtopic contents focused with both concepts and applications.

**Final Project**

To integrate your learning of all the material covered in the course, in the final project, you will design, undertake, and report on a spatial analysis research project that will be the context of the assignments throughout the semester. Students can conduct either an independent or 2-person team projects. The four components of the project will be due at different times throughout the semester. The grading rubric for each project component will be provided at the time the assignment is released. The four final project components include:

*Project Idea Presentation - 5%. An in-class presentation for your final project idea, including the spatial questions you would like to investigate, how you plan to solve them, the data to be used for analysis, and expected outcomes.*

*Proposal - 10%. A proposal document developed from the project idea presentation and the feedback received.*

*Final Presentation - 10%. A final presentation during the final week of the class session.*

*Report - 15%. A written report in the format of a research paper on your final project methodology and outcomes.*

**Grading Breakdown**

<table>
<thead>
<tr>
<th>Assessments</th>
<th>Number</th>
<th>% Each</th>
<th>Total % of Grade</th>
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</thead>
<tbody>
<tr>
<td>In-Class Engagement</td>
<td></td>
<td>12</td>
<td>12</td>
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<tr>
<td>Reading Assignments</td>
<td>6</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Homework Assignments</td>
<td>3</td>
<td>8</td>
<td>24</td>
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<tr>
<td>Class Lead Discussion</td>
<td>1</td>
<td>12</td>
<td>12</td>
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**Project Components**

<table>
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<tr>
<th>Assessments</th>
<th>Number</th>
<th>% Each</th>
<th>Total % of Grade</th>
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<tbody>
<tr>
<td>Idea Presentation &amp; Discussion</td>
<td>1</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Project Proposal</td>
<td>1</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Final Presentation</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Project Report</td>
<td>1</td>
<td>15</td>
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<td>Total</td>
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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.

Students are expected to attend and participate in every class session and to complete and upload all assignments before the deadlines detailed in the Course Schedule. Late work will be assessed a penalty of 10% per day and zero grades will be assigned for work that is more than one week late.

Course Schedule: A Weekly Breakdown

<table>
<thead>
<tr>
<th>Week</th>
<th>1/21</th>
<th>1/28</th>
<th>2/4</th>
<th>2/11</th>
<th>2/18</th>
<th>2/25</th>
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<tr>
<td><strong>Week 2</strong></td>
<td><strong>Geospatial Data Analysis Potentials and Problems</strong></td>
<td><strong>Reading Assignment 1</strong>: due by 12 pm, Wednesday 2/3</td>
<td><strong>Spatial Autocorrelation</strong>&lt;br&gt;O’Sullivan &amp; Unwin (2010) Ch. 7 &amp; 8&lt;br&gt;Martins-Melo et al. (2012)&lt;br&gt;Vaz et al. (2015)&lt;br&gt;Harris et al. (2017)&lt;br&gt;Dogru et al. (2017)</td>
<td><strong>Reading Assignment 2</strong>: due by 12 pm, Wednesday 2/10</td>
<td><strong>Module 2: Exploratory Spatial Data Analysis</strong></td>
<td><strong>Reading Assignment 3</strong>: due by 12 pm, Wednesday, 2/17&lt;br&gt;Homework Assignment 1: due Friday, 2/19</td>
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<td><strong>Week 3</strong></td>
<td><strong>Maps for Spatial Analysis and Processes</strong></td>
<td><strong>Homework Assignment 1</strong>: due Friday, 2/19</td>
<td><strong>Homework Assignment 2</strong>: due by 12 pm, Wednesday, 2/24&lt;br&gt;<strong>Project Idea Presentation/Discussion</strong></td>
<td><strong>Homework Assignment 2</strong>: due by 12 pm, Wednesday, 2/17&lt;br&gt;Homework Assignment 1: due Friday, 2/19</td>
<td><strong>Module 3: Regression-based modeling</strong></td>
<td><strong>Reading Assignment 4</strong>: due by 12 pm, Wednesday, 2/24&lt;br&gt;<strong>Project Idea Presentation/Discussion</strong></td>
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**Module 4: Spatial Interpolations**


**Module 5: Network and Spatial Accessibility**


**Module 6: Grid-Based Analysis**


No class on the week of 4/19-4/23*
*4/22 is a university Wellness Day

| Week 14 4/29* 4/29 is last day of class | Final Presentations | Final presentation during the class session |
| Final Exam | TBD – Final report due |
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**
Counseling and Mental Health– (213) 740-9355 – 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
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 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**
[uscsa.usc.edu](http://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](http://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](http://dps.usc.edu), [emergency.usc.edu](http://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.