SSCI 683: Principles of Spatial Data Analysis

Units: 4

Term—Day—Time: Spring 2019, Thursdays, 2-4:50 pm

Location: Spatial Sciences Institute, AHF 145D

Instructor: An-Min Wu, Ph.D.
Office: AHF B55B
Office Hours: Tuesdays, 3 – 4 p.m. and Thursdays, 12 – 1 p.m. Also available most days and times by appointment via email.
Contact Info: anminwu@usc.edu, 213-740-2876 (office)

Library Help: Andrzej (Andy) Rutkowski
Office: VKC Library 36B
Office Hours: Tuesdays 10am – 12 noon & Thursdays 4:30 pm – 5:30 pm
Contact Info: arutkows@usc.edu, 213-740-6390 (office), http://bit.ly/andyhangout

IT Help: Richard Tsung
Office: AHF B57E
Office Hours: By appointment
Contact Info: ctsung@usc.edu, 213-821-4415 (office)
Course Description
This course explores the theoretical foundations, methods, techniques, and software systems for spatial data analysis. The course aims to provide students with the knowledge and skills necessary to investigate research questions, with a focus on spatial health problems, using spatial analysis methods. Essential concepts of quantitative geographic information are presented, including the fundamental spatial concepts, the core components of geospatial analysis techniques, exploratory spatial data analysis and spatial statistics, surface analysis, and 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 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 health-related challenges and problems.

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

- Describe key theoretical concepts of spatial analysis approaches.
- Identify spatial and non-spatial data required to investigate the place and its role in shaping environmental exposures, health-related impacts and outcomes, and the efficacy of health care delivery systems.
- Evaluate spatial analysis approaches and techniques for working with health-related geospatial data.
- Apply appropriate and relevant spatial analysis techniques to solve spatial health problems.

Prerequisite(s): Some experience in any GIS software is recommended but not required
Co-Requisite(s): Students must be enrolled in an existing USC PhD program
Concurrent Enrollment: None
Recommended Preparation: None

Course Structure
The course will be delivered using both lectures, class discussion and hands-on practice formats. During the first half of each class session, the instructor will present the core topics and selected students will give presentations on some of the 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, homework assignments will give students first-hand experience in spatial analysis and weekly written briefings will ensure students keep up with the
related readings. Students will design and conduct individual final projects to learn more in-depth spatial analysis approaches in a specific topic of research interest and demonstrate their ability to apply spatial analysis tools in resolving spatial health problems.

Technological Requirements

The analysis software and geospatial data required for course assignments will be accessed using computing resources provided by the Spatial Sciences Institute. Students are encouraged to sign-in Spatial Sciences Institute server remotely for the required software. The course will be focused on using ArcGIS and R.

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:


**Description and Assessment of Assignments**

Students must prepare two small lecture-style presentations, participate in class discussion, submit weekly briefings, and turn in homework assignments, including:

**Weekly Briefings** (12, worth a total of 12%): Each week students select one or more of the assigned readings and share a commentary with other students in the online Discussion Forum before the class session. Students are exempt from writing the weekly briefings on the (2) weeks they have scheduled class presentations.

**Class Participation** (15, worth a total of 15%): A class participation grade for the semester will be assigned based upon how actively students engage in the class sessions. Students will be required to read all material outlined for each week of the course, and be prepared to participate in group discussions about the readings or to work on hands-on practices in class, depending on the class week (see Weekly Schedule below). Failure to attend or to be adequately prepared for discussion or hands-on practices will lead to the assignment of a lower grade for that week.

**Homework Assignments** (6, worth a total of 24%): Students will be assigned a total of 6 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 Presentations** (2, worth a total of 20%): Students will conduct two presentations based on topics determined in consultation with the instructor. Students will work alone and will be expected to become an expert on that topic and present a short lecture of 30-40 minutes on the topic.
Final Project

Each student will design, conduct and report on a research project related to spatial analysis topics covered in class. The students will propose their own project ideas and determine the topics to be included after consultation with the instructor. The project might take one of two forms: (1) You may have a specific problem in mind and some data you want to analyze; or (2) You may be interested in exploring a spatial analysis method more deeply. The three components of the project will be due at different times during the semester. The grading rubric for each project component will be provided at the time the assignment is released. The three final project components include:

Proposal (4%): A brief description of the spatial questions and/or spatial analysis method you would like to investigate, how you plan to solve them and the data to be used for analysis. Proposal Meeting worth 1%; Proposal Documentation worth 3%.

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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<tbody>
<tr>
<td>Class Participation</td>
<td>15</td>
<td>1</td>
<td>15</td>
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<tr>
<td>Weekly Briefings</td>
<td>12</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Homework Assignments</td>
<td>6</td>
<td>4</td>
<td>24</td>
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<tr>
<td>Class Presentations</td>
<td>2</td>
<td>10</td>
<td>20</td>
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<tr>
<td>Final Project Proposal</td>
<td>1</td>
<td>4</td>
<td>4</td>
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<tr>
<td>Final Project Presentation</td>
<td>1</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Final Project Report</td>
<td>1</td>
<td>15</td>
<td>15</td>
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<tr>
<td>Total</td>
<td>38</td>
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<td>100</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.

Additional Policies

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>DATES</th>
<th>Topics/Daily Activities</th>
<th>Readings and Assignments</th>
<th>Deliverables/Dues</th>
</tr>
</thead>
</table>
| Week 1 | 1/7  | Introduction to Course | De Smith et al. (2018) Ch. 1  
O’Sullivan & Unwin (2010) Ch.1  
Rezaeian et al. (2007) | No deliverables |
| Week 2 | 1/14 | Introduction to Geospatial Analysis | O’Sullivan & Unwin (2010) Ch.2  
Bolstad (2016) Ch.3  
Beyer et al. (2012)  
Roots (2012) | Sign-up for class presentations  
Weekly Briefing: Wednesday, 1/16 |
Spielman and Logan (2013)  
Kwan (2012)  
Mobley et al. (2012)  
**Homework Assignment #1** | Weekly Briefing: Wednesday, 1/23  
Sign-up for final project discussion meetings |
| Week 4 | 1/28 | Maps for Spatial Analysis and Processes | O’Sullivan & Unwin (2010) Ch.3 & 4  
Perchoux et al. (2016)  
Bell et al. (2006)  
**Homework Assignment #2** | Weekly Briefing: Wednesday, 1/30  
Homework Assignment #1 |
| Week 5 | 2/4  | Exploratory Spatial Data Analysis | De Smith et al. (2018). Ch. 5-§5.2  
Spencer and Angeles (2007)  
Wu et al. (2004)  
**Homework Assignment #3** | Weekly Briefing: Wednesday, 2/6  
Homework Assignment #2  
Final project proposal discussion meetings |
| Week 6 | 2/11 | Spatial Point Pattern Analysis | De Smith et al. (2015). §5.3.3 & 5.4  
O’Sullivan & Unwin (2010) Ch. 5-6  
Gatrell et al. (1996)  
Nkoko et al. (2011)  
Homework Assignment #3 |
| Week 7 | 2/19* | Spatial Autocorrelation | De Smith et al. (2018), §5.5  
O’Sullivan & Unwin (2010) Ch. 7- §8.4  
Anselin (1995)  
Wu et al. (2011)  
Martins-Melo et al. (2012)  
**Homework Assignment #4** | Weekly Briefing: Wednesday, 2/20  
Final Project Proposal due Monday 2/25 |
| Week 8 | 2/25 | Spatial Regression | De Smith et al. (2018), §5.6  
Matthew and Yang (2012)  
Homework Assignment #4 |
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<tbody>
<tr>
<td>3/10-3/19</td>
<td></td>
<td>Spring Recess</td>
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<tr>
<td>4/1*</td>
<td>*AAG week</td>
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<tr>
<td>4/22*</td>
<td>*Friday, 4/26 is the last day of class</td>
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<tr>
<td>FINAL</td>
<td>5/1- 5/8</td>
<td>Final Presentation &amp; final discussion</td>
<td></td>
<td>Final presentation slides due on the DAY of presentation Final presentation date/time based on USC final exam schedule</td>
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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) 740-4900 – 24/7 on call engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086 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.

Bias Assessment Response and Support – (213) 740-2421 studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation 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.

Student Support and Advocacy – (213) 821-4710
studentaffairs.usc.edu/ssa
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.