GEOG 4/594: Spatial Analysis

Fall 2020

Instructor Dr. Hui (Henry) Luan
hluan@uoregon.edu
Office hours: Fridays, 2pm-4pm

Lecture Tuesdays & Thursdays, 2:15pm–3:45pm

Labs Wednesdays, 1pm-3pm

GE Insang Song
isong@uoregon.edu
Office hours: Fridays, 10am-12pm

Course Description

In the past decades, spatially referenced data has been increasingly available due to the continuing advances of geospatial technologies. To effectively extract meaningful information and knowledge from these spatial datasets, spatial statistical approaches are usually required. This course will introduce the theory, methods, and tools used to conduct spatial analysis and understand geographical phenomena. Topics covered in this course include descriptive spatial analysis, probability theory, spatial sampling, inferential spatial analysis, spatial interpolation, spatial correlation, and spatial regression. Common issues in spatial analysis will also be introduced, such as the Modifiable Areal Unit Problem (MAUP) and the Uncertain Geographic Context Problem (UGCoP). Lectures focus on the geographic theory and associated (mathematical) equations behind each method, and assignments provide an opportunity for students to implement a variety of methods to address questions that are geographic in nature. Students who successfully complete this course will not only have more analytical tools at their disposal, but will also become versed in spatial analysis discourse, which will allow them to interrogate scientific research employing a range of spatial analytical approaches.

Learning objectives

After completing this course, the students are expected to:

- Evaluate and determine appropriate spatial analysis methods needed for specific geographical questions;
- Analyze geographic data to characterize spatial patterns of observations and spatial relationships between variables;

- Demonstrate familiarity with the concepts and terminology of spatial analysis to understand current scientific research in spatial analysis;
- Demonstrate proficiency in using a variety of software and tools to conduct spatial analysis;
- Be able to implement a suitable spatial analytical workflow for providing answers to geographical questions;
- Effectively communicate analysis results in the forms of academic writing and presentations.

Textbooks

1. McGrew J.C., Lembo A.J., and Monroe C.B. *An Introduction to Statistical Problem Solving in Geography*. Waveland Press, 3rd Edition, 2014.
2. Fotheringham A.S. and Rogerson P.A (Eds). *The SAGE Handbook of Spatial Analysis*. London: Sage. 2009. (Freely accessible from UO library)
3. de Smith M.J., Goodchild M.F., and Longley P.A. *Geospatial Analysis: A Comprehensive Guide to Principles Techniques and Software Tools*. Winchelsea Press, 6th Edition, 2018. (Free online: http://www.spatialanalysisonline.com/HTML/index.html)

Course outline

Week 1	
Sep 29	**Course Introduction**
Oct 1	**Geographic Data for Spatial Analysis**
Reading	1. McGrew et al. (2014), Chapter 2: Geographic Data: Characteristics and Preparation, in *An Introduction to Statistical Problem Solving* in Geography 2. Haining (2009) The Special Nature of Spatial Data, in *The SAGE Handbook of Spatial Analysis*
Week 2	
Oct 6	**Descriptive (Spatial) Statistics**
Oct 8	**Basics of Probability**
Reading	1. McGrew et al. (2014), Chapter 4: Descriptive Spatial Statistics, in *An Introduction to Statistical Problem Solving in Geography*. 2. Seeing theory: A visual introduction to probability and statistics: https://seeing-theory.brown.edu/index.html#secondPage. Chapter 1: The Basic Probability and Chapter 3: Probability Distributions
Week 3	
Oct 13	**Basics of Probability (cont'd)**
Oct 15	**Spatial Sampling**
Reading	Delmelle (2009), Spatial Sampling, in *The SAGE Handbook of Spatial Analysis*

Week 4	
Oct 20	**Point Pattern Analysis**
Oct 22	**Defining neighbors**
Reading	1. de Smith et al. (2018) 5.4.2 Nearest neighbor methods & 5.4.4 Hot spot and cluster analysis, in *Geospatial Analysis: A Comprehensive Guide to Principles Techniques and Software Tools*
Week 5	
Oct 27	**Area Pattern Analysis I: Global Spatial Autocorrelation**
Oct 29	**Area Pattern Analysis II: Local Indicators of Spatial Association (LISA)**
Reading	1. de Smith et al. (2018) 5.5 Spatial Autocorrelation, in *Geospatial Analysis: A Comprehensive Guide to Principles Techniques and Software Tools*
Week 6	
Nov 3	**Midterm exam**
Nov 5	**Spatial Interpolation I: IDW**
Reading	1. de Smith et al. (2018) 6.6.1 Inverse Distance Weighting (IDW), in *Geospatial Analysis: A Comprehensive Guide to Principles Techniques and Software Tools*
Week 7	
Nov 10	**Spatial Interpolation II: Kriging**
Nov 12	**Correlation and regression**
Reading	1. de Smith et al. (2018) 6.7 Geostatistical Interpolation Methods, in *Geospatial Analysis: A Comprehensive Guide to Principles Techniques and Software Tools*
Week 8	
Nov 17	**Spatial regression I: Spatial Lag and Spatial Error Regression**
Nov 19	**Spatial regression II: Geographically Weighted Regression**
Reading	1. Anselin (2009) Chapter 14: Spatial Regression, in *The SAGE Handbook of Spatial Analysis* 2. Fortheringham (2009) Chapter 13: Geographically Weighted Regression, in *The SAGE Handbook of Spatial Analysis*
Week 9	
Nov 24	**Common issues in spatial analysis**
Nov 26	**No class: Thanksgiving vacation**
Reading	1. Wong, D. W. S. (2009). The Modifiable Areal Unit Problem (MAUP). In *The SAGE Handbook of Spatial Analysis* (pp. 105–123). London: Sage.

		2. Kwan, M.-P. (2012). The Uncertain Geographic Context Problem. *Annals of the Association of American Geographers*, *102*(5), 958–968.
Week 10		
	Dec 1	**Group project presentation**
	Dec 3	**Group project presentation (cont'd)**

Assignments	**Available on Canvas**	**Due date**
#1: Probability and sampling estimations	**Oct 7**	**Oct 21**
#2: Crime event patterns in San Francisco	**Oct 21**	**Oct 28**
#3: Crime clustering in San Francisco at the Census Block Group level	**Oct 28**	**Nov 4**
#4: Air quality interpolation in California	**Nov 11**	**Nov 18**
#5: The association between crime rates and socioeconomic environments in Cincinnati at the Census Block level	**Nov 18**	**Nov 25**

Group project

Requirements	**Submission/Output**
▪ 4-5 students per group (group on your own or randomly assigned by the GE) Identify and analyze a spatial dataset using at least two spatial techniques covered in the course	▪ 15 mins presentation ▪ 5-page report (Times New Roman, 12pt, double-space) **(due Dec 7, midnight)**

Note: Graduate students will have to complete the project by themselves. Other requirements are the same.

Grading

Assignments	**50% (10%*5)**
Midterm exam	**15%**
Final exam	**15%**
Project	**20% (Report 10% + Presentation 10%)**
Total	**100%**

Notes:

- Late assignments will receive a deduction of 5% per day including weekends and holidays. Assignments submitted 7 days later than the deadline will NOT be accepted. The only exception is when you can provide a university-approved excuse.
- All times are based on Pacific Standard Time (PST).
- Grades for the course will be based on the following grading scale.

A+ 97-100	B+ 85-89.9	C+ 70-74.9	D 55-59.9
A 92-96.9	B 80-84.9	C 65-69.9	F less than 55
A- 90-91.9	B- 75-79.9	C- 60-64.9	

Academic Integrity Code

All students are expected to complete assignments in a manner consistent with academic integrity. Students must produce their own work and properly acknowledge and document all sources (ideas, quotations, paraphrases). Students can find more complete information about the University of Oregon's Policy on Academic Dishonesty in the University of Oregon Student Handbook. **If you are found to have plagiarized (copied) off a classmate or from other materials for a test or an assignment of any sort, your first warning will be a zero on the assignment. Your second incident will result in an F in the course.**

Accessibility Statement

The University of Oregon is working to create inclusive learning environments. Please notify me at the beginning of the term if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

The professor of this course reserves the right to change aspects of this syllabus any time during the term. Students will be informed if and when this occurs.