GEOG651 Syllabus
Spatial Statistics

Course Details:
Session: Winter 2024
Format: In-person and remote
Classroom: LEF 2166
Lecture and Lab Times: Wed/Thu 5:30 pm – 8:00 pm

Instructor: Xin Tao (xtao@umd.edu)
Office: LEF 1167
Office hours: By appointment
Teaching assistant: Yingrui Zhao (yzhao120@umd.edu)
Office: 4600 River Road
Office hours: By appointment

Course Objectives:
This course is about quantitative analysis of spatial data. It aims to provide a broad survey of various spatial statistic methods useful in environmental and social sciences. It covers several broad topics: (1) point pattern analysis; (2) area data analysis; (3) continuous data analysis; (4) spatial sampling; and (5) multivariate spatial and temporal analysis. The course is a mix of theories, methods, and applications geared towards helping students to: (1) develop an understanding of the important theoretical concepts in spatial statistical analysis; and (2) gain practical experience in applying spatial statistics to a variety of social and environmental problems using advanced statistical software.

The format of this course will consist of lectures, lab assignments, readings, and a final project. The lectures will be presented online via the Live Classroom on the Zoom. All lectures involve the interaction between students and the instructor in real time. Lectures will be archived into videos that will be made available. Please note that video recordings are intended for occasional or backup use in case students have to miss lectures due to personal, business, or medical reasons. Real time, online participation is strongly recommended. The readings and lab assignments will also be posted in a timely manner.

Learning Outcomes
The specific objectives of this course are that students are expected to learn the following:

- Understand concepts of random process and heterogeneous spatial process
- Understand the concept of spatial autocorrelation
- Identify and interpret global and local spatial patterns of point and polygon data
- Understand the principals and practical applications of ordinary least square regression and spatial regression

- Understand the principals and practical applications of kriging and cross-validation
- Understand the principals and practical applications of spatial sampling
- Understand the principals and practical applications of spatiotemporal pattern analysis

Prerequisites
Students are expected to have backgrounds in elementary statistics and introductory GIS.

Course Outline:

Review of elementary statistics…….…….. 2 weeks
Point pattern analysis…….. 1 week
Cluster detection…….. 1 week
Spatial autocorrelation…….…….. 1 week
Ordinary least squares regression…….. 1 week
Geographically weighted regression…….. 1 week
Spatial interpolation …….. 2 weeks
Spatial sampling…….…….. 1 week
Spatiotemporal data analysis…….. 2 weeks

References

Rogerson, P. (2015) *Statistical Methods for Geography*, 4th Edition. London, SAGE Publications.

Issacks, E.H. and R. Mohan Srivastava (1989) *An Introduction to Applied Geostatistics*, Oxford university press.

O'Sullivan, D. and D. J. Unwin (2002 or 2010) *Geographic Information Analysis*, Wiley & Sons.

Stevens, D.L., and A.R. Olsen. 2004. "Spatially balanced sampling of natural resources." *Journal of the American Statistical Association* 99 (465): 262–278

Grading:
It is strongly encouraged to attend each lecture and actively participate in the online discussion board as well as in class. Students are required to post a reply on the forums posted by the instructor. Lab assignments will be given weekly to help students gain practical experience in developing websites. Students need to complete final projects to design or process spatial dataset.

There will be 7 labs and 1 final project. The lowest lab score will be dropped and the highest six is worth 66% of the final grade. The final project score will be worth 24% of the final grade. 10% will be based on attendance and participation.

Grade Policy:

- Project, online class activities, and labs:

	% of total grade	Due date

Project	24%	2/16
Online class activities	10%	In class
Labs	66% (11% × highest 6 labs)	12/13 (Lab 1), 12/20 (Lab 2), 1/3 (Lab 3), 1/10 (Lab 4), 1/17 (Lab 5), 1/24 (Lab 6), 1/31 (Lab 7)

Letter Grade Distribution:

The plus/minus grading system will be used to assign student grades. Minor adjustments to this scale might be made based on the performance of the class as a whole.

97-100.0 = A+
94-96.99 = A
90-93.99 = A-
87-89.99 = B+
84-86.99 = B
80-83.99 = B-
77-79.99 = C+
74-76.99 = C
70-73.99 = C-
67-69.99 = D+
64-66.99 = D
60-63.99 = D-
<60 = F

All students must have a UMD email account for communication. All assignments should be submitted through email or on ELMS. Details about the ELMS will be provided in the class.

Academic Honesty: The University of Maryland, College Park, has a nationally recognized Code of Academic Integrity, administered by the Student Honor Council. This Code sets standards for academic integrity at Maryland for all undergraduate and graduate students. As a student, you are responsible for upholding these standards for this course. You need to be aware of the consequences of cheating, fabrication, facilitation, and plagiarism.

Within our class, students may work together to review class notes and home assignments. However, assignments must be done individually. Each student must turn in his or her own work, from his or her personal computer. Any discussion or problem solution must be his or her alone, without assistance from any other person.

Accessibility Resources: Any student with a disability is encouraged to meet with the instructor privately during the first week of class to discuss accommodations. I will make every effort to accommodate students who are registered with the

Disability Support Services (DSS) Office and provide a DSS accommodation form. Please refer to the Online Undergraduate Catalog Policy on Religious Observance.

Email: Both the TA and the instructor will always be available by email. The professor may not always reply to emails after 6pm or on weekends. Normally, an email would be replied within 24 hours. Emails sent over weekend may not be replied until next work day. E-mails should be respectful and professional.

Course schedule

The weekly coverage is subject to change as it depends on the progress of the class. However, you must keep up with the reading assignments.

Week	Date	Topics	Readings	Assignments
1	11/29 11/30	Overview of spatial statistics Review of elementary statistics	Ch. 1	
2	12/6 12/7	Continuous distribution Hypothesis testing	Ch. 4	Lab 1 out
3	12/13 12/14	Spatial process Point pattern analysis	Ch. 10	Lab 1 due Lab 2 out
4	12/20 12/21	Cluster detection Cluster detection analysis	Ch. 12	Lab 2 due Lab 3 out Project topic out
5	12/27 12/28	No class (holiday) No class (holiday)		
6	1/3 1/4	Spatial autocorrelation Useful GIS resources	Ch. 7	Lab 3 due Lab 4 out
7	1/10 1/11	Ordinary least squares regression Regression	Ch. 8	Lab 4 due Lab 5 out Project topic due
8	1/17 1/18	Geographically weighted regression Spatial interpolation	Ch. 11	Lab 5 due Lab 6 out
9	1/24 1/25	Gaussian process regression models Spatial interpolation	Applied Geostatistics	Lab 6 due Lab 7 out Project proposal due
10	1/31 2/1	Spatial interpolation Spatial sampling	Ch. 5	Lab 7 due
11	2/7 2/8	Spatiotemporal data analysis Independent study for final project	Ch. 9	
12	2/14 2/15	Final project presentation Independent study for final project		Final Project due