Geography 651
Spatial Statistics
Fall 2014

Instructor: Eunjung (Elle) Lim
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Online office hours: Wednesdays 8-9 pm
Offline office hours: Thursdays 4-5 pm

Lecture: Online Wednesdays 5:30 – 8:00 pm
On campus 1166 LeFrak Hall
Website: http://elms.umd.edu
Lab: Online Thursdays 5:30-7:00 pm
On campus 1166 LeFrak Hall
TA : Varada Shevade (vshevade@umd.edu)

Course Description

This course is about quantitative analysis of spatial data. It is intended to provide a broad survey of various spatial statistic methods useful in environmental and social sciences. This course covers four broad topical areas: (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: (1) develop an understanding of the important theoretical concepts in spatial data analysis; and (2) gain practical experience in application of spatial statistics to a variety of social and environmental problems using advanced statistical software.

Learning Outcomes

Upon completion of this course, students should be able to

- Understand concepts of homogenous (complete spatial random ness) and heterogeneous spatial process
- Understand 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 and distinguish deterministic and stochastic spatial interpolation
- Understand the principals and practical applications of experimental semivariograms, semivarigoram models, kriging, and cross validation
- Understand the principals and practical applications of spatially balanced sampling
- Understand the principals and practical applications of spatiotemporal pattern analysis
- Apply proper spatial methods for their own research using various statistical software and interpret spatial analysis results

Prerequisites

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

Course Requirements and Grading

It is strongly encouraged to attend each lecture and actively participate in online discussion board as well as in class. Students are required to post a reply on the issue posted by the instructor. Lab assignments will be given on a weekly basis to help students gain practical experience to answer specific problems. Students need to complete final projects with spatial data in their area of interest using various methods covered in this course. Final grades will be determined by the following items:

- Weekly discussions and participation 5%
- Lab assignments 55%
- Final project 40%

Textbook

This course will include many contents from several books and papers and not follow the contents of one main textbook step by step. There is no required textbook. Supplemental reading materials (in electronic format or as links to certain web sites) will be posted on ELMS by the instructor. Some recommended books include:

OU: O'Sullivan, D. and D. J. Unwin (2002 or 2010) *Geographic Information Analysis*, Wiley & Sons. Electronic version is available at http://www.gisresources.com/wp-content/uploads/2013/09/Geographic_information_analysis_2nd.pdf.

FR: Fotheringham, A. S.and Peter A. Rogerson (2009) *The SAGE Handbook of Spatial Analysis*, Sage Pblications Ltd.

RY: Rogerson, P. and I. Yamada (2008) *Statistical Detection and Surveillance of Geographic Clusters*, CRC Press.

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

WL: Wong, D. W. S. and J. Lee (2005) *Statistical Analysis of Geographic Information*, Wiley & Sons

FB: Fotheringham, A. S., Brunsdon C. and Charlton M. (2000, 2002, 2004) *Quantitative geography:Perspectives on Spatial Data Analysis*, Sage Publications Ltd.

Make-up Policy

Assignments must be turned in by 11:59PM at which they are due. Late assignments will result in penalties unless prior arrangements are made with the instructor. If you have a documented disability and wish to discuss academic accommodations, please contact the instructor immediately. Students should not expect 'Incomplete' grade as they will be only given under extra-ordinary circumstances.

Academic Integrity

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. It is very important for you to be aware of the

consequences of cheating, fabrication, facilitation, and plagiarism. For more information on the Code of Academic Integrity or the Student Honor Council, please visit http://www.shc.umd.edu.

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 own computer. Any discussion or problem solution must be his or her alone, without assistance from any other person.

Online Learning

This is an online course with occasional in-person experiences. We will meet online at the announced time for a live audio/video lecture. The lecture will be archived for anyone who absolutely must miss the class, but I encourage you to login at the appointed time so that you can ask questions.

Our class will meet within Blackboard, the university's online learning system. Go to http://elms.umd.edu to access the course. After you login, our course will be listed in the right column under My Courses. Click on the course link to access the course.

Short videos that illustrate how to use the online learning system are available on the course page. Click the Tutorials button on the left sidebar to access the tutorials.

Hardware and Software Requirements for this course

All students must have a UMD TerpConnect (used to be Glue) account to obtain permissions to access the software in the computer labs on campus (LeFrak 1146) and on VMWare virtual computers. You can access virtual computers remotely through VMWare Client View. VMWare View Client tutorial (MPS_ViewTutorial-VMWare.pdf) will be posted on ELMS.

You may use either a PC or a Macintosh computer to access ELMS. Whichever you choose, it must be equipped with the following hardware:

- Headset (including headphones and microphone)
- Webcam (optional)

You will also need the following plug-ins (be sure you have the latest versions):

- Adobe Flash Player

Support for Online Learning

This method of taking classes is undoubtedly new to some of you, so we have a few tools to make life easier for you.

Email

Both TA and instructor will always be available by email. Use the email link in the sidebar to send us emails at any time. We will try to answer within 24 hours and probably much sooner.

Online office hours

We will have office hours in a Live Classroom each week. The times will be posted in the Announcements. Use the link in the sidebar to access office hours.

On campus office hours
We will post times when we will be available on campus for face-to-face office hours. The TAs will have lab office hours on periodic Saturday mornings.

Online Discussion & Chat rooms
We have created places for you to visit with your classmates. Share everything from discussions about the course material to what you did last weekend. I will look in from time to time but I probably won't respond to anything posted.

Course Schedule
This is a tentative schedule and may be adjusted to suit our class. Changes will be announced and posted on Blackboard.

Dates	Topics	Reading	Assignment
Sep 3	Review of probability theory and elementary statistics Why spatial statistics Characteristics of spatial data	OU Ch 1 Appendix A WL Ch4 FB Ch2	Lab1
Sep 10	Spatial process Point pattern analysis Testing for Complete Spatial Randomness	OU Ch 2,3,4 FB Ch 5,6 FR Ch 16	Lab2
Sep 17	Cluster detection analysis	FB Ch 5, 6 OU Ch 5 RY Ch 5	Lab3
Sep 24	Area Data Analysis Statistical test for spatial autocorrelation	OU Ch 7	Lab4 Final Project Topic Discussion
Oct 1	Spatial Regression Geographic Weighted Regression (GWR)	FR Ch 13, 14 FB Ch 5 WG Ch 9	Lab5 Final Project Topic Discussion Due: Oct 5
Oct 8	Continuous data analysis Introduction to spatial stochastic process Description of continuous surface	OU Ch 8,9 IR Ch 7 FB Ch 7	Lab 6 Proposal
Oct 15	Spatial interpolation Variogram modeling Kriging	IR Ch 12 15 16 FR Ch 9 FB Ch 7	Lab7
Oct 22	Spatial Sampling	FR Ch10 FR Ch18 RY Ch 7, 8, 9	Proposal Due : Oct 22 Lab7 Due : Oct 23

Oct 29	Spatio-temporal data analysis	FR Ch23 FR Ch24	
Nov 5	Spatio-temporal data analysis	FR Ch23 FR Ch24	Lab 8 (Optional for bonus points) Out Lab8 & Final Project Due: Nov 9