Geog 560: Advanced Quantitative Analysis

Credit: 3 units
Lectures (444 Science Hall): Tuesday & Thursday 9:30 AM-10:45 AM
Labs (380 Science Hall): Tuesday 9:30 AM – 10:45 AM (Dates are available in the schedule table)

Instructor: Prof. Song Gao
Office Hours: Tuesday 1:00-2:00 PM, Thursday 1:00-2:00 PM, or by appointment (421 Science Hall)
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Overview

Geography 560 (GEOG 560) is an advanced course in statistical methods and spatiotemporal data analysis covering techniques widely used in quantitative geography and Cartography/GIS. The primary emphasis is on data-driven predictive modeling, including multiple regression and extensions, geographically weighted regression, and categorical prediction. We also cover principal components analysis, (spatial) clustering, and computation-intensive analysis methods. In addition, we will introduce times series analysis and spatiotemporal statistical models if time permits. Moreover, this course utilizes R script programming tools to solve statistics and spatiotemporal analysis problems.

Course Learning Outcomes

Upon completion of the course modules, the student is expected to:

- Understand statistical concepts, methods, and techniques
- Be able to conduct various statistical analyses on geographic data
- Be familiar with R script programming for (spatiotemporal) statistical analysis
- Be able to solve practical problems using statistics and spatiotemporal analysis methods

Course Materials

Textbook:

- *James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. An Introduction to Statistical Learning with Applications in R. New York: springer, 2013*. (Free PDF copy available at: http://www-bcf.usc.edu/~gareth/ISL/ISLR%20Sixth%20Printing.pdf)
- Bivand, Roger S., Edzer J. Pebesma, Virgilio Gomez-Rubio, and Edzer Jan Pebesma. *Applied Spatial Data Analysis with R (2nd ed)*. Vol. 747248717. New York: Springer, 2013.

Recommended Readings:

- Burt, James E., Gerald M. Barber, and David L. Rigby. *Elementary statistics for geographers*. Guilford Press, 2009.
- Cressie, Noel, and Christopher K. Wikle. *Statistics for Spatio-Temporal Data*. John Wiley & Sons, 2015.
- Everitt, Brian, and Torsten Hothorn. *An Introduction to Applied Multivariate Analysis with R*. Springer Science & Business Media, 2011.

All lecture slides and notes are available on the *Canvas*. Notice that our communication will be almost exclusively through the messaging platform on *Canvas*. It is advised that you set up your email alerts in Canvas to send you daily updates about assignments, communication from your instructors, TAs, and changes to the course. See instructions at: https://guides.instructure.com/m/4212/l/710344-how-do-i-set-my-canvas-notification-preferences-as-a-student

Grading

50% Lab Assignments + 20% Exam + 30% Final Project

Course grades will be based on in-class quiz/midterm (20% of total grade), 5 laboratory assignments (50% of total grade), and one final project (30% of total grade). Quiz will be given in the class and will cover the material presented in the course lectures and notes with an emphasis on concepts and vocabulary. Lab assignments will require R programming based on lecture material. Lab assignments are not scheduled weekly and dates will be announced during the lectures. There is no final exam for this course. But you will have one final project to solve a problem related to your area of study or topic of interest using data-driven analysis methods that you learn in this course.

Grading Scale:

Score	Grade	Grade Points Per Credit
> or = 90	A (Excellent)	4
86 ~ 89.99	AB (Intermediate grade)	3.5
80 ~ 85.99	B (Good)	3
76 ~ 79.99	BC (Intermediate grade)	2.5
70 ~ 75.99	C (Fair)	2
60 ~ 69.99	D (Poor)	1
< 60	F (Failure)	0

More information: https://registrar.wisc.edu/grades_and_gpa.htm

Course Outline (2018 Spring)

The following is a tentative schedule. Please check the Canvas website for updates.

Modules	Lectures & Date	Labs
Module 1: Review	Lesson 1: Basic Statistical Concepts (1/23, 1/25)	
	Lesson 2: Hypothesis Testing and Confidence Intervals (1/30)	
Module 2: Regression Analysis	Lesson 3: Bivariate Linear Regression (2/1)	Lab 1: Linear Regression Analysis (2/6)
	Lesson 4: Multiple Regression (2/8, 2/13)	
	Lesson 5: Geographically Weighted Regression (GWR) (2/15)	Lab 2: Spatial Data in R and GWR (2/20)
Module 3: Categorical Prediction Methods	Lesson 6: Logit Models (2/22)	
	Lesson 7: Support Vector Machines (2/27)	
	Lesson 8: Bayesian Inference and Estimation (3/1)	Lab 3: Categorical Prediction (3/6)
	Lesson 9: Classification and Regression Trees (3/8)	
Module 4: Multivariate Methods	Lesson 10: Principal Components Analysis (3/15)	Lab 4: Multivariate Methods (3/20)
	Lesson 11: Multidimensional Scaling (3/22)	Spring Break: Mar 24-Apr 1, 2018
	Lesson 12: Clustering Analysis (4/3, 4/5)	Lab 5: Clustering Methods (4/10)
Module 5: Spatiotemporal Data Analysis	Lesson 13: Time Series Analysis (4/17, 4/19)	Final project proposal (4/12)
	Lesson 14: Spatiotemporal Analysis Methods (4/24, 4/26)	Final project working time (5/1, 5/3)
In-Class Exam	Midterm: 3/13	

Attendance (Required)

You must attend all lectures & lab sessions and complete all course assignments and quizzes on time. You should appropriately comment all code you submit for a grade. Please seek assistance when you have a question or problem through office hours and/or your peers.

Communication & Accommodation

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty will work either directly with the student or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. If you face any personal or professional difficulties or require accommodation or a disability, please feel free to contact me as soon as possible.

Academic Integrity

Academic Integrity is critical to the mission of the University of Wisconsin-Madison, a research institution with high academic standards and rigor. All members of the University community play a role in fostering an environment in which student learning is achieved in a fair, just, and honest way. Plagiarism is prohibited in lab assignments and quizzes. Any offense results in a zero for the grade and disclosure of the impropriety to the Department and University.