

GEOG 410: SPATIAL ANALYSIS SPRING 2016

Instructor: Christopher Bone

Lectures: 2 x 1-hour lectures/week

Labs: 1 x 2-hour lecture/week

TEXTBOOKS

McGrew Jr, J. C., & Monroe, C. B. (2000). *An Introduction to Statistical Problem Solving in Geography*. Waveland Press.

Brunsdon, C. and L. Comber 2015. *An Introduction to R for Spatial Analysis and Mapping*. SAGE Publications Ltd.

COURSE DESCRIPTION

In this course students are introduced to a variety of spatial analysis techniques that can be used for understanding geographic phenomena. Topics covered in this course include descriptive spatial analysis, probability theory, spatial sampling, inferential spatial analysis, spatial interpolation, spatial correlation and geographic regression. Lectures focus on the geographic theory and equations behind each method, while labs provide an opportunity for students to implement a variety of methods to address questions that are geographic in nature. All labs and exercises are completed using the scientific programming language R. 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.

Students enrolled in *Geog 494/594: Spatial Analysis* should also consider *Geog 495/595: Geographic Data Analysis*; together, these two courses will provide students with a broad range of analytical and knowledge and tools for handling geographic data.

EXPECTED LEARNING OUTCOMES

Students who successfully complete this course will be able 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;
- analyze and interpolate observational spatial data in order to create continuous surfaces;
- demonstrate the ability to implement a suitable spatial analytical workflow for providing answers to geographic questions;
- demonstrate proficiency in using the scientific programming language R to conduct spatial analysis;
- demonstrate familiarity with spatial analysis language in order to effectively interrogate scientific research employing relevant methods.

ESTIMATED STUDENT WORKLOAD

Each week students will attend two 1-hour lectures and one 2-hour lab. Lectures will include presentations by the instructor covering spatial analysis approaches, and brief exercises involving spatial analysis. Together, the presentation and exercises will help students achieve learning objectives related to evaluating and determining appropriate methods, demonstrating the ability to implement a suitable spatial analytical workflow, and becoming proficient in spatial analysis as a language for interrogating scientific

research. Labs will consist of students working on assignments that are to be submitted for grading. These assignments will be directly related to the lecture material for a given week, and will require students to gradually become familiar with the analysis software. In addition to time spent in the classroom and in labs, students are expected to spend approximately one hour each week outside of the classroom preparing for lectures by reading course textbook, and three hours each week on completing lab assignments that were assigned during the lab periods.

All students are expected to complete four assignments and one final project. The assignments will be 1-2 weeks in length, and will cover topics presented in lectures. The objective of these assignments is to ensure students understand concepts and can perform the relevant spatial analysis in R. The final project will be three weeks in duration in which students are given a research question about a geographic problem and are required to collect data from the Web that can be used to address this question. Students are then expected to apply the spatial analytical techniques learned throughout the term to derive a solution to this problem. The final project will be submitted as a brief scientific paper with an introduction section, literature review, methods, results section with figures and statistical results, and discussion section describing the implications of the results.

GRADING

GEOG 494

Exercises (10)	= 10%
Assignments (4)	= 40%
Final Project	= 20%
Midterm	= 15%
Final	= 15%

GRADING RUBRIC

A+ (97% and greater) Only used when a student's performance significantly exceeds all requirements and expectations for the class. Typically very few to no students receive this grade.

A (90% to <97%) Excellent grasp of material and strong performance across the board, or exceptional performance in one aspect of the course offsetting somewhat less strong performance in another. Typically no more than a quarter of the students in a class receive this grade, fewer in lower-division classes.

B (80% to <90%) Good grasp of material and good performance on most components of the course. Typically this is the most common grade.

C (70% to <80%) Satisfactory grasp of material and/or performance on significant aspects of the class.

D (60% to <70%) Subpar grasp of material and/or performance on significant aspects of the class.

F (<60%) Unacceptable grasp of material and/or performance on significant aspects of the class.

COURSE SCHEDULE AND ASSIGNMENTS

WEEK 1

Lecture 1

GEOGRAPHIC DATA FOR SPATIAL ANALYSIS

Reading: McGrew and Monroe (2000). Chapters 1: The Context of Statistical Techniques, pp. 3-13.
McGrew and Monroe (2000). Chapters 2: Geographic Data, pp. 16-31.

Lecture 2

DESCRIPTIVE STATISTICS & FREQUENCY DISTRIBUTION

Reading: McGrew and Monroe (2000). Chapter 3: Descriptive Statistics pp. 37-51.
McGrew and Monroe (2000). Chapter 4: Descriptive Spatial Statistics pp. 52-58

Lab 1

Assignment 1: Describing a Forest

WEEK 2

Lecture 3

PROBABILITY

Reading: McGrew and Monroe (2000). Chapter 5: Probability pp. 65-81.

Lecture 4

SAMPLING

Reading: McGrew and Monroe (2000). Chapter 6: Basic Elements in Sampling pp. 82-96.
McGrew and Monroe (2000). Chapter 7: Estimation in Sampling, pp. 97-114.

Lab 2

Assignment 2: Are Landslides Random?

WEEK 3

Lecture 5

INFERENCEAL ANALYSIS

Reading: McGrew and Monroe (2000). Chapter 8: Elements of Inferential Statistics pp. 115-129.

Lecture 6

POINT PATTERN ANALYSIS

Reading: McGrew and Monroe (2000). Chapter 12: Inferential Spatial Statistics pp. 171-181.
Brunsdon and Comber (2015). Chapter 6.2-6.5: What's So Special About Spatial pp. 173-180.

Lab 3

Assignment 2: Are Landslides Random?

WEEK 4

Lecture 7

GLOBAL MORAN'S I

Reading: Brunson and Comber (2015). Chapter 7.4 Moran's I: An Index of Autocorrelation pp. 229-234.

Lecture 8

LOCAL INDICATORS OF SPATIAL ASSOCIATION

Reading: Brunson and Comber (2015). Chapter 8.3-8.5: Local Indicators of Spatial Association pp. 225-272.

Lab 4

Assignment 3: Why People Live Where They Do

WEEK 5

Lecture 9

Midterm

Lecture 10

R AS A GIS

Reading: Brunson and Comber (2015). Chapter 5.1-5.8: Using R as a GIS pp. 129-159.

Lab 5

Assignment 3: Why People Live Where They Do

WEEK 6

Lecture 11

SPATIAL INTERPOLATION

Reading: Brunson and Comber (2015). Chapter 6.7: Interpolation of Point Patterns with Continuous Attributes pp. 199-208.

Lecture 12

KRIGING

Reading: Brunson and Comber (2015). Chapter 6.8: The Kriging Approach pp. 208-217

Lab 6

Assignment 4: Urban Pollution

WEEK 7

Lecture 13

ANALYZING SURFACE DATA

Reading: Brunson and Comber (2015). Chapter 5.9: Introduction to Raster Analysis pp. 160-67.

Lecture 14

SPATIAL AUTOREGRESSIVE MODELS

Reading: Brunson and Comber (2015). Chapter 7.5-7.6: Spatial Autoregression pp. 235-250.

Lab 7

Assignment 4: Urban Pollution

WEEK 8

Lecture 15

CORRELATION

Reading: McGrew and Monroe (2000). Chapter 13: Correlation pp. 193-209.

Lecture 16

REGRESSION

Reading: McGrew and Monroe (2000). Chapter 14. Regression pp. 211-224.

Lab 8

Final Project: Race, Class & Environment

WEEK 9

Lecture 17

SPATIAL WEIGHTED APPROACHES

Reading: Brunson and Comber (2015). Chapter 8.7: Geographically Weighted Approaches pp. 278-291.

Lecture 18

GEOGRAPHIC WEIGHTED REGRESSION

Reading: Brunson and Comber (2015). Chapter 8.7.5: Geographically Weighted Regression pp. 291-297.

Lab 9

Final Project: Race, Class & Environment

WEEK 10

Lecture 19

ACCESSING WEB DATA WITH R

Reading: Brunson and Comber (2015). Chapter 9: R and Internet Data pp. 298-328.

Lecture 20

WRAP UP

Lab 10

Final Project: Race, Class & Environment