GEOG 4870/6870, NR 6950

Geospatial Analysis

Day(s), Time, Place TBD

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Course Objectives

By the end of this course, you will be able to:

1. Use R to summarize (spatial) data numerically and visually.
2. Explore (spatial) data patterns and relationships.
3. Conduct independent and reproducible research by applying techniques learned in class to novel datasets.
4. Effectively communicate results and implications.
5. Critically assess data-driven assertions.

Perhaps most importantly of all, you'll do this using the powerful, free, and open resources developed by the community supporting the R programming language. These specific course objectives are connected to broader objectives to help you achieve greatness outside of the classroom:

1. Develop specific skills, competencies, and points of view needed by professionals.
2. Learn how to find and use resources for answering questions or solving problems.

Prerequisites

Students should take GEOG 1800 (Introductory GIS) and STAT 1040 (Introduction to Statistics) prior to taking this class. Knowledge of introductory programming (Python, `R`, etc.) is helpful, but not required. If you need additional resources to help get up to speed, check out the More Resources page on Canvas.

Course Materials

Since we are working with open source tools, the resources we'll use in class are free. While there's no required textbook for the class, *Applied Spatial Data Analysis with* `R` by Roger Bivand, Edzer Pebesma, and Virgilio Gomez-Rubio is a fantastic resource. I will also frequently reference the `R` *for Data Science* text by Hadley Wickham, creator of `dplyr` and `ggplot2`. This textbook is openly available online.

You will need regular access to a computer with both R and RStudio installed (PC or Mac, no difference).

Course Structure

The course is organized into modules. Each module contains:

- **Background** required to complete the
- **Assignment** for the module and
- **Additional Resources** if you want to learn more about the topic.

Each module culminates in a project that applies module content and a dataset of your choosing.

Grading

Weekly assignments	120 points
Final project	80 points

Data science can only be learned by doing, so the majority of your grade will come from Weekly Assignments (120 points total). Life happens, so you can replace your lowest lab grade by completing a spatial tutorial for your classmates (see Extra Credit section).

For the Final Project (80 points total), you will apply the tools and techniques learned in class to your own spatial datasets. This project will be split into three sections, each worth 20 points:

- Wrangle, describe, and visualize your data.
- Explore your data.
- Analyze your data.

As we move through the class, I'll provide more information about each of these steps. The goal here is for you to use this class to advance your own research! My expectations for graduate students will be slightly more demanding than for undergraduates. These differences will be detailed in rubrics for each section of the project.

Discussion Board

Yes, programming can be frustrating. But we're in this together. I've set up a Discussion Board for the class and I encourage you to use it regularly to post/discuss issues with assignments. The Discussion Board is modeled after StackExchange, a website you will likely frequent this semester. StackExchange provides a space for folks to post questions and receive answers. Users can "upvote" helpful answers. If an answer you give is upvoted, then your reputation increases. Many programmers list their StackExchange statistics on their resumes when applying for jobs.

I will regularly monitor the Discussion Board and provide feedback on comments and questions.

Course Policies

- Outside materials: All assignments are open notes, open book, open computer. In the real world, you will be able to access the vast amounts of online resources to help you solve complex problems. In as much as it is possible, I want this class to reflect reality.
- Late policy: Items turned in the next day lose 30% of total possible points. Items turned in after the next day lose all points. For the final project, the grade will be reduced by 10% for each day late.
- Regrading: Regrade requests must be made within one week of when the assignment is returned to you.

Troubleshooting

If you get stuck, as tends to happen when running code, here's what you need to do:

- Search the InterWebs.
- If that doesn't work, post to the Discussion Board.
- If that doesn't work post to StackExchange.
- If that doesn't work, send me a detailed email with a `RMarkdown` document describing the problem and including the code. This document should also include a description of (1) your fruitless internet search, (2) your post on the Discussion Board, and (3) your unanswered post to StackExchange.

This may seem a bit ruthless, but one of my main goals is for you to learn how to troubleshoot R on your own.

Extra Credit

I will provide several extra credit opportunities throughout the semester that you can use to add points to your overall grade. This is my first iteration of this course, so it is highly likely

that course material will contain typos and (horror!) even errors. The first student to catch any errors will receive 1 point of extra credit. Each student can receive up to 3 points of extra credit for monitoring and correcting my mistakes. Let's hope there are not that many errors!

You can also complete a tutorial (`RMarkdown`) on a `R` package or spatial dataset that is relevant to the class. More information on the requirements for these tutorials will be provided on Canvas. If you follow the guidelines, you should get a good grade on this tutorial. I will replace your lowest lab grade with the grade you receive on this tutorial.

Note that if you are a graduate student, you will be expected to complete this tutorial.

Accessibility

I am strongly committed to making this course highly open and accessible. USU provides many resources for students with disabilities. If you have, or suspect you may have, a physical, mental health, or learning disability that may require accommodations in this course, please contact the Disability Resource Center (DRC) as early in the semester as possible (University Inn 101, 435.797.2444, drc@usu.edu). Disability related accommodations must be approved by the DRC. Once approved, the DRC will coordinate with me to provide accommodations.

Academic Integrity

Students will be held accountable to the Honor Pledge which they have agreed to: I pledge, on my honor, to conduct myself with the foremost level of academic integrity. I will will take appropriate actions in response to Academic Dishonesty, as defined the University's Student Code. Acts of academic dishonesty include but are not limited to:

1. Cheating
2. Falsification
3. Plagiarism

Keep things simple, don't cheat.

Contact Information

You can contact me at emily.burchfield@usu.edu or on my office phone at 435.797.4089. If your email is related to a programming issue, please see the Troubleshooting section above.

Course Summary:

Week	Content
	UNIT 1: Introduction to data
Week 1	Introduction to R
Week 2	Tidy data with dplyr
Week 3	Descriptive statistics and visualization
Week 4	Project - Part I
	UNIT 2: Introduction to spatial data
Week 5	Introduction to spatial data
Week 6	Finding spatial data / Raster crash course
Week 7	Integrating spatial data
Week 8	Mapping spatial data
Week 9	Project - Part II
	UNIT 3: Spatial analysis
Week 10	Areal data analysis
Week 11	Spatial regression
Week 12	Point-pattern analysis
Week 13	Classification
Week 14	Kriging and interpolation
Week 15	Project - Part III