Geography 385 Spatial Data Analysis

Fall 2024

Class Meetings

Meeting	Location	Time
Lecture	LSN 111	Mon & Wed 3:30 - 4:45pm

Instructor

Name	Office hours	Location
Sergio Rey	Mon 9:00 - 10:00 (by appointment)	PSFA 361G

Introduction

Welcome to GEOG 385: Spatial Data Analysis!

The purpose of this course is to introduce you to methods of spatial data analysis. The focus is on both the conceptual and applied aspects of spatial statistical methods. We will place particular emphasis on the computational aspects of Exploratory Spatial Data Analysis (ESDA) methods for different types of spatial data including point processes, lattice data, geostatistical data, network data, and spatial interaction. Throughout the course you will gain valuable hands-on experience with several specialized software packages for spatial data analysis. The overriding goal of the course is for you to acquire familiarity with the fundamental methodological and operational issues in the statistical analysis of geographic information and the ability to extend these methods in your own research.

The course takes an explicitly computational thinking approach to its pedagogy. Students are introduced to computational concepts and tools that are increasingly important to research

that engages with geospatial data. By adopting these tools, students acquire a deeper engagement with, and mastery of, the substantive concepts. Put differently, students will *learn to code*. But this is a means to the end goal: students will *code to learn* spatial data analysis.

In the scope of a 15-week semester course we can only introduce a handful of the key concepts and methods relevant to the field of spatial data analysis. As such, the course is not intended as an exhaustive treatment. Instead, the goal is that students will acquire an understanding of the more common and useful methods and practices, and use the course as an entry point for further engagement with the field.

Prerequisites

- GEOG 101 or GEOG 102
- STAT 250 or comparable course in statistics.

All students are required to complete the prerequisite assessment quiz before 2024-08-28 3:30pm.

Computational Learning

We will be using open source geospatial software throughout the course together with Jupyter Notebooks, and Python as our scripting language.

All software for the course will be made available through JupyterHub, a web-based framework. Students wishing to install these materials on their own machines will be given instructions to do so, **but this is not required**.

Readings

All required readings are available through the links listed below. Assigned readings should be completed before the date listed in the schedule (see below). Readings are a critical part of the discussions we will hold in class, and therefore being prepared for class means having completed the readings and thought about the content. It will be difficult to do well in this course without having completed the readings.

Abbrevation	Source
GDA	Tenkanen, H., V. Heikinheimo, D. Whipp (2023) Python for Geographic Data Analysis. CRC Press.
GDS	Rey, S.J., D. Arribas-Bel, L.J. Wolf (2023) Geographic Data Science with Python. CRC Press.

Schedule (Planned)

Week	Date	Topic	Reading	Due
1	8-26	Introduction		Prerequisite Quiz
	8-28	Jupyter		
2	9-02	Labor Day (Holiday)		
	9-04	Pandas		
3	9-09	Spatial Data Analysis		
	9-11	Geopandas		
4	9-16	Area Unit Data		Topic Approval
	9-18	Geoprocessing: Area Units		
5	9-23	Visualizing Area Unit Data		Python Primer
	9-25	Choropleth Mapping		
6	9-30	Spatial Weights		Project Proposal
	10-02	Neighbor Relations		Peer Evaluation 1
7	10-07	Global Spatial Autocorrelation		
	10-09	Testing for Clustering		
8	10-14	Local Spatial Autocorrelation		Data Acquisition
	10-16	Cluster Detection		Peer Evaluation 2
9	10-21	Clustering Area Unit Data		
	10-23	Region Building		
10	10-28	Point Pattern Data		
	10-30	Geoprocessing: Points		
11	11-04	Centrography		Data Visualization
	11-06	Describing Point Patterns		Peer Evaluation 3
12	11-11	Veteran's Day (Holiday)		
	11-13	Point Process Simulation		
13	11-18	Nearest Neighbor Statistics		Data Analysis
	11-20	Testing for Randomness		Peer Evaluation 4
14	11-25	Distance Based Statistics		
	11-27	Thanksgiving (Holiday)		
15	12-02	Clustering Point Pattern Data		Narrative
	12-04	DBScan		
16	12-09	Integrating Point and Area Data		
	12-11	Geoprocessing: Synthesis		Computational Notebook
17	12-18	Final Presentations (1-3pm)		

Grading

GEOG 385 uses specification grading in evaluating student work and in determining your final course grade. Your course grade will be based on the quality and quantity of the work that you submit that is evaluated to be of an acceptable level of quality. The acceptable level of quality demonstrates competency in the concepts and methods covered in the course.

There is a two-step process for determination of your final course grade at the end of the quarter:

1. Using your quizzes and exercises, your **base grade** is determined.
2. Using your final exam results, determine if your base grade includes a "plus", "minus", or level drop to form the course grade.

Base Grade

For Step 1, the base grade is determined using the following specification:

Level	Thresholds
A-	All the B- Thresholds Pass 11 or more reading quizzes Participate in 12 or more studios Complete 4 peer evaluations Presentation of Computational Essay
B-	All the C- Thresholds Pass 9 or more reading quizzes Participate in 8 or more studios Complete 3 peer evaluations Computational Essay
C-	All the D- Thresholds Pass 6 or more reading quizzes Participate in 6 or more studios Complete 2 peer evaluations
D-	Pass 4 or more reading quizzes Participate in 4 or more studios Complete 1 peer evaluation
F	Failing to clear all the D- Thresholds

Final Grade

For Step 2, your final course grade is determined as follows:

If your base grade is not an A-:

- 2 tokens can increment a B(C,D)- to a B(CD)
- 3 tokens can increment a B(C,D)- to a B(CD)+

If your base grade is an A-:

- 2 tokens increments an A- to an A
- 3 tokens increments an A- to an A and earns a recommendation certificate

> **Note**
>
> Note that SDSU grading policy does not allow A+ grades.

Quizzes

Starting in week three, there will be a quiz due before a session that pertains to the background reading that is required before our work in class. Quizzes are graded on a pass/fail basis.

Studio Participation

Each Wednesday, we will x focus on hands-on exercises that explore the material from lecture. Each student will be assigned to a small group that works together to carry out a set of spatial data analysis tasks. At the end of the session each group will submit a single notebook demonstrating their work.

Each notebook is graded using a **CRN** rubric that classifies work with marks of **C** ("Demonstrates Competence"), **R** ("Needs Revision"), or **N** ("Not assessable"):

Of each notebook the following questions will be asked: Does the work demonstrate that the student understands the concepts? Does the work demonstrate competence and meet the expectations outlined in the exercise?

If the answer is "yes" to both of the questions, the group passes the hurdle for that studio.

If the initial submission does not clear the hurdle, then a second question is asked: Is there evidence of partial understanding of the concepts? If the answer to this question is "Yes" the group can exchange one token (from each student) to attempt a revision of their work. If the answer is "No", the group does not clear the hurdle for this exercise and will not have the opportunity to revise their work.

For our studio sessions on Wednesdays, it is essential that you bring your own device, such as a laptop or tablet. These sessions will involve hands-on activities that require access to software and online resources. Having your own device will allow you to fully participate and

engage with the exercises. Please ensure your device is charged and ready to use at the start of each studio session. If you have any concerns about this requirement, please reach out to me in advance so we can make necessary arrangements.

Computational Essay

Each student will have the opportunity to write a computational essay using Jupyter notebooks to apply the methods of ESDA to a topic of their choice, approved by the instructor. The essay should demonstrate your ability to analyze spatial data, identify patterns, and interpret the results using ESDA techniques.

Instructions

1. Topic Selection

Select a topic of interest that involves spatial data. The topic should be relevant to your field of study or personal interest. Ensure that the data is accessible and suitable for spatial analysis. Submit your topic for approval by the instructor by **September 16**. If you are unsure about a topic, speak to the professor.

2. Data Acquisition

Identify and acquire spatial data related to your chosen topic. This may include data from public repositories, government databases, or other reliable sources.

3. ESDA Techniques

Apply appropriate ESDA methods such as spatial autocorrelation, clustering, and visualization techniques to explore your data. Use libraries like PySAL, GeoPandas, or others as needed.

4. Analysis and Interpretation

Document your analysis in a Jupyter notebook. Include clear explanations of the methods used, the rationale behind your choices, and a discussion of your findings. Visualizations should be integrated into the narrative to support your analysis.

5. Submission

Submit your Jupyter notebook along with a brief (500-word) reflection on what you learned from the analysis and how ESDA techniques enhanced your understanding of the topic. At submission you can indicate whether you wish to present your computational essay during the final period.

> **!** Important
>
> You must demonstrate competency on each of the stages above to have the computational essay count towards your base grade.

Deadline

Submit your completed essay by **December 12, Midnight**.

Final Exam Activity

Our final exam activity is scheduled for December 18 from 1-3pm. Students who applied to submit their computational essay will present during this period.

Tokens

Each student is provided with three tokens at the beginning of the semester.

Using Tokens

1. Credit for a reading quiz that was failed (1 token).
2. Obtaining a one-day extension for a milestone prior to due date (1 token).
3. Handing in a milestone activity one day late without permission (2 tokens).
4. Revising a milestone that was submitted on-time but evaluated as "Needing Revision" (1 token).
5. Revising a studio exercise that needs revision (1 token).
6. Requesting a make-up date for the presentation **by 2024-12-01 17:00** (3 tokens)
7. Missing a studio session (3 tokens).

8. Any tokens remaining after determination of the base grade will be used to determine the final course grade (see above).

To use a token you must complete a request using the token spending form.

Earning Tokens

Additional tokens can be earned in several ways:

- Submitting topics for discussion in lectures in our board
- Attending an in-person office hour to discuss a proposed question/topic
- Attending a geography colloquium (write a paragraph description)
- Completing the python primer (3 tokens)

Policies

Accommodations

If you are a student with a disability and are in need of accommodations for this class, please contact Student Ability Success Center at (619) 594-6473 as soon as possible. Please know accommodations are not retroactive, and I cannot provide accommodations based upon disability until I have received an accommodation letter from Student Ability Success Center.

Privacy and Intellectual Property

Student Privacy and Intellectual Property: The Family Educational Rights and Privacy Act (FERPA) mandates the protection of student information, including contact information, grades, and graded assignments. I will use Canvas to communicate with you, and I will not post grades or leave graded assignments in public places. Students will be notified at the time of an assignment if copies of student work will be retained beyond the end of the semester or used as examples for future students or the wider public. Students maintain intellectual property rights to work products they create as part of this course unless they are formally notified otherwise.

Academic Integrity

The SDSU student academic integrity policy lists violations in detail. These violations fall into eight broad areas that include but are not limited to: cheating, fabrication, plagiarism, facilitating academic misconduct, unauthorized collaboration, interference or sabotage, non-compliance with research regulations and retaliation. For more information about the SDSU student academic integrity policy, please see the following: https://sacd.sdsu.edu/student-rights/academic-dishonesty.

Code of Conduct

As course instructor, I am dedicated to providing a harassment-free learning experience for all students, regardless of gender, sexual orientation, disability, physical appearance, body size, race, religion, or choice of operating system. All course participants are expected to show respect and courtesy to other students throughout the semester. As a learning community we do not tolerate harassment of participants in any form.

- All communication should be appropriate for a professional audience including people of many different backgrounds. Sexual language and imagery are not appropriate in this course.
- Be kind to others. Do not insult or put down other students. Behave professionally. Remember that harassment and sexist, racist, or exclusionary jokes are not appropriate for this course.
- Students violating these rules may be asked to leave the course, and their violations will be reported to the SDSU administration.

This code of conduct is an adaptation of the SciPy 2018 Code of Conduct.