Geography 385 Spatial Data Analysis

Spring 2023

Class meetings

Meeting	Location	Time
Lecture	GMCS 307	Tue & Thu 2:00 - 3:15pm

Teaching team

Name	Office hours	Location
Sergio Rey	Thu 3:30 - 4:30pm	PSFA 361G
Dylan Skrah	Tue 3:20-4:20pm	PSFA 361F

Introduction

Welcome to 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 three different types of spatial data: point processes, lattice, and geostatistical. We will also cover an introduction to regression analysis on spatially referenced data. 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 re-

search that engages with geospatial data. By adopting these tools, students acquire a deeper engagement with, and mastery of, the substantive concepts.

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 Monday 1/24 11:59pm.

Computational Learning

We will 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 coming into class prepared 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
GDS	Rey, S.J., D. Arribas-Bel, L.J. Wolf (2023) Geographic Data Science with Python. CRC Press.
GSA	de Smith, M., M.F. Goodchild, P.A. Longly (2021) Geospatial Analysis. Winchelsea Press.
SAH	de Smith, M. (2021) Statistical Analysis Handbook. Drumlin Security Ltd.

Schedule (Planned)

Week	Dates	Topic	Reading	Activities
1	Jan-19	Introduction		
2	Jan-24	Spatial Analysis	GDS 1	Quiz 1
	Jan-26	Spatial Analysis Software	GDS 2	Exercise 1 Out
3	Jan-31	Spatial Data	GDS 3	Quiz 2
	Feb-02	Point Pattern Basics	GDS 8.1	
4	Feb-07	Centrography	GDS 8.2	Quiz 3
	Feb-09	Point Processes		
5	Feb-14	Nearest Neighbor Methods	GDS 8.3	Quiz 4
	Feb-16	Distance Distributions		Exercise 2 Out Exericse 1 Due
6	Feb-21	Area Data	GDS II	Quiz 5
	Feb-23	Visualization of Area Data	GDS 5	
7	Feb-28	Spatial Autocorrelation Concepts	GDS 6.1	Quiz 6
	Mar-02	Spatial Weights	GDS 4	Exercise 2 Due
8	Mar-07	Join Count Tests	GDS 5.1	Quiz 7
	Mar-09	Global Autocorrelation Tests	GDS 5.2	
9	Mar-14	Local Autocorrelation	GDS 6	Quiz 8
	Mar-16	Geostatistical Data	GSA gs	Exercise 3 Out
10	Mar-21	Spatial Interpolation	GSA int	Quiz 9
	Mar-23	Kriging	GSA krg	
	Mar-28	*Spring Break*		
	Mar-30	*Spring Break*		
11	Apr-04	Introduction to Multivariate Analysis	SAH mv	Quiz 10
	Apr-06	Correlation and Spatial Correlation	SAH cor	Exercise 3 Due
12	Apr-11	Introduction to Regression	GSA reg	Exercise 4 Out
	Apr-13	Inference in Regression	SAH inf	
13	Apr-18	Regression with Spatial Data	GDS 11	
	Apr-20	Diagnostics for Spatial Effects		
14	Apr-25	Spatial Dynamics	GDS 9	Exercise 4 Due
	Apr-27	Next Steps With Spatial Data Analysis		
15	May-02	Presentations		
	May-04	Presentations		
	May-10	Final Examination (13:00-15:00)		

Grading

GEOG385 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, exercises, and projects, 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.

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

Level	Hurdles
A	Pass at least 8 of 10 quizzes, earn "Demonstrates Competency" on 4 of 4 exercises, **and** submit a project that earns "Demonstrates Competency"
B	Pass at least 7 of 10 quizzes, earn "Demonstrates Competency" on 3 of 4 exercises
C	Pass at least 6 of 10 quizzes, earn "Demonstrates Competency" on 2 of 4 exercises
D	Pass at least 5 of 10 quizzes, earn "Demonstrates Competency" on 1 of 4 exercises
F	Fail to clear D-level hurdles

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

- If you earn at least 85% on the final exam, you will obtain a + for your grade. So an A base grade becomes a final A+ course grade, a B becomes a B+, and so on.
- If you score between 70-85% on the final exam, your base grade becomes your course grade.
- If you score between 50% and 69% on the final exam, you will obtain a - for your grade. So an A becomes and A-, a B becomes a B-, and so on.
- If you score less than 50% on the final exam, your course grade will drop one level: An A base grade becomes a final B course grade.

Quizzes

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

Exercises

Four exercises will be introduced in class and are due in two weeks.

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

Of each exercise 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, a student passes the hurdle for that exercise.

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 student can exchange one token to attempt a revision of their work. If the answer is "No", the student does not clear the hurdle for this exercise and will not have the opportunity to revise their work.

Project

The project is a required hurdle to earn a level A grade. In order to clear this hurdle, the project must obtain a "Demonstrates Competence" evaluation. There will be opportunities for feedback along the way, but the final submission will be evaluated. There will be no opportunity for revising this final submission.

Students need to commit to the project by specifying their team (maximum of 4 members on a team) by **3-09**. Once the commitment is made, the team composition is final. Any student who does not submit a team definition by this date will not be able to pursue the project.

Details on the project rubric will be given out on **2-16**.

Final Exam

A closed book, closed note, timed final exam will be given on **May 10 (13:00-15:00)**. The exam will be based on a blend of previous quiz questions and additional questions that pertain to material covered in class.

Tokens

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

Using Tokens

1. One token can be used for a one-day extension for an exercise.
2. One token can be used to revise an exercise that was submitted on-time but evaluated as "Needing Revision".
3. Two tokens can be used to request a make-up date for the final exam.

Earning Tokens

1. Handing in an exercise at least 24 hours before its due date.
2. Submitting all four exercises on time (or early).
3. Attempting all 10 quizzes.

Remaining Tokens

Each token that remains unused after **4-27** will be counted as a passed quiz. *Tokens cannot be exchanged with other students.*

Policies

Accomodations

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.