THE OHIO STATE UNIVERSITY

College of Arts and Sciences
Department of Geography

SYLLABUS
GEOG 5103: Intermediate Spatial Data Analysis

Spring 2026
3 credit hours
12:45 - 2:05 MW, Derby 0135 and online

CONTENTS

COURSE OVERVIEW

Instructor

Instructor: Dr. Huyen Le, Associate Professor, Department of Geography

Email: le.253@osu.edu

Office hours: 2:10 – 3pm Monday (in person) Derby 1110, and by online appointment via email.

Prerequisites

GEOG 4103 or equivalent (with basic knowledge of statistics), or as approved by the instructor.

Course description

This course focuses regression-based multivariate methods widely used by geographers and other scientists, including linear regression (including generalized linear models) and spatial regression (including spatial autoregressive models, conditional autoregressive models, and geographically weighted regression). By the end of the course, you will know how to select the appropriate regression method to answer a research question, be comfortable using multiple software packages to analyze data, and correctly interpret and write-up the results of your statistical analysis.

This course emphasizes hands-on experience and practical/conceptual understanding. The material covered in this course falls into one of four categories: (1) principles of multiple regression, (2) functional forms of the generalized linear model, (3) regression diagnostics, and (4) spatial regression alternatives. The course will emphasize the assumptions inherent in regression analyses, consequences of violating these assumptions, and (spatial) solutions when assumptions have been violated.

Course learning outcomes

Upon successful completion of this course, students should be able to:

1. Develop “statistical literacy,” a working understanding of statistics that can help in critically evaluating data-driven results in the discipline of geography (or urban planning, public health, etc…).

2. Apply statistical tools for data analysis, with an understanding of the how to choose which tool to use and how to implement them in statistical software.

3. Interpret the results of data analyses and clearly communicate those results.

4. Develop practical experience in using real datasets to address meaningful research questions.

HOW THIS COURSE WORKS

Mode of delivery: This class is hybrid (in-person and online). All learning materials will be uploaded on Carmen Canvas. There will be additional components:

- Lectures slides (uploaded before class time)
- Recordings of lectures (uploaded after class time)
- Quizzes and labs
- Assignments and exams
- In-person and online office hours.

Credit hours and work expectations: This is a **3-credit-hour course**. According to Ohio State policy (go.osu.edu/credithours), students should expect around 3 hours per week of time spent on direct instruction (instructor content, group and Carmen activities, for example) in addition to 6 hours of homework (reading and assignment preparation, for example) to receive a grade of (C) average.

Communications with instructor: Questions related to class materials should be posted on Carmen Canvas discussion forum. Make sure you include a detailed description of the problem and attach a screenshot if applicable. You are encouraged to help your classmates out if you know the answers, but make sure you are not violating the code of student conduct (e.g., do not upload your assignment or show them the exact answer to complete their assignments). ***Email me if you have questions related to personal issues and/or when you want to send me the code. Make sure that you put "GEOG 5103" in the subject line, along with your issues.***

Weather or other short-term closing: Should in-person classes be canceled, I will notify you as to which alternative methods of teaching will be offered to ensure continuity of instruction for this class. Communication will be via Carmen Canvas announcement.

COURSE MATERIALS AND TECHNOLOGIES

Textbooks

Chi, G. and J. Zhu (2020). *Spatial Regression Models for Social Sciences.* Los Angeles: Sage Publications

We will use chapters from the following texts, which will be available on Carmen Canvas:
Hair, Anderson, Tatham, and Black. (2014). Multivariate Data Analysis, 7th Edition. England: Pearson Education.

Gelman, A. and J. Hill. (2007). Data Analysis Using Regression and Multilevel/Hierarchical Models. New York: Cambridge University Press. (e-book available through the OSU Libraries: https://ebookcentral.proquest.com/lib/ohiostate-ebooks/detail.action?docID=288457)

Course technology

Technology support

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** ocio.osu.edu/help
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu
- **TDD:** 614-688-8743

Technology skills needed for this course

- Newest R and RStudio versions (at the time you start the course)
- Basic computer and web-browsing skills
- Navigating Carmen (go.osu.edu/canvasstudent)

Required equipment

- Computer: current Mac (Mac OS) or PC (Windows 10 or higher) with high-speed internet connection
- Other: a mobile device (smartphone or tablet) to use for BuckeyePass authentication

Required software

- Newest version of R, which is a free and open source program for statistical computing and graphics (https://www.r-project.org/). Its privacy policy can be found at https://www.r-statistics.com/privacy-policy/.
- Newest version of RStudio (https://rstudio.com/products/rstudio/), which is a shell for enhanced visualization and programming. Its privacy policy can be found at https://www.rstudio.com/about/privacy-policy/.
- Microsoft Office 365: All Ohio State students are now eligible for free Microsoft Office 365. Full instructions for downloading and installation can be found at go.osu.edu/office365help.

Carmen access

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions (go.osu.edu/add-device).
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application (go.osu.edu/install-duo) to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357(HELP) and IT support staff will work out a solution with you.

GRADING AND FEEDBACK

How your grade is calculated

All submissions must be made via Carmen Canvas by 11:59 pm on the due date to be considered on time. All lab assignments are due on Mondays except for holidays.

CATEGORY	POINTS	OCCURRENCE	DUE DATES
Participation	15%	Multiple	In-class or Fridays
Assignments	56%	Four assignments	Mondays (check Canvas for specific dates)
Exam 1 (midterm)	12%	Once	TBD
Exam 2 (final) or final paper	17%	Once	TBD
Total	**100%**		

Participation (15%)

Class participation is required and accounts for 15% of the total grade. Participation grade is calculated based on quizzes, lab outputs, and/or discussion. It is very important that you attend all class sessions because this course follows sequential learning: each week's material is built on the content of the previous week. You may find yourself lost if you miss the class completely for a week or two.

If you have excuses, please notify me before class. You still need to turn in lab outputs and quizzes in order to get full participation credit for the missing class.

Assignments (4*14% = 56%)

You will have 4 assignments throughout the semester, each of them is worth 14% of your grade. Each assignment requires that you use R to analyze data, interpret the results of these statistical

analyses, and demonstrate an understanding of statistical principles discussed in class. Discussion forum and office hours will be available to help you troubleshoot the coding problems that you encounter in the labs and assignments.

You will submit the HTML outputs from your R markdown code for grading, along with a written memo to summarize the results. Detailed guidelines and rubrics are available on Carmen Canvas.

Exam 1 (midterm, 12%)

All exams are take home. All students are expected to take exam 1 (midterm). Late exams will not be accepted except in case of emergency. Honor code applies.

Exam 2 or final paper (final, 17%)

Undergraduate students will take exam 2 (final). Exam 2 is also take-home, and will be in similar format as exam 1. Late exams will not be accepted except in case of emergency. Honor code applies. You may choose to write a final paper but only with approval from me.

Graduate students will write a final paper instead of taking exam 2. You are expected to consult with me during the semester about the topic, data gathering, and analysis. You will turn in a short proposal and final paper for grading on Carmen Canvas.

Details about each assignment, including guidelines and rubric, will be made available on Carmen Canvas.

Late submissions

By default, late submissions of assignments and final project (or paper) are subject to 5% grade reduction for each late day, up until the 10th day after the deadline. The max late penalty is 50%. **Submissions that are more than 10 days late will NOT be accepted (and Canvas submission portal will be closed), unless you have permission from the instructor before or on the due date.** Late submission is always better than no submission.

One-day automatic extension: You have one opportunity to extend your deadline for one day during the semester (indicate it in your submission to get the full credit). This extension will be applied to an assignment of your choice (including the final paper). No permission is required; you will indicate in your submission that you are using the one-day extension. I'd suggest that you use this opportunity wisely and reserve it for the end of the semester when the workload is unusually high.

In case of personal and family emergencies, please notify the instructor as soon as possible so that we can work out a new submission time. Such extensions will be granted on a case-by-case basis. If you fail to notify the instructor by 5 days after the deadline, your excuses will not be accepted and all blanket policies in this class will apply.

No late submission will be accepted for exams, unless in case of emergencies, and will be approved by me on a case-by-case basis.

Grading scale

A	A-	B+	B	B-	C+	C	C-	D+	D	E
≥93%	90-92%	87-89%	83-86%	80-82%	77-79%	73-76%	70-72%	67-69%	60-66%	<60%

Instructors' feedback and response time

We are providing the following list to give you an idea of our intended availability throughout the course. (Remember that you can call **614-688-4357(HELP)** at any time if you have a technical problem).

- **Grading and feedback:** For large assignments, you can generally expect feedback within **20 school days**, unless emergencies occur to the instructor.
- **Email:** I will reply to emails within **48 hours on school days when class is in session at the university**.

OTHER COURSE POLICIES

Academic integrity policy related to AI

See **Descriptions of major course assignments**, above, for my specific guidelines about collaboration and academic integrity in the context of this class.

Using AI as a research or troubleshooting tool is permitted in this class with caution: current large language models are known for producing misleading information (i.e., AI hallucination) or codes that don't operate correctly on your machine. **You may not use direct AI outputs as part of your submissions in this class. All usage of AI for class assignments should be acknowledged at the end of your paper. Failure to do so may result in grade penalty and/or further investigations of academic misconducts.** We strongly recommend that you use version control while working on your assignment (e.g., Google Docs or Microsoft Word that syncs to your OneDrive or other cloud services).

The instructor reserves the right to assign alternative tests (including, but not limited to, oral exams) in case students' submissions show signs of AI use.

If we suspect that a student has committed academic misconduct in this course, we are obligated by university rules to report my suspicions to the Committee on Academic Misconduct (COAM). COAM determines that you have violated the university's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact the instructor.

Copyright for instructional materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Additional OSU Policies

The following website: https://ugeducation.osu.edu/academics/syllabus-policies-statements/standard-syllabus-statements contains the Ohio State University's policies regarding:

- Academic Misconduct
- Artificial Intelligence and Academic Integrity
- Religious Accommodations
- Disability Statement with Accommodations for Illness
- Intellectual Diversity
- Grievances and Solving Problems
- Creating an Environment Free from Harassment, Discrimination, and Sexual Misconduct

The following website: https://ugeducation.osu.edu/academics/syllabus-policies-statements/optional-syllabus-statements contains the Ohio State University's policies regarding:

- Counseling and Consultation Services / Mental Health Statement
- Content Warning Language
- Military-Connected Students

ACADEMIC FREEDOM

The Ohio State University is committed to the "freedom of faculty to … discuss in classrooms, in their own manner, any material that is relevant to the subject matter as defined in the course syllabus" (rule 3335-5-01.B.2). Consistent with the principle of academic freedom, this course encourages open inquiry, critical questioning, and respectful debate. By ensuring the right to express thoughts, challenge assumptions, and pursue knowledge freely, academic freedom not only enriches individual growth but also upholds the integrity of higher education as a site of discovery.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Requesting accommodations

The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. If you anticipate or experience academic barriers based on your disability (including mental health,

chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

If you are ill and need to miss class, including if you are staying home and away from others while experiencing symptoms of a viral infection or fever, please let me know immediately. In cases where illness interacts with an underlying medical condition, please consult with Student Life Disability Services to request reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu.

Accessibility of course technology

This online course requires use of Carmen Canvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- Canvas accessibility (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- Collaborative course tools

COURSE SCHEDULE

This schedule is subject to change. The most updated schedule is available on Carmen Canvas.

Week	Start date	Topic	Reading	Major submission
1	1/12	Introduction to Spatial Data Analysis Meet R	Chi & Zhu, Chapter 1; Goodchild, 2000; Anselin, 1989	
2	1/19	**No class on Mon 1/19 - MLK Day** Correlation & Global Spatial Autocorrelation	Chi & Zhu, Chapter 2.1 - 2.4.3	
3	1/26	Local Spatial Autocorrelation	Chi & Zhu, Chapter 2.4.4	
4	2/2	Local Spatial Autocorrelation Simple Linear Regression	Hair, et al, pp 151-161	**Assignment 1**

Week	Start date	Topic	Reading	Major submission
5	2/9	Simple Linear Regression (II) Multiple Linear Regression (I)	Hair, et al, pp 161-181	
6	2/16	Multiple Linear Regression (II)	Hair, et al, pp 182-203	
7	2/23	Regression Diagnostics (Aspatial)	Hair, et al, pp 203-230	**Assignment 2**
8	3/2	Regression Diagnostics (Spatial)	Chi & Zhu, Chapter 3.1	
9	3/9	Generalized Linear Regression (I)	Gelman & Hill, pp 79-108	**Exam 1 (Wed- Fri)**
10	3/16	**NO CLASS – SPRING BREAK**		
11	3/23	Generalized Linear Regression (II)	Gelman & Hill, pp 109-117	
12	3/30	Spatial Regression 1 (SAR + SEM)	Chi & Zhu, Chapter 3.2	
13	4/6	Spatial Regression 2 (practice)	Chi & Zhu, Chapter 3.3	**Assignment 3**
14	4/13	Spatial Regression 3: combined lag and error models, Geographically Weighted Regression	Chi & Zhu, Chapter 4.1 - 4.2 Chi & Zhu, Chapter 5.1, 5.3	***Grad students: final project proposal***
15	4/20	Spatial Regression 4 (GWR, practice)	Chi & Zhu, Chapter 5.1, 5.3 Fotheringham & Brunsdon, Chapter 1	**Assignment 4** ***Grad students: final project progress check***
16	4/27	Class wrap-up		**Exam 2 (undergrad - due Fri) / Final paper (grad)**