

**Intermediate Spatial Data Analysis**  
**GEOG 5103**  
**Spring 2021**

**RPAC B138E, Monday/Wednesday 11:10-12:30**

**Instructor**

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Office Hours: Tuesday 2-3 (virtual), or by appointment

**Course Description**

**OSU Catalog Description:** Application of quantitative methods to geographic problems; spatial statistics, area sampling, maps of residuals, regionalization methods, and simulation maps.

**My Description:** Geography is a diverse discipline with a wide variety of subject matter including physical (environmental), human (socio-economic), and integrated (human-physical) topics of inquiry. Even within physical geography, biogeographers study different phenomena than hydrologists and climatologists. Therefore, it is not surprising to learn that there are a variety of advanced analytical methods that geographers can employ in their studies. Space, and spatial data, complicate traditional statistics and geographic scientists have developed their own statistical tools to properly draw inferences from spatial data. 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, I want you to 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.

I don't believe in memorizing formulas or asking students to regurgitate those formulas. Therefore, this course emphasizes hands-on experience and practical/conceptual understanding. You should leave this course with confidence in the methods we have discussed and an appreciation for how these statistical methods are applied to issues in geographic research. 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. Throughout the course, I will be emphasizing the assumptions inherent in regression analyses, consequences of violating these assumptions, and (spatial) solutions when assumptions have been violated.

**Course Objectives:**

1. To 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. To obtain a rich set of 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. To enable you to confidently and carefully interpret the results of data analyses and clearly communicate those results.
4. To receive practical experience in using real datasets to address meaningful research questions.

**Course Website:** The course schedule, announcements, lecture notes, assignments, readings, datasets, and other course information will be posted on Carmen (<https://carmen.osu.edu>).

**Prerequisites:** Students enrolled in this course must have completed an introductory statistics course (e.g. GEOG 4103 or the old GEOG 5100). Introductory courses from other departments are sufficient to meet this requirement.

### **How this Course Works**

**Mode of delivery:** This course is a flipped classroom, hybrid model class. There are required weekly in-person sessions where you must be in the classroom at a designated time. During these in-class sessions, we will be working through R coding problems and working on homework. The rest of the course will be taught through asynchronous online learning modules.

**Pace of online activities:** This course is divided into **weekly modules** through Carmen that are released a week ahead of time. Students are expected to keep pace with weekly deadlines but may schedule their efforts freely within that time frame.

**Credit hours and work expectations:** This is a **3-credit-hour course**. According to Ohio State policy ([go.osu.edu/credithours](http://go.osu.edu/credithours)), students should expect around 3 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 4-6 hours of homework (reading and assignment preparation, for example) to receive a grade of (C) average. In a hybrid setting, you will have 1.5 hours of in-class instruction and I expect you to spend about 1.5 hours reviewing lectures, some of which may be recorded and others which may be presented synchronously online.

**Attendance and participation requirements:** Because this is a hybrid course, your attendance is based on both your in-class and online activity and participation. If you have a situation that might cause you to miss an entire week of class (or more), discuss it with me *as soon as possible*. The following is a summary of students' expected participation:

- **In-class synchronous learning: MANDATORY**
- **Participating in online asynchronous activities: AT LEAST ONCE PER WEEK**  
You are expected to log in to the course in Carmen every week. (I expect that you will probably log in many times each week.) You will be asked to review lectures, submit assignments, and monitor discussion boards via Carmen.
- **Office hours: OPTIONAL**  
Virtual office hours will be offered. Please email me if you'd like to chat outside that time.

### **Course Materials**

**Text:** 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 the Carmen site:

- Hair, Anderson, Tatham, and Black. (2014). *Multivariate Data Analysis*, 7<sup>th</sup> 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>)

**Additional Recommended Texts:**

- Bivand, R., E.J. Pebesma and V. Gomez-Rubio (2008). *Applied Spatial Data Analysis with R*. New York: Springer. (e-book available through the OSU Libraries – you must be on the VPN: <http://ebooks.ohiolink.edu/xtf-ebc/view?docId=tei/sv2/9781461476184/9781461476184.xml&query=&brand=default>)
- Dalgaard, P. (2008). *Introductory Statistics with R*. 2nd edition. New York: Springer. (e-book available through the OSU Libraries: <http://ebooks.ohiolink.edu/xtf-ebc/view?docId=tei/sv/9780387790541/9780387790541.xml&query=&brand=default>)
- Waller, L. and C. Gotway (2004). *Applied Spatial Statistics for Public Health Data*. New York: John Wiley. (e-book available through the OSU Libraries: <https://ebookcentral.proquest.com/lib/ohiostate-ebooks/detail.action?docID=214360>)
- Fortin, M-J. and M. Dale (2005). *Spatial Analysis: A Guide for Ecologists*. Cambridge: University Press.

**Software:** This course will use the R statistical software environment, which is a free and open source program for statistical computing and graphics (<https://www.r-project.org/>). There is both a MacOS and Windows version. We will also use R Studio (<https://rstudio.com/products/rstudio/>), which is a shell for enhanced visualization and programming. These software packages are available on the lab computers, but I recommend you download them and use your own computer. We will be doing "hands on" work in the classroom, so please bring your laptop to class each day.

**Grading:** Grades will be based on the following elements:

Homework	4 x 15% =	60%
Exams (take home)	2 x 15% =	30%
In-class exercises		10%

Late assignments up to 1 week late will be downgraded 20%, 100% thereafter. Students must complete all lab assignments to receive a passing grade, even if they are submitted too late to receive any points.

**Homework:** There will be four homework assignments, each of which is worth 15% of your overall course grade (12.5% for graduate students). Assignments will be posted by the Wednesday of the week noted in the schedule and due by 5pm the following Tuesday. 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. I will not be handing you a "script" for how to do a statistical analysis during the homework. I will

provide you with a dataset and some programming advice and ask you to figure out how to use the software packages we learn to run models and answer a set of broad questions. Homework assignments will be submitted electronically via Carmen.

I believe that teamwork is a crucial skill for today's workforce. Therefore, I encourage you to work together on homework assignments. There is a fine line between cooperative work and copying from one another. Please keep in mind that the purpose of this class is for you to understand how to use statistical techniques to analyze data. This goal will be facilitated by working in small groups – not by copying each other's answers. Therefore, talk and consult with other students as much as you like, but in the end each student is required to complete their own individual written work. If you have any questions or concerns about this distinction, please discuss them with me prior to turning in your assignment.

**Exams:** There will be two take-home exams that account for 30% of your overall course grade (midterm = 15%, final = 15%). I will typically open the exams on a Tuesday and it must be turned in by Friday at 5pm. Late exams will not be accepted. The content of the examination will include the range of topics covered during the course. In contrast to the homework assignments, exams are exclusively a test of individual work; therefore, you are not permitted to work together. Any question regarding the content or format of the exam should be directed to me.

All lab/exams must be typed, double-spaced, and use 12-point font. Formulas should be created using an equation editor. Tables should be constructed in Excel; graphs should be generated via R unless otherwise specified by the TA, in which case you will use Excel to generate them. An R file with the code you created for your assignments/exam should also be prepared and submitted with your lab write-up. This requires that you properly annotate your code and save it as a .R file. All assignments will be submitted via Carmen.

### **Additional Policies**

**Health and Safety Requirements:** All students, faculty and staff are required to comply with and stay up to date on all university safety and health guidance (<https://safeandhealthy.osu.edu>), which includes wearing a face mask in any indoor space and maintaining a safe physical distance at all times. Non-compliance will be warned first and disciplinary actions will be taken for repeated offenses.

**Religious Holidays:** Please contact me regarding any conflict between religious observance dates and course examinations or assignments.

**Statement on title IX:** Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <http://titleix.osu.edu> ([Links to an external site.](#)) or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at [titleix@osu.edu](mailto:titleix@osu.edu)

**Your mental health:** As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or

stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting [ccs.osu.edu](https://ccs.osu.edu) ([Links to an external site.](#)) or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at [suicidepreventionlifeline.org](https://suicidepreventionlifeline.org) ([Links to an external site.](#))

**Accessibility accommodations for students with disabilities (including COVID-related illness):** The University strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. 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. SLDS contact information: [slds@osu.edu](mailto:slds@osu.edu) ([Links to an external site.](#)); 614-292-3307; [slds.osu.edu](https://slds.osu.edu) ([Links to an external site.](#)); 098 Baker Hall, 113 W. 12th Avenue.

#### **Additional Student Support Services:**

**Student Advocacy Center:** Answer students' questions, direct students to appropriate resources and departments, provides general university guidance

- 614-292-1111 <http://advocacy.osu.edu/> ([Links to an external site.](#))

**Student Wellness Center: Promoting student wellness through nine dimensions of wellness**

- 614-292-4527 <http://swc.osu.edu/> ([Links to an external site.](#))

**Multicultural Center: Offering programs, services and outreach for all OSU students; supporting and celebrating all students through a intercultural model**

- 614-688-8449 <http://www.mcc.osu.edu/> ([Links to an external site.](#))

**Academic Advising:** Advising for undergraduate students on the Columbus campus is provided by the individual college or department that offers the program of study you are pursuing. This allows you to get advice from someone who knows the specifics of your curriculum

- <https://advising.osu.edu/> ([Links to an external site.](#))

Student Academic Services: Find information by topic and take care of your personal Buckeye business (i.e. Financial Aid and other services) online at [buckeyelink.osu.edu](http://buckeyelink.osu.edu) ([Links to an external site.](#)). Or speak with someone in person.

- Student Academic Services Bldg., Lobby  
281 W. Lane Ave. [[map \(Links to an external site.\)](#)]  
Monday–Thursday: 9 a.m. to 5 p.m.  
Friday: 9 a.m. to 4 p.m.

Academic Support Services: This includes various resources for learning support from tutoring and study strategies to stress management and confidence building.

- <http://younkinsuccess.osu.edu/academic-services/> ([Links to an external site.](#))

**Academic Misconduct:** Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the University’s Code of Student Conduct, and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the University’s Code of Student Conduct and this syllabus may constitute “Academic Misconduct.”

The Ohio State University’s Code of Student Conduct (Section 3335-23-04) defines academic misconduct as: “Any activity that tends to compromise the academic integrity of the University, or subvert the educational process.” Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an exam. Ignorance of the University’s Code of Student Conduct is never considered an “excuse” for academic misconduct, so I recommend that you review the Code of Student Conduct and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by University Rules to report my suspicions to COAM. If COAM determines that you have violated the University’s Code of Student Conduct, 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 me. Other sources of information on academic misconduct (integrity) to which you can refer include:

- The Committee on Academic Misconduct web pages (COAM Home)
- Ten Suggestions for Preserving Academic Integrity (Ten Suggestions)
- Eight Cardinal Rules of Academic Integrity ([www.northwestern.edu/uacc/8cards.html](http://www.northwestern.edu/uacc/8cards.html))