

## Term Information

Effective Term Spring 2021  
*Previous Value Autumn 2019*

## Course Change Information

### What change is being proposed? (If more than one, what changes are being proposed?)

We are proposing this course be offered in alternative formats. In addition to the traditional in person lecture, we propose to teach this course as a completely online course.

### What is the rationale for the proposed change(s)?

The new format will make the course more available to students in all terms who need the course offered in an alternative format to accommodate work or athletic schedules, greater accessibility needs, as well as to accommodate students who are away from the OSU campus. The COVID-19 pandemic has also made it necessary for our courses to have online offerings. Alternative formats will also provide greater capacity potential enrollments without detracting from student learning and instructor engagement.

### What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?

None

Is approval of the request contingent upon the approval of other course or curricular program request? No

Is this a request to withdraw the course? No

## General Information

Course Bulletin Listing/Subject Area Geography  
Fiscal Unit/Academic Org Geography - D0733  
College/Academic Group Arts and Sciences  
Level/Career Graduate, Undergraduate  
Course Number/Catalog 5103  
Course Title Intermediate Spatial Data Analysis  
Transcript Abbreviation Int Spatial Data  
Course Description An intermediate class in spatial data analysis for geography. This course focuses on multivariate model building and evaluation, with a special emphasis on multiple regression models commonly used by geographers: spatial regression, conditional autoregressive, and geographically weighted regression.  
Semester Credit Hours/Units Fixed: 3

## Offering Information

Length Of Course 14 Week, 12 Week  
Flexibly Scheduled Course Never  
Does any section of this course have a distance education component? Yes  
Is any section of the course offered 100% at a distance  
*Previous Value No*  
Grading Basis Letter Grade  
Repeatable No  
Course Components Laboratory, Lecture  
Grade Roster Component Lecture

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|                                   |          |
|-----------------------------------|----------|
| <b>Credit Available by Exam</b>   | No       |
| <b>Admission Condition Course</b> | No       |
| <b>Off Campus</b>                 | Never    |
| <b>Campus of Offering</b>         | Columbus |

## Prerequisites and Exclusions

|                                   |  |
|-----------------------------------|--|
| <b>Prerequisites/Corequisites</b> | Prereq: 4103.                              |
| <b>Exclusions</b>                 | Not open to students with credit for 5100. |
| <b>Electronically Enforced</b>    | Yes  |

## Cross-Listings

Cross-Listings

## Subject/CIP Code

|                         |                                   |
|-------------------------|-----------------------------------|
| <b>Subject/CIP Code</b> | 27.0501                           |
| <b>Subsidy Level</b>    | Doctoral Course                   |
| <b>Intended Rank</b>    | Junior, Senior, Masters, Doctoral |

## Requirement/Elective Designation

Required for this unit's degrees, majors, and/or minors  
The course is an elective (for this or other units) or is a service course for other units

## Course Details

|   |  |
|---|--|
| <b>Course goals or learning objectives/outcomes</b> | <ul style="list-style-type: none"><li>• It will emphasize spatial data handling and hands-on computational skills development and will focus on the use and interpretation of statistical output to answer questions most relevant to geographers.</li><li>• Experience with real-world examples</li><li>• Introduction to more advanced spatial data analysis methods</li></ul> |
| <b>Content Topic List</b>                           | <ul style="list-style-type: none"><li>• Geographic data</li><li>• Descriptive statistics</li><li>• Geographic Information Science</li><li>• Probability</li><li>• Hypothesis testing</li><li>• Analysis of variance</li><li>• Regression</li><li>• Spatial analysis</li></ul>  |
| <b>Sought Concurrence</b>                           | No   |

**Attachments**

- GEOG5103-asctech-review.docx: ASC Tech review  
*(Other Supporting Documentation. Owner: Xiao,Ningchuan)*
- GEOG5103-online-intermediate-spatial-data-analysis.docx: Online syllabus  
*(Syllabus. Owner: Xiao,Ningchuan)*
- GEOG5103-inperson-intermediate-spatial-data-analysis.docx: In-person syllabus  
*(Syllabus. Owner: Xiao,Ningchuan)*

**Comments**

**Workflow Information**

| Status           | User(s)   | Date/Time           | Step                   |
|------------------|---|---------------------|------------------------|
| Submitted        | Xiao,Ningchuan  | 07/20/2020 01:35 AM | Submitted for Approval |
| Approved         | Munroe,Darla Karin  | 07/24/2020 05:33 PM | Unit Approval          |
| Approved         | Haddad,Deborah Moore  | 07/25/2020 09:05 AM | College Approval       |
| Pending Approval | Jenkins,Mary Ellen Bigler<br>Hanlin,Deborah Kay<br>Oldroyd,Shelby Quinn<br>Vankeerbergen,Bernadette Chantal | 07/25/2020 09:05 AM | ASCCAO Approval        |

## Intermediate Spatial Data Analysis (ONLINE)

GEOG 5103

Spring 2021

### Instructor

Elisabeth Root, Associate Professor, Geography & Epidemiology

Email: [root.145@osu.edu](mailto:root.145@osu.edu)

Office: 1160 Derby Hall

Virtual Office Hours: XXX

### 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.

### **How this course works**

**Mode of delivery:** This course is 100% online. There are no required sessions when you must be logged in to Carmen at a scheduled time.

**Pace of online activities:** This course is divided into **weekly modules** that are released one week ahead of time. Each module is organized around a specific topic (see course schedule below) and consists of introduction videos, coding tutorials, and student activities. 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](#), a 3 credit hour course comprises 3 hours of instruction in class (including online instruction content and Carmen activities) and 6 hours of homework/study time outside class per week, for a total of 9 hours per course per week, for the student to earn a C grade.

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

### **Course Texts**

**Required 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, 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>)

**Recommended Texts:** Here are a few additional text books that are very useful for this course:

- 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>)
- Fortin, M-J. and M. Dale (2005). *Spatial Analysis: A Guide for Ecologists*. Cambridge: University Press.

## **Course technology**

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at <https://ocio.osu.edu/help/hours>, and support for urgent issues is available 24x7.

- **Self-Service and Chat support:** <http://ocio.osu.edu/selfservice>
- **Phone:** 614-688-HELP (4357)
- **Email:** [8help@osu.edu](mailto:8help@osu.edu)
- **TDD:** 614-688-8743

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Carmen

Technology skills necessary for this specific course

- CarmenZoom text, audio, and video chat
- Recording a slide presentation with audio narration
- Recording, editing, and uploading video

Necessary equipment

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

Necessary software

- R statistical software environment, which is a free and open source program for statistical computing and graphics (<https://www.r-project.org/>). T
- R Studio (<https://rstudio.com/products/rstudio/>), which is a shell for enhanced visualization and programming.

## **Carmen Access**

You will need to use BuckeyePass multi-factor authentication to access your course 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.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click “Enter a Password” and then click “Text me new codes” button that appears. This will text you ten passcodes good for 365 days that can be each used once.
- [Download the Duo Mobile application](#) 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 614-688-4537 (HELP) and the IT support staff will work out a solution with you.

### **Grading and Faculty Response**

Grades will be based on the following elements:

| <b>Assignment or category</b>         | <b>Percent</b> |
|---------------------------------------|----------------|
| <b>Problem Sets</b>                   | <b>30</b>      |
| <b>Homework</b>                       | <b>40</b>      |
| <b>Quizzes</b>                        | <b>20</b>      |
| <b>Discussion posts and responses</b> | <b>10</b>      |
| <b>Total</b>                          | <b>100</b>     |

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.

**Discussion posts & responses:** During each weekly module, 2 or more questions on the discussion board will be posted and students are required to post their responses. In addition, students are also expected to actively participate the discussion board by either posting their problems or responding to other students' posts (or both).

**Problem sets:** At the end of each weekly module, there will be a short review exercise that students will be required to finish by two days after wrapping up the online tutorial. These are typically reflection questions that are used to make sure students have completed the contents. Quick feedbacks will be provided to students.

**Homework:** For each major topic on the course schedule, there will be a homework assignment that includes in-depth analysis students are required to complete. There will be 4 assignments throughout the semester ( $4 \times 10 = 40\%$  of the total 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. 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.

All homework 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 or Excel. 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.

I believe that teamwork is a crucial skill for today's workforce. Therefore, I encourage you to work together on homework assignments. You may set up online groups and Zoom meetings to facilitate group work and interactions. 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.

**Quizzes:** Quiz will be given after we finish a major topic. There will be 4 quizzes throughout the semester ( $4 \times 5 = 20\%$  of the total grade). All exams will be administered online via Carmen quizzes. Typically you will have a 3 day window during which you can choose when to start and finish the exam, and 2 hours to actually take the exam once you open it and begin. Start and end dates will be clearly posted. 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, the 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, not the TA.

**Grading scale:** Grades are rounded to the nearest decimal point.

93–100: A  
90–92.9: A-  
87–89.9: B+  
83–86.9: B  
80–82.9: B-  
77–79.9: C+  
73–76.9: C  
70–72.9: C-  
67–69.9: D+  
60–66.9: D  
Below 60: E

**Faculty feedback and response time:** I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

- Grading and feedback: For the exercises, students should be able to see the grade and feedback in 3 days. For large assignments (homework and projects), the timeframe to expect feedback is generally **7 days**.
- E-mail: E-mails will be replied within **48 hours, and we aim for 24 hours during school days**.
- Discussion board: We will check and reply to messages in the discussion boards every **24 hours on school days**.
- Office Hours: Virtual office hours (held on CarmenZoom) require at least 24 hours notification and will only be offered during school days.

### **Attendance, participation, and discussions**

**Student participation requirements:** Because this is a distance-education course, your attendance is based on your online activity and participation. The following is a summary of everyone's expected participation:

- Logging in: **AT LEAST TWICE PER WEEK**  
Be sure you are logging in to the course in Carmen each week, including weeks with holidays or weeks with minimal online course activity. (During most weeks you will probably log in many times.) If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible*.
- Office hours & video recordings: **OPTIONAL OR FLEXIBLE**  
All video recordings will be posted, no live sessions. If you are interested in discussing an assignment in person, please contact us at the beginning of the week to schedule office hours by appointment.
- Participating in discussion forums: **2+ TIMES PER WEEK**  
As participation, each week you can expect to post at least two times (including your response to the discussion questions, your own questions, and other students' post).

**Discussion and communication guidelines:** The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- Writing style: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. Informality (including an occasional emoticon) is fine for non-academic topics.
- Tone and civility: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.

- Citing your sources: When we have academic discussions, please cite your sources to back up what you say. (For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.)
- Backing up your work: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

### **Additional Policies**

**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> 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) 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)

**Accessibility accommodations for students with disabilities:** The University strives to make all learning experiences as accessible as possible. 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); 614-292-3307; [slds.osu.edu](https://slds.osu.edu); 098 Baker Hall, 113 W. 12th Avenue.

**Accessibility of course technology:** This online course requires use of Carmen (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.

- [Carmen \(Canvas\) accessibility](#)
- Streaming audio and video (Kanopy & DocuSeek)
- Synchronous course tools

#### **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/>

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

- 614-292-4527 <http://swc.osu.edu/>

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/>

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/>

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). Or speak with someone in person.

- Student Academic Services Bldg., Lobby  
281 W. Lane Ave. [\[map\]](#)  
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/>

For more student services offered on the OSU main campus, visit <http://ssc.osu.edu>.

**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 examination. 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 ([northwestern.edu/uacc/8cards.html](http://northwestern.edu/uacc/8cards.html))

**Copyright disclaimer:** 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.

## Course Schedule (Tentative)

The following is a tentative course schedule. Detailed links to each reading and homework assignment /quiz will be provided on the Carmen course page.

| <b>Date</b>                                    | <b>Topic</b>   | <b>Reading</b>  | <b>HW/Q</b>    |
|--|--|---|----------------|
| Jan 6 <sup>th</sup> & 8 <sup>th</sup>          | Introduction to Spatial Data Analysis                    | Chi & Zhu, Chapter 1;<br>Goodchild, 2000; Anselin, 1989           |                |
| Jan 13 <sup>th</sup> & 15 <sup>th</sup>        | Correlation & Global Spatial Autocorrelation             | Chi & Zhu, Chapter 2.1 - 2.4.3                                    |                |
| Jan 20 & Jan 22 <sup>nd</sup>                  | NO CLASS 1/20 (MLK Day)<br>Local Spatial Autocorrelation | Chi & Zhu, Chapter 2.4.4  |                |
| Jan 27 <sup>th</sup> & 29 <sup>th</sup>        | Local Spatial Autocorrelation<br>Bivariate Regression    | Hair, et al, pp 151-161   | HW 1<br>Quiz 1 |
| Feb 3 <sup>rd</sup> & 5 <sup>th</sup>          | Multiple Regression (I)                                  | Hair, et al, pp 161-181   |                |
| Feb 10 <sup>th</sup> & 12 <sup>th</sup>        | Multiple Regression (II)                                 | Hair, et al, pp 182-203   |                |
| Feb 17 <sup>th</sup> & 19 <sup>th</sup>        | Regression Diagnostics                                   | Hair, et al, pp 203-230   | HW 2           |
| Feb 24 <sup>th</sup> & 26 <sup>th</sup>        | Regression Diagnostics (Spatial)                         | Chi & Zhu, Chapter 3.1  | Quiz 2         |
| March 2 <sup>nd</sup> & 4 <sup>th</sup>        | Generalized Linear Regression (I)                        | Gelman & Hill, pp 79-117  |                |
| March 9 <sup>th</sup> & 11 <sup>th</sup>       | SPRING BREAK   | -   |                |
| March 16 <sup>th</sup> & 18 <sup>th</sup>      | Spatial Regression (SAR & SEM)                           | Chi & Zhu, Chapter 3.2 – 3.3                                      | HW 3           |
| March 23 <sup>rd</sup> & 25 <sup>th</sup>      | Spatial Regression (SAR & SEM)                           |   | Quiz 3         |
| March 30 <sup>th</sup> & April 1 <sup>st</sup> | Spatial Regression (SEMSLR)                              | Chi & Zhu, Chapter 4.1 - 4.2                                      |                |
| April 6 <sup>th</sup> & 8 <sup>th</sup>        | Spatial Regression (CAR)                                 |   |                |
| April 13 <sup>th</sup> & 15 <sup>th</sup>      | Geographically Weighted Regression                       | Chi & Zhu, Chapter 5.1, 5.3<br>Fotheringham & Brunsdon, Chapter 1 | HW 4           |
| April 20 <sup>th</sup>                         | Catch-up and Conclusion                                  | -   | Quiz 4         |

**Intermediate Spatial Data Analysis**  
**GEOG 5103**  
**Spring 2020**

**Derby Hall 1080, Monday/Wednesday 11:10-12:30**

**Instructor**

Elisabeth Root, Associate Professor, Geography & Epidemiology

Email: [root.145@osu.edu](mailto:root.145@osu.edu)

Office: 1160 Derby Hall

Office Hours: XXX, or by appointment

**Teaching Assistant**

Sohyun Park

Email: [park.2627@osu.edu](mailto:park.2627@osu.edu)

Office: 0160 Derby Hall

Office Hours: WR 13:00-15:00, 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.

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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.

**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 some "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% (12.5% each for grads= 50%) |
| Exams (take home)                           | 2 x 15% = | 30%                             |
| In-class problem sets (e.g., participation) |           | 10%                             |
| <u>Graduate students only:</u>              |           |                                 |
| Article critique                            |           | 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 or the TA 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 distribute the exams on a Wednesday during class 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, the final exam is 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, not the TA.

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.

**Graduate Student Assignment:** I will ask graduate students in the class to provide a critical assessment of a journal article of my choosing about 2/3 of the way through the semester. This will count for 10% of your grade. Assessment of other researcher's work is a critically important skill for graduate students, and I will assess whether you can read an article applying statistical principles discussing in class and point out strengths and weaknesses of the researcher's assumptions, implementation of statistical methods, and interpretation of results.

**Attendance:** Attendance is required to gain an adequate understanding of the course material, complete homework assignments, and pass the exams. You do not need to email me to tell me that you will not be or were not in class on a specific day. However, if you need to miss more than one class session during the course of the semester, you should alert me to the necessity of your absences. It is your responsibility to find out what we covered in class when you were not in attendance. Do this by asking other students in the course or consulting with the TA. Do not email me to ask what we covered in lecture when you were not there.

### **Additional Policies**

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

**Disability Statement:** The University strives to make all learning experiences as accessible as possible. 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); 614-292-3307; 098 Baker Hall, 113 W. 12th Avenue.

**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 examination. 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))

## Proposed Lecture Schedule

| <b>Date</b>                                    | <b>Topic</b>   | <b>Reading</b>  | <b>HW</b> |
|--|--|---|-----------|
| Jan 6 <sup>th</sup> & 8 <sup>th</sup>          | Introduction to Spatial Data Analysis                    | Chi & Zhu, Chapter 1;<br>Goodchild, 2000; Anselin, 1989             |           |
| Jan 13 <sup>th</sup> & 15 <sup>th</sup>        | Correlation & Global Spatial Autocorrelation             | Chi & Zhu, Chapter 2.1 - 2.4.3                                      |           |
| Jan 20 & Jan 22 <sup>nd</sup>                  | NO CLASS 1/20 (MLK Day)<br>Local Spatial Autocorrelation | Chi & Zhu, Chapter 2.4.4  |           |
| Jan 27 <sup>th</sup> & 29 <sup>th</sup>        | Local Spatial Autocorrelation<br>Bivariate Regression    | Hair, et al, pp 151-161   | HW 1      |
| Feb 3 <sup>rd</sup> & 5 <sup>th</sup>          | Multiple Regression (I)                                  | Hair, et al, pp 161-181   |           |
| Feb 10 <sup>th</sup> & 12 <sup>th</sup>        | Multiple Regression (II)                                 | Hair, et al, pp 182-203   |           |
| Feb 17 <sup>th</sup> & 19 <sup>th</sup>        | Regression Diagnostics                                   | Hair, et al, pp 203-230   | HW 2      |
| Feb 24 <sup>th</sup> & 26 <sup>th</sup>        | Regression Diagnostics (Spatial)                         | Chi & Zhu, Chapter 3.1  |           |
| March 2 <sup>nd</sup> & 4 <sup>th</sup>        | Generalized Linear Regression (I)                        | Gelman & Hill, pp 79-117  | Exam 1    |
| March 9 <sup>th</sup> & 11 <sup>th</sup>       | NO CLASS – SPRING BREAK                                  | -   |           |
| March 16 <sup>th</sup> & 18 <sup>th</sup>      | Spatial Regression (SAR & SEM)                           | Chi & Zhu, Chapter 3.2 – 3.3  | HW 3      |
| March 23 <sup>rd</sup> & 25 <sup>th</sup>      | Spatial Regression (SAR & SEM)                           |   |           |
| March 30 <sup>th</sup> & April 1 <sup>st</sup> | Spatial Regression (SEMSLR)                              | Chi & Zhu, Chapter 4.1 - 4.2  |           |
| April 6 <sup>th</sup> & 8 <sup>th</sup>        | Spatial Regression (CAR)                                 |   |           |
| April 13 <sup>th</sup> & 15 <sup>th</sup>      | Geographically Weighted Regression                       | Chi & Zhu, Chapter 5.1, 5.3<br>Fotheringham & Brunson,<br>Chapter 1 | HW 4      |
| April 20 <sup>th</sup>                         | Catch-up and Conclusion                                  | -   | Exam 2    |

## Arts and Sciences Distance Learning Course Component Technical Review Checklist

**Course: Geog 5103**

**Instructor: Elisabeth Root**

**Summary: Intermediate Spatial Data Analysis**

| Standard - Course Technology  | Yes | Yes with Revisions | No | Feedback/<br>Recomm.  |
|---|-----|--------------------|----|---|
| 6.1 The tools used in the course support the learning objectives and competencies.  | X   |                    |    | <ul style="list-style-type: none"> <li>Office 365</li> <li>Carmen</li> <li>R and R Studio</li> </ul>  |
| 6.2 Course tools promote learner engagement and active learning.  | X   |                    |    | <ul style="list-style-type: none"> <li>CarmenZoom</li> <li>CarmenWiki</li> <li>Carmen Discussion Boards</li> </ul>  |
| 6.3 Technologies required in the course are readily obtainable.   | X   |                    |    | All tools are available via OSU site license free of charge.  |
| 6.4 The course technologies are current.  | X   |                    |    | All are updated regularly.  |
| 6.5 Links are provided to privacy policies for all external tools required in the course.   | X   |                    |    | No external tools are used.   |
| Standard - Learner Support  |     |                    |    |   |
| 7.1 The course instructions articulate or link to a clear description of the technical support offered and how to access it.  | X   |                    |    | Links to 8HELP are provided   |
| 7.2 Course instructions articulate or link to the institution's accessibility policies and services.  | X   |                    |    | a   |
| 7.3 Course instructions articulate or link to an explanation of how the institution's academic support services and resources can help learners succeed in the course and how learners can obtain them. | X   |                    |    | b   |
| 7.4 Course instructions articulate or link to an explanation of how the institution's student services and resources can help learners succeed and how learners can obtain them.                        |     | X                  |    | Add statement c   |
| Standard – Accessibility and Usability  |     |                    |    |   |
| 8.1 Course navigation facilitates ease of use.  | X   |                    |    | Recommend using the Carmen Distance Learning "Master Course" template developed by ODEE and available in the Canvas Commons to provide student-users with a consistent user experience in terms of navigation and access to course content. |
| 8.2 Information is provided about the accessibility of all technologies required in the course.   | X   |                    |    | No 3 <sup>rd</sup> party tools are used.  |
| 8.3 The course provides alternative means of access to course materials in formats that meet the needs of diverse learners.   | X   |                    |    | Instructions are provided to obtain materials in another format.  |
| 8.4 The course design facilitates readability   | X   |                    |    |   |
| 8.5 Course multimedia facilitate ease of use.   | X   |                    |    | All assignments and activities that use the Carmen LMS with embedded multimedia facilitates ease of use. All other multimedia resources facilitate ease of use by being available through a standard web browser                            |

### Reviewer Information

- Date reviewed: 7/13/20

- Reviewed by: Ian Anderson

**Notes: Add statement C and this is ready to go!**

<sup>a</sup>The following statement about disability services (recommended 16 point font):  
Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614- 292-3307, [slds@osu.edu](mailto:slds@osu.edu); [slds.osu.edu](http://slds.osu.edu).

<sup>b</sup>Add to the syllabus this link with an overview and contact information for the student academic services offered on the OSU main campus.  
<http://advising.osu.edu/welcome.shtml>

<sup>c</sup>Add to the syllabus this link with an overview and contact information for student services offered on the OSU main campus. <http://ssc.osu.edu>. Also, consider including this link in the “Other Course Policies” section of the syllabus.