GEOGRAPHY 287 Fall 2020
SPATIAL ANALYSIS, 3 credits
MWF 10:50-11:40am
Waterman 413 and synchronous participation for at-home students

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Office hours:	Mondays 4:30-5:30pm, Thursdays 8:30-9:30am on MSTeams (scheduled in 20 minute appointment blocks via Navigate)

COURSE DESCRIPTION
This course is designed to provide you with quantitative tools to address research questions in geography and associated disciplines. The course begins with a brief discussion of experimental design, probability concepts, assumptions embedded in parametric statistical techniques, and the nature of spatial data. The remainder of the course focuses on tools used for hypothesis testing and inferential problem solving, and spatial modeling. The course addresses the limitations of statistical inference for spatially dependent data and explores the use of spatial relationships to evaluate patterns and the underlying drivers of those patterns. Upon completion of the course you should:

- understand the assumptions behind a range of tests used for drawing statistical inferences
- be able to select and run the appropriate statistical test for assessing differences among groups or relationships among variables
- be familiar with statistical tools for evaluating spatial dependence and spatial patterns in data sets
- be able to apply statistical models spatially using mapping software
- be able to critically evaluate the limitations of quantitative methods for drawing inferences and making predictions
- use your understanding of spatial statistical approaches to read and consider a selection of recently-published studies that examine racial bias and marginalization in the U.S.

TEXT & READINGS
There are many excellent resources in a growing literature on spatial statistics and spatial analyses. I will refer to some of these over the semester and will provide references to important papers and texts. I also encourage you to search the literature for new publications that apply quantitative (and spatial) techniques to research questions in your area of interest. The textbook and readings I have selected for the course represent accessible and in some cases classic works on topics we will cover. In other cases, the readings represent applications of techniques we will practice. Some of the readings have been around for quite some time, but have been chosen because they are excellent introductory pieces to concepts developed in the course.

Textbook:
J. C. McGrew, Jr. and C. B. Monroe. 2014. An Introduction to Statistical Problem Solving in Geography, 3rd edition. Waveland Press. ISBN-10: 1478611197. This book can be purchased through the UVM bookstore or directly from the publisher at http://waveland.com/browse.php?t=419&r=d|113 for $55.95. There are new

and used copies available on Amazon starting at $35. Amazon also rents the book for $28. You will definitely need the book for this course!

Articles to be posted on Blackboard:

Agresti, A. and B. Finlay. 1997. Chapter 15, *Logistic Regression: Modeling Categorical Responses* in Statistical Methods for the Social Sciences. Prentice Hall.

Childs, C. 2004. Interpolating Surfaces in ArcGIS Spatial Analyst. ArcUser Magazine, July-September, 32-35.

Del Toro, J. , Tr. Lloyd, K. S. Buchanan, S. J. Robins, L. Z. B., M. G. Smiedt, K. S. Reddy, E. Rodriguez Pouget, E. M. Kerrison, P. A. Goff 2019. The criminogenic and psychological effects of police stops on adolescent black and Latino boys. Proceedings of the National Academy of Sciences,116 (17) 8261-8268; https://doi.org/10.1073/pnas.1808976116

Eberhardt, L. L. and J. M. Thomas. 1991. Designing Environmental Field Studies. Ecological Monographs, 61 (1): 53-73.

Brunsdon, C, S. Fotheringham, M. Charlton. 1998. Geographically weighted regression: modelling spatial non-stationarity. The Statistician, 47(3): 431-443.

Harvey, D. 1969. Explanation in Geography. London: Edward Arnold. *Chapter 4*: Scientific Explanation – the model of natural science and *Chapter 5*: Problems of Explanation in the Social Sciences and History.

Legendre, P. & M.-J. Fortin. 1989. Spatial Pattern and Ecological Analysis. Vegetatio, 80: 107-138.

Mennis, J. 2006. Mapping Results of Geographically Weighted Regression. The Cartographic Journal, 43(2): 171-179.

Pouyat, R., P. Groffman, I Yesilonis, and L. Hernandez. 2002. Soil carbon pools and fluxes in urban ecosystems. Environmental Pollution 116: S107-S118.

Raine S, Liu A, Mintz J, Wahood W, Huntley K, Haffizulla F. Racial and Ethnic Disparities in COVID-19 Outcomes: Social Determination of Health. *International Journal of Environmental Research and Public Health*. 2020; 17(21):8115. https://doi.org/10.3390/ijerph17218115

Sugg, M.M., Woolard, S., Lawrimore, M. et al. Spatial Clustering of Suicides and Neighborhood Determinants in North Carolina, 2000 to 2017. Appl. Spatial Analysis 14, 395–413 (2021). https://doi.org/10.1007/s12061-020-09364-1

COURSE FORMAT

This class is a methods-intensive course designed for students in physical and human geography, environmental and social science disciplines, and for students completing the Geospatial Technologies minor. Learning how to visualize and analyze a wide range of data types should prove very useful to many future endeavors, either as you move into the job market, or as you seek to be a more informed citizen and more critically evaluate news and research publications that present data and the analysis of it.

For Fall 2020, because of the COVID-19 pandemic, I am offering the course with the option to attend in person or remotely. If you are experiencing any symptoms of COVID-19 on any class day, you must stay off campus and participate remotely. I hope to have all of you participate synchronously during class sessions and ask and answer questions, but I will also record class sessions and make them available, in case you are ill or time-zone differences make synchronous participation difficult. It is your responsibility to stay current with the course content. All students enrolled in the MIXD section of the course will be expected to attend in person on the two test days scheduled. At-home students will be expected to take the exam during or before our scheduled test sessions, using a proctoring method that I will monitor.

In general, Monday sessions will be devoted to new content delivery. To be prepared, you should have read through the assigned reading for the week, at least in a cursory way, and be prepared to answer questions I may pose on the reading (or ask a question you have!). I will use Mondays to deliver a slide presentation on the method we will cover that week. Wednesday's class session will be asynchronous and a chance to apply the concepts to a data analysis problem. I will post a video recording that introduces a sample dataset and the analysis method we will use. I will also post a homework assignment and dataset for the homework. I advise you to listen/watch the video ahead of our Wednesday 10:50-11:40 class time, so that you can join me via MS Teams during class time to ask questions or hear questions posed by your classmates. This is a time you can be assured I am available that fits into your schedule, since you have this block of time scheduled for class. You'll be able to use it most effectively if you build in some time before Wednesday's class to tune into the class video and try the homework exercise. Friday's class session will be devoted to a discussion of the week's concepts and the homework assignment. You should always come to Friday's class having attempted the homework and reviewed the assigned reading and lecture. I will expect that you devote the three hours of class time weekly to class attendance and participation and roughly six hours per week to reading, completing homework, and reviewing lecture notes, in accordance with expectations for this 3-credit course (see http://catalogue.uvm.edu/undergraduate/enrollmentregistration/registration/ for definition of workload expectations of a credit hour).

CLASS POLICIES and EXPECTATIONS

- The Green and Gold Promise clearly articulates the expectations that UVM has for students, faculty, and staff to remain compliant with all COVID-19 recommendations from the federal CDC, the State of Vermont, and the City of Burlington. This include following all rules regarding facial coverings and social distancing when attending class. If you do not follow these guidelines, I will ask you to leave the class. If you forget your mask, you cannot enter the class and should go back and retrieve your mask. The Code of Student Conduct outlines policies related to violations of the Green and Gold Promise. Sanctions for violations include fines, educational sanctions, parent notification, probation, and suspension.
- We will use Blackboard for all course materials, Microsoft Teams for virtual class meetings and office hours, and two software packages, SPSS v. 27 and ArcGIS Pro v 2.6 for weekly exercises. Please read this UVM Knowledge Base article https://www.uvm.edu/it/kb/student-technology-resources/ for an overview of technology resources. Please read this UVM Knowledge Base article on AppsAnywhere https://www.uvm.edu/it/kb/article/appsanywhere/ for information on accessing software for download and using the Virtual Desktop to run ArcGIS Pro (necessary for Mac users). I will provide a detailed guide for getting access to SPSS and ArcGIS Pro. Students needing help getting their computers set up with Teams, accessing Blackboard, or dealing with other non-class specific technology issues should contact the Helpline (802-656-2604) for support.
- Please be sure you check your email regularly or ensure that you forward your UVM email to an address you check regularly. When emailing me, please type GEOG 287 in the subject line. Class announcements and assignment grades will be posted on our course Blackboard site. Email communications will be sent regularly to your UVM email address.
- Our class sessions will be audiovisually recorded for students in the class to refer back to, and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate orally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which

allows students to type questions and comments live. I will not publish the class recordings or make them available to anyone beyond those enrolled in our class and any note taker or transcriptionist provided by the Student Accessibilities Services office. Because participation is a required element of the course, you should speak with me prior to the drop deadline if you have concerns about participating in class while attending remotely.

- Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.). Students are also prohibited from sharing assessments (for example homework or a take-home examination) with those who have previously, are currently, or will in the future take this course. Students are also not permitted to share video recordings of class content. Violations will be handled under UVM's Intellectual Property policy and Code of Academic Integrity.
- I will expect that you are coming into the class with a previous course in geographic information systems (GIS) and basic familiarity with the ArcGIS software (ArcGIS desktop – aka ArcMap or ArcGIS Pro). I will provide refresher content that you can use to get up to speed on Pro (for former ArcMap users) or get acquainted with Pro (for users who have not used the ESRI software suite).
- You will have approximately one week to complete weekly assignments. Due dates will be provided for each assignment, and the assignments and datasets will be posted on Blackboard. Assignments must be turned in during class in order to receive full credit. Assignments turned in after the due date will receive a 10% per day (not including weekends) deduction. Once an assignment has been graded and returned to the class, you cannot receive credit for turning it in late. I advise you to begin working on assignments early, so that you have the optimal chance of completing them on time. Do not wait until the night before assignments are due to complete them – this gives you no safeguard for completion if you fall ill immediately before the due date.
- Students have the right to engage in religious observances of their choice. If you expect that a religious observance this semester will necessitate missing a class session, please provide me with a list of dates by Friday, Sept 11. Similarly, if you are participating in UVM varsity athletic event that requires an absence, please provide me with the Athletics Department memo outlining these dates. You will be responsible for any missed class material, but I will work with you to adjust deadlines to accommodate these absences.
- Students with documented academic accommodation needs should make an appointment to discuss these or stop by during office hours. I am happy to make the accommodations for you, but would like to discuss the best course of action.
- Please do not be shy about asking questions during class. No question is "stupid" and there's a good chance a classmate has a similar question. Our class sessions will be most interesting if you come with questions and use class time to inquire about concepts in the reading or exercises that you do not understand.
- All students are expected to complete an evaluation of the course at its conclusion. Evaluations will be anonymous and confidential. The information provided on your course evaluation, including constructive criticisms, will be used to improve the course.
- Academic integrity is an essential part of learning at UVM. UVM faculty, staff and students expect that students will conduct themselves in an ethical way while at the University and abide by the behavior written in *Our Common Ground*. Offenses against academic integrity are any acts which would have the effect of unfairly promoting or enhancing one's academic standing within the entire community of learners. Such acts are serious offenses, which insult the integrity of the entire academic community of

the University. Any suspected violations of the policy will not be tolerated and all allegations will be forwarded to the Center for Student Ethics & Standards. More information on UVM's code of academic integrity is available on the web at http://www.uvm.edu/~uvmppg/ppg/student/acadintegrity.pdf .

- The University of Vermont reserves the right to make changes in the course offerings, mode of delivery, degree requirements, charges, regulations, and procedures contained herein as educational, financial, and health, safety, and welfare considerations require, or as necessary to be compliant with governmental, accreditation, or public health directives.

OFFICE HOURS & HELP

I will hold regular office hours on a weekly basis to be available to answer your questions and provide help. My office hours will be held on Microsoft Teams. You can schedule a 20-minute consultation during office hours in the Navigate student app (see https://www.uvm.edu/registrar/eab-navigate if you do not have the app downloaded). I will also use Wednesday's class session from 10:50-11:40 exclusively for questions – this is a good time to join me and your classmates on MSTeams to get content and technical questions clarified.

GRADING

The final grade in the course will be based upon attendance and active participation in class discussions and upon performance on weekly exercises, a mid-term exam, and a final exam and porfolio as follows:

attendance, preparation and participation	15%
weekly exercises (deadlines strictly enforced)	35%
tests (2 over the semester)	25%
portfolio or project	25%

Additional details on flexible options for earning grades on attendance and exercises will be posted on Blackboard.

Graduate students enrolled in the course must complete both the portfolio and an independent project.

Course grades will be assigned according to the following scheme:

97-100: A+	87-89: B+	77-79: C+	67-69: D+
93-96: A	83-86: B	73-76: C	63-66: D
90-92: A-	80-82: B-	70-72: C-	60-62: D-

A cumulative score on all graded materials below 60 will result in a failing grade in the course.
I will keep Blackboard updated regularly with your grades. Please let me know if you think I have made an error in recording a grade for you.

WRITING and LAB REPORTS

The purpose of report writing for this class is to train you to write up the results of your analysis in a fashion appropriate for the publication of your work. Because of this purpose, we will follow a report style that includes *Introduction*, *Methods*, *Results*, and *Discussion* sections. For any given outlet (journal articles for academics, project reports for consultants or other professionals), the format of sections will vary, but using this style in this class will help train you to write about these key pieces of a research or project effort. Inserting these headers improves readability of your report and helps a reader navigate the document. Below are some general guides for each section, along with guidelines for supplemental material.

Introduction

The Introduction *sets context* for the reader. In most published work, this draws on other research and narrows in on your research topic. I will not ask you to review other published work relevant to the week's exercise, but you should strive to write a short introduction that frames the substance (not the method) of the research problem, beginning very broadly, and getting more narrow as you develop the paragraph. The paragraph should end with a statement of objective or goal for the exercise. Write the introduction as if you are a researcher; not as a student in a course.

Methods

The Methods section tells the reader *what you did*. Here, you do not need to lay out every step, but you should briefly describe the dataset, outline the hypothesis(es) or question(s) addressed, describe the analysis method(s) used, and the software employed. If the methods involve conducting statistical tests, this is the place to tell the reader the significance level at which you are evaluating a hypothesis.

Results

This section tells the reader *what you found*. Under no circumstances should you repeat a method here. Stick to what you found. This can include a statement of summary statistics (*values of the observations ranged from xx to yy; the mean of this group was zz*), and should include declarative statements that address the question(s) or hypothesis(es) posed (*… there is a statistically significant difference in ….*). When a statistic and probability value help support your statements of findings, these should be given parenthetically in the text or included on figures, rather than described at length in narrative form. When tables or figures help illustrate the results, they should be referenced parenthetically and in sequential order. These tables and figures should then be ordered from 1 to *n* in the sequence in which you refer to them in the text. We will look at examples of how researchers do this as we begin to prepare written reports.

Discussion

A Discussion section allows the researcher to reflect on the work and discuss its implications. Often, I will ask you questions on the assignment that I would like you to address in the Discussion section of your report.

Supplemental material (attached to the end of a report)

Reports will typically be illustrated with figures and occasionally tables. A figure is a map or graph. A table includes rows and columns of text and/or numbers. Each should include a label (Figure 1, Figure 2, Table 1, Table 2) and a caption (…Map of Vermont showing location of ….). All maps must follow appropriate cartographic standards, including legends that can be easily understood by a reader not familiar with your data. This requires that you avoid using abbreviated GIS layer names as titles or headers in your legend, that you label variables with appropriate units, that you develop classifications that can be understood by a reader (generally no more than 8-10 classes), and that you are attentive to significant figures, avoiding more decimal values that would reasonably expected for the precision of a measurement technique used to generate the data (i.e. if mapping precipitation in inches, expressing precipitation to more than one decimal place on the inch is probably not appropriate, since weather stations rarely measure to more than one-tenth of an inch).

SCHEDULE OF TOPICS & READINGS:

Week (dates)	Topics & Readings
1 (Aug 31, Sept 2, 4)	Study design and the nature of statistical inference Read: Mon: text Ch. 1; Wed: Harvey and Eberhardt & Thomas; Fri: text Ch. 2 pages 21-25 and Ch. 3 pages 39-45 + 52-53
2 (Sept 9, 11)	Mapping and describing spatial patterns and distributions Read: text Ch. 6 pages 93-96
3 (Sept 14, 16, 18)	Concepts in hypothesis testing, comparisons between two groups Read: text Ch. 9 pages 141-148 and Ch. 10 pages 155-159
4 (Sept 21, 23, 25)	Comparisons between multiple groups, analysis of variance Read: text Ch. 11; Pouyat et al.
5 (Sept 28, 30, Oct 2)	Correlation and linear regression analysis; mapping regression models Read: text Ch. 16 pages 239-241, Ch. 17
6 (Oct 5, 7, 9)	Building models for multiple regression analysis Read Ch. 18 pages 269-277
7 (Oct 12, 14, 16)	Regression diagnostics and review; Test #1 – Friday, Oct 16
8 (Oct 19, 21, 23)	Categorical data analysis Read: text Ch. 12 pages 187, 195-201
9 (Oct 26, 28, 30)	Logistic regression analysis: modeling and mapping Read: Agresti and Finlay
10 (Nov 2, 4, 6)	Geographically weighted regression Read: Brunsdon
11 (Nov 9, 11, 13)	Geographically weighted regression, continued – map visualizations Read: Mennis
12 (Nov 16, 18, 20)	Measuring spatial autocorrelation Read: text Ch 13; skim Legendre and Fortin
14 (Nov 23)	Test #2 – Monday, Nov 23
15 (Nov 30, Dec 2, 4)	Spatial statistics in action – disease transmission, racial bias and more Readings posted on Blackboard

Final project or portfolio due: Monday, Dec. 7 at midnight ET (end of our scheduled exam day).