GES 774: Statistics for Geographers – Spring 2025

Professor Ronald E. Wilson
Office Hours: By appointment.
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Classroom: Sondheim Hall, 007
University of Maryland, Baltimore County
1099 Hilltop Rd,
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Meeting Days: Thursday 6:00 pm – 8:30 pm
Session Dates: January 30 – May 24, 2023

Course Description

The purpose of this class is to learn how to analyze geographic data using several spatial statistical techniques. Students are given a foundation in basic statistical concepts followed with an in-depth review of spatial statistics, including an understanding of how each technique works. The emphasis in this course is on interpreting and describing analysis results.

Students will become familiar with the most common tools used for spatial statistics and gain an understanding how each techniques produces results. Specifically, students will use several spatial tools in the ArcGIS 10.7 Spatial Statistics Toolbox, Open GeoDa 1.8.1 and R Studio.

It must be *noted* and *emphasized* **THIS IS NOT AN INTRO TO GIS course** and the operation of a GIS will not be part of the instruction. Students are expected to have a moderate to strong experience with processing geographic data in a GIS environment in order to carry out the exercises in this course. Data from various sources are used in this course and will require the use of previously obtained GIS skills to prepare data and for analysis, such as executing spatial operations, manipulating attribute data, joining data sets spatially and non-spatially, and displaying results.

This class is divided into **for parts**. Part One is an overview of the fundamentals of geographical analysis and classical statistics. Basic mathematical calculations are examined and how they situate data within a geographic context for identifying spatial patterns through the calculation of several indices that incorporate geography.

Part Two will include the use of several global level spatial statistical techniques as the first step in conducting analysis of geographic data. The mechanics of each technique, their operation, what the output represents, and how to interpret them will be demonstrated and discussed. The main objective will be their interpretation and how the resulting global output guide local-level analysis.

Part Three will include several local level statistical techniques. The mechanics of each technique, their operation, what the output represents, and how to interpret them are demonstrated and discussed. It is

vital when using these techniques to understand what how they work to properly select which technique to use based on the analytical objective.

Part Four will cover basic regression concepts and its extension to include geography. The basics of classical linear regression will be covered, followed by how the technique incorporates geography into the classic framework. Also covered is linear regression is extended to account for spatial relationships, including how to assess the diagnostics for those spatial relationships.

The R programming language, using R Studio, may be used throughout the course in conjunction with ArcPro. The two will be used together to demonstrate the strengths and weakness of both tools and to take advantage of using each tool or preparing, cleaning, and visualizing data.

Articles and References

While there are no required textbooks for this course, journal articles, book chapters, and report sections are required for reading. These readings are listed below under the dates they are relevant to the current or next lecture. These articles will be made available for student use on the course website in Blackboard. Several reference articles, book chapters, report sections, or appendices that are relevant to the course materials will be provided for supplemental reading, but are not required.

The readings are pertinent to meeting assignment objectives and for students to adequately demonstrate they understand the material. These readings are meant to supplement the lectures and any labs and it is recommended that students keep pace with the readings to maximize their comprehension of the material.

Course Requirements

Competency with ArcPro or QGIS

This focus of this course is on the execution and interpretation of spatial statistics. As such, the assignments require students to be competent in the use of ArcGIS 10.x or higher or ArcPro 2.0 and higher. The course is analytically intensive and will involve working with large amounts of data. There is little time, nor opportunity to become competent in ArcGIS while attempting to complete the assignments. Students who wish to use QGIS may do so, but the expectation is that they complete all assignments on-time while not faulting the software or unfamiliarity with the software as reason for late submissions.

Exams

There are **no** formal in-class exams for this course. As an applied course, the emphasis is on gaining a thorough understanding of the spatial statistics and the tools used by working directly with raw data as part of a series of analyses. Students are expected to replicate the analyses presented during lecture by following along in class and taking notes. Recordings of the class for review are not always provided, and when provided they will be for extenuating circumstances that warrant a recording. Attendance and attention in the class is important toward developing an adequate foundation of statistical analysis of geographic data, to which participation is a keystone of developing that foundation.

Assignments

Students will be given a data set and are expected to replicate the analyses from the lectures to demonstrate an understanding of the techniques in relation to the concepts of geographical data analysis. As an applied course the emphasis will be on understanding the interpretation of analysis results, as well as how the statistical techniques operate and any methods employed in deriving results from those techniques. Knowledge of any statistical technique, analysis, and/or methods are demonstrated through written responses for assessment by the instructor to demonstrate comprehension. Assignment responses should be informed by a combination of materials covered in class, readings and discussions.

Assignment Ethos

UMBC guidelines state that for every credit, you should spend 2+ hours outside of class. The general expectation for graduate school, when you're taking fewer credits as a full-time load, jumps to 3+ hours per credit hour.

During outside class times, students are expected to do their own research about the topics and materials presented in classroom. The instructor is always available for guidance, but graduate school is about students learning how to use their own devices in solving assignment problems that can aid in completing the assignments.

Communications

Blackboard will be used to provide all student assignments, documents, and materials for the class. Grades will also be recorded in Blackboard for students to keep track of their progress. Communications between instructor, students, and teaching assistants will be done through our UMBC email accounts and DISCORD on a specific channel for the class. Class discussions and direct messages will, though, primarily be using DISCORD. Information on the class channel will be provided in class and posted on Blackboard at the start or ahead of class.

Student Evaluation:

To receive a letter grade of an ‘A’ the student must adequately demonstrate a full understanding of both aspects. The letter grade of a ‘B’ will be earned if the student is only able to demonstrate a solid understanding of one aspect but is lacking in the other. A letter grade of ‘C’ or lower will be given if the student is unable to demonstrate sufficient knowledge of either aspect. The number of assignments may range between nine and 11 depending on how well the class moves along in covering the material. The following is the grade percentage rubric across all assignments for the session:

Assignments (each)	8.4%
Total (8.4 * 12)	100.8%

Grades will be determined on a weighted percentage basis. 90-100% = A to A-; 80-89% = B+ to B-; 70-79% = C+ to C-; less than 70% = F.

For any reason an assignment cannot be turned in on time **a student MUST do** two things. First, the student must notify the instructor with a full description of the reason before the date it is due. Second,

the student must give a due date to turn in the assignment afterwards. That due date cannot be later than the start of the next class. If the assignment is not turned in by that date, then a letter grade will be deducted based off the grade the student received from initial review. If the assignment is not submitted two weeks after the due date, the student will receive no credit for the assignment.

Writing Quality Expectations for Assignments and Exams

This course is part of a curriculum that awards a Master's in Professional Studies (M.P.S.) degree. Because the course requires students to describe –in writing– their interpretations of statistical results it is expected that students will generate products that meet the professional standards of such a program. One of the main facets of an M.P.S. is to gain an ability to clearly communicate analytical results to audiences of all types. All assignment and project products for this course **are evaluated** on the student's ability to write high-quality reports on their analyses and findings. Exercises and projects are designed to train students on how to professionally report analytical results in documents or write software code that others will read or use. This is an important facet in demonstrating the value of geography and spatial analysis over other forms of analysis. All products, written or coded, must be refined and polished. **Poorly written assignments may be downgraded one letter from achieved grade.**

UMBC offers two options for helping students improve their writing. The first is through the Center for Academic Success, who directly help students improve their writing. The second option is through the UMBC Writing Center, which offers online tutoring for ANY written assignment in ANY course during both summer sessions. Students may choose to chat synchronously online with a tutor, or submit a paper and receive asynchronous feedback. All appointments must be made at least one day in advance of meeting for a session. The following is a rubric for writing expectations:

Grade	*Style*	*Substance*
A	Clear and novel organization Accessible and concrete language Few mechanical errors Noteworthy graphics	Well-supported arguments Use of pertinent examples and facts Awareness of complexities Appropriate use of sources
B	Clear and competent organization Few sentence errors Well-prepared graphics	A few incorrect statements Adequately supported statements Appropriate secondary sources
C	Clear organization Adequate content Adequate graphics	Several incorrect statements Major arguments supported Inconsistent use of sources
D	Unclear organization Many mechanical errors Incomplete visual graphics	Many incorrect or unclear statements Unsupported arguments Irrelevant or misapplied examples

Using Generative AI for Assignments

Generative AI (GenAI) such as ChatGPT, Bard/Gemeni, Windows CoPilot, or Bing may be used to help in completing assignments, projects, assessments, or in-class work. However, the results from using these tools must be in the context of the assignment's (i) objectives, (ii) subject matter, (iii) geographic context, and the (iv) data used in the analysis. GenAI is unable to provide an exact answer to the questions from an assignment because the tool can only provide a general answer from its stores of data about a subject that has broad application, not specific classroom encounters.

Successful use of the GenAI to meet the assignment objectives has students integrating AI-generated responses with their own writing for a more nuanced analysis that leverages the speed and processing power of tools but showcases a students' ability to apply their human skills of assembling and formulation specific responses. This process may even involve scrutinizing the GenAI's interpretations, possibly challenging or iteratively exploring responses further for deepening the insights about the subject or analysis with additional context-specific research or relevant theories. This process also may involve refining an integrated response by the student though a review by the GenAI tool.

When assessing assignments, projects, or in-class work, that used GenAI, students must revise the output to ensure that (i) the objective of the assignment is demonstrated, (ii) includes the subject being covered, (iii) uses the data from class, and (iv) depicts the geography being studied.

Plagiarism

Copying or using another's work in written or oral form –partial or complete– without giving credit to the other person is a serious academic offense and is taken **VERY** seriously in this class, by the Department and by the University of Maryland, Baltimore County. UMBC specifically defines plagiarism as anyone who:

> "knowingly, or by carelessness or negligence, representing as one's own in any academic exercise the words, ideas, works of art or computer-generated information and images of someone else."

Any student who plagiarizes will be referred to the Department Chair and will be subject to the policies of the university. In general, the consequences of plagiarism include failing an assignment, receiving a lower course grade, and even failing a course.

Examples of plagiarism are:

- Submit someone else's work as your own.
- **Soley submit what Generative AI provides you from a response.**
- Buy a paper from a paper-mill, website or other source.
- Copy sentences, phrases, paragraphs, or ideas from someone else's work, published or unpublished, without giving the original author credit.
- Replace select words from a passage without giving the original author credit. ·
- Copy any type of graphics, tables, graphs, or charts from someone else's work without giving the original author credit.

- Piece together phrases, ideas, and sentences from a variety of sources to write an essay.
- Build on someone else's idea or phrase without giving the original author credit.

Details about avoiding plagiarism, examples, and disciplinary policies should be reviewed to gain a clear understand prior to working on an assignment or exam.

In Final… A Note About Mac Use

There are no version of ArcGIS and ArcPro for Mac computers. As such, students need to make arrangements to complete the assignments. There are three options for using ArcPro on a Mac, which can be found here: **Install ArcGIS On A Mac.** There is also the option of using a virtual machine to run ArcGIS/ArcPro on a server from the Mac. Please contact Charlie Kaylor ckaylor@umbc.edu at for help in getting you set up with the Mac.

QGIS will and can be used as an alternate GIS in this class for mapping and other geo-processing tasks. However, the assignments must be completed according to the requirements for the final map products that are an output of the GIS. This means, if an assignment comes up short in meeting the requirements or objectives because of a limitation in QGIS, then the complete points for that assignment cannot be awarded because the decision to use an alternate software than what is used in the class rests on the student's choice. The loss of points can be minor or significant depending on the assignment. This same principle extends to the use of R and Python for making maps.

Course Structure & Outline:

Semi-Hybrid Course: *This class is primarily in-person, with up to four classes being held virtually. There may be instances due to inclement weather or emergencies that will require the class to be virtual beyond the number listed above. When classes are held virtually, we will use Collaborate in the Blackboard Course Room. Any class meeting date that is scheduled to be virtual, students will be notified in advance so they can plan accordingly to be available on Collaborate. Otherwise, the class is in-person.*

Class contents, topics, and coverage are subject to change during the semester based on the pace of learning in the class or as opportunities to enhance learning present themselves. First and foremost, the objective of the class is for all students to gain the maximum knowledge and experience on the topics covered in class. Comprehension will not be sacrificed to expediency just to check the box that something was covered and to reach completed checklist.

Readings listed in each class may or may not be assigned for that class when the date arrives. It may be decided that the readings that on that class date are no longer needed or relevant based on the material covered. As well, additional readings may be added or changed based on the material covered in the class. Students should check Blackboard for the "official" readings assigned for that class.

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Part I: Foundations of Geographical Analysis

Thursday, January 30

Lecture: Foundations of Spatial Statistical Analysis

Lab: None

Reading: Davies, W. (2017). *How Statistics Lost their Power – and Why We Should Fear What Comes Next*. The Guardian, January, pp. 1 – 18.

Desai, A., Greenbaum, R. T., & Yushim, K. (2009). Incorporating Policy Criteria into Spatial Analysis. *The American Review of Public Administration*, 39(1): 23 – 42.

Getis. A. (2000). Chapter 16; Spatial Statistics. In Longley, P., Goodchild, M., Maguire, D., & Rhind, D. *GIS: Principles, Techniques, Management, and Applications*: pp. 239 – 251.

Video: Wilson, R. (2021). Section 2: Why Use Statistics – *Lecture*. 20:53: mm/ss.

Reference: Burt, J. E., Barber, G. M., & Rigby, D. L. (2009). Elementary Statistics for Geographers, 3rd Edition. New Guilford Press. New York, NY.
Chapter 1; Statistics in Geography, pp. 3 – 36.

Assignment: None

Thursday, February 06

Lecture: Incorporating Geography into Statistics

Lab: Calculating the Location Quotient

Reading: Pruitt, S. L., Lee, S. C., Trio, J. A., Xuan, L., Ruiz, J. M. & Inrig, S. (2015). Residential Racial Segregation and Mortality among Black White and Hispanic Urban Breast Cancer Patients in Texas 1995-2009. *Cancer*, 121(11): 1845–1855.

Pominova, M., Gabe, T. & Crawley, A. (2021) The Pitfalls of Using Location Quotients to Identify Clusters and Represent Industry Specialization in Small Regions. International Financial Discussion Papers; Number 1329, pp. 1 – 25.

Various Authors (2005). The Location Quotient. *Science Direct: Science Topics – Terms, Concepts & Definitions*, pp. 1 – 14. Elsevier, New York, NY.

Video: Wilson, R. (2023). A Review of Data Distributions – *Lecture*. 53:21: mm/ss.

Reference: Burt, J. E., Barber, G. M., & Rigby, D. L. (2009). Elementary Statistics for Geographers, 3rd Edition. New Guilford Press. New York, NY.
Chapter 3; Statistics in Geography, pp. 95 – 155.

Assignment: Calculating the Location Quotient & Describing the Geographic Context

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Thursday, February 13

Lecture: Validating and Statistically Measuring Indices

Lab: Randomization in the Analysis of Geographic Data, Part I
Calculating a Random Comparison Distribution
Identifying Significant Geographies with Z- Scores

Reading: Feitosa, F. F., Camara, G. C., Monteiro, A. M. V., Koschitzki, T. & Silva, M. P. S. (2007) Global and Local Spatial Indices of Urban Segregation. *International Journal of Geographic Information Science*, 21(3): 299 – 323.

Tian, Z. (2013). Measuring Agglomeration Using the Standardized Location Quotient with a Bootstrap Method. *Regional Analysis & Policy*, 43(2): 186 – 197.

Video: Wilson, R. (2021). Section 3: Introduction to Distributions and Hypotheses Testing – *Lecture*. 20:10: mm/ss.

Assignment: Randomizing Locations & Comparing Statistics

Thursday, February 20

Lecture: The Focal Location Quotient

Lab: Modifying the Location Quotient to Account for Spatial Interaction

Reading: Batty, M. (2007). Spatial Interaction. In the *Encyclopedia of Geographic Information Science*. SAGE Reference Online. Thousand Oaks Press: pp 417 – 419.

Cromley, R. G. & Hanick, D. M. (2012). Focal Location Quotients: Specification and Applications. *Geographical Analysis*, 44(4): 398 – 410.

Goodchild, M. F. (2009). What Problem? - Spatial Autocorrelation and Geographic Information Science. *Geographical Analysis*, 41: 411 – 417.

Pun-Cheng, L. S. C. (2014) Distance Decay. *Working Paper*. The Hong Kong Polytechnic University, pp. 1 – 5.

Video: Wilson, R. (2024). The Four Spatial Theory Families – *Lecture*. 44:36: mm/ss.

Wilson, R. (2024). A Review of z-scores, p- and t-values – *Lecture*. 60:21: mm/ss.

Assignment: Calculating the Focal Location Quotient & Understanding Spatial Effects

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Part II: Global Level Spatial Statistics

Thursday, February 27

Lecture: The Mechanics of Global Spatial Autocorrelation

Distance Decay and Measuring Spatial Autocorrelation
Moran's I
Getis-Ord G
Geary's C

Lab: Calculating Global Measures of Spatial Patterns

Reading: Fortin, M. J. & Dale, M. R. T. (2009). Spatial Autocorrelation in Ecological Studies: A Legacy of Solutions and Myths. *Geographical Analysis*, 41: 392 – 397.

Miller, H. J. (2004). Tobler's First Law and Spatial Analysis. *Annals of the Association of American Geographers*, 94(2); pp. 254 – 289.

Reference: Wong, D.W.S. & Lee, J. (2005). *Statistical Analysis of Geographic Information with ArcView GIS and ArcGIS*:
Chapter 5; Point Pattern Descriptors, sections 5.1 to 5.3: pp. 185 – 207.
Chapter 8; Point Pattern Analyzers, sections 8.1 to 8.5: pp. 327 – 352.

Assignment: Calculating & Interpreting Global Measures of Spatial Autocorrelation

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Wednesday, March 06

Lecture: The Mechanics of Nearest Neighbor Distance Analyses

Lab: Calculating Spatial Dependence and Identifying Distance Parameters
Randomization in the Analysis of Geographic Data, Part II
Nearest Neighbor Analysis

Reading: Getis, A. (2009). Spatial Weights Matrices. *Geographical Analysis*, 41: 404 – 410.

Grossbart, S. L., Mittelstaedt, R. A., & Murdock, G. W. (1978). Nearest Neighbor Analysis: Inferring Behavioral Processes from Spatial Patterns. *Advances in Consumer Research*, 5; 114 – 118.

Rands, S. A. (2014). Nearest Neighbor Clusters as a Novel Technique for Assessing Group Associations. *Royal Society Open Science: Working Paper*, 2; 1 – 9.

Assignment: Calculating Distances and Describing the NNI Output

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Thursday, March 13

Lecture: K-order Nearest Neighbor
Median & Quartile-based Nearest Neighbor Distance Analysis

Lab: Generating Median & Quartile Nearest Neighbor Statistic
Modifying the Randomization in the Analysis of Geographic Data

Reading: Goodchild, M. F. (2011). Scale in GIS: An Overview. *Geomorphology*, 130; pp. 5 – 9.

Pezullo, J. (2013). The Bootstrap Method for Standard Errors and Confidence Intervals. In. Pezullo, J. *Biostatistics for Dummies*. John Wiley & Sons, Inc. Hoboken, NJ., pp. 1 – 4.

Wilson, R. E. & Din, A. (2018). Calculating Varying Levels of Clustering Among Locations. *Cityscape: A Journal of Policy Development and Research*, 20(1): 215 – 231.

Assignment: Calculating Median & Quartile Nearest Neighbor Statistics

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Thursday, March 20

Spring Break – No Class

Part III: Local Level Spatial Statistics

Thursday, March 27

Lecture: ZIP Codes and their Statistical Problems
Introduction to the HUD Cross-walk Files

Lab: Processing and Connecting HUD Cross-walk Data to Census Tract Geography

Reading: Din, A. & Wilson, R. (2018). Cross-walking ZIP Codes to Census Geographies: Geoprocessing the U.S. Department of Housing & Urban Development's ZIP Code Crosswalk Files. *Cityscape: A Journal of Policy Development and Research*. 22(1), 293 – 314.

Parenteau, M. P. & Swada, M. C. (2011). The Modifiable Areal Unit Problem (MAUP) in the Relationship between Exposure to NO2 and Respiratory Health. *International Journal of Health Geographics*, 10(58): 1 – 15.

Wilson, R. & Din, A. (2018). Analyzing and Enhancing the U.S. Department of Housing & Urban Development's ZIP Code Cross-walk Files. *Cityscape: A Journal of Policy Development and Research*. 20(2), 277 – 294.

Wong, D.W.S. (2004). The Modifiable Areal Unit Problem. In B. Warf, D. Janelle, and K. Hansen (eds.) World Minds: *Geographical Perspectives on 100 Problems*, pp. 571 – 578.

Reference: Brown, R. H., Barram, D. J., Ehrlich, E. M., & Scarr H. A. (1994). Chapter 11, Census Tracts and Block Numbering Areas. In *Geographic Areas Reference Manual*. pp. 2.1 – 2.19, 2-25 – 2.34, and 10-1 – 10.17.

Assignment: Disaggregating ZIP Code data to Census Tracts

Thursday, April 03

Lecture: The Mechanics of Aerial-based Statistics (Univariate)

Local Indicators of Spatial Autocorrelation (LISA)
Getis-Ord Gi
Local Geary's C

Lab: Interpreting the Univariate Moran's Scatter Plot and Identifying Clusters

Reading: Anselin, L. (2017). A Local Indicator of Multivariate Spatial Association: Extending Geary's C*. *Working Paper - Center for Spatial Data Science University of Chicago*, pp 1 - 25. November.

Braithwaite, A. & Li. Q. (2007). Transnational Terrorism Hot Spots: Identification and Impact Evaluation. *Conflict Management and Peace Science*, 24: 281 – 296.

Anselin, L. (2003): An Introduction to Spatial Autocorrelation Analysis with GeoDa. *Working Paper*.

Video: Local Measures of Spatial Autocorrelation - Data Preparation for Evaluating the Techniques – *Lecture*. 2:06:24: hh/mm/ss.

Reference: Anselin L. (2005):
Chapter 1; Getting Started with GeoDa, pp. 1 – 5.
Chapter 15; Contiguity-based Spatial Weights, pp. 106 – 116.
Chapter 16; Distance-based Spatial Weights, pp. 117 – 123.
Chapter 19; Local Spatial Autocorrelation, pp. 138 – 147.

Wong, D.W.S. & Lee, J. (2005). *Statistical Analysis of Geographic Information with ArcView GIS and ArcGIS*:
Chapter 3; Relational Descriptors: Two Variables (Bivariate), sections 3.1 to 3.4: pp. 94 – 107.
Chapter 8; Polygon Pattern Analyzers, sections 8.7 to 8.9: pp. 367 – 404.

Assignment: Calculating Local Clusters

Thursday, April 10

Lecture: Assessing the Impact of the Modifiable Areal Unit Problem on Statistics

The Modifiable Areal Unit Problem (MAUP)
The Density Accuracy Index (DAI)
Sensitivity Analysis

Lab: Calculating the DAI and Filling in the Results Table

Reading: Parenteau, M. P. & Swada, M. C. (2011). The Modifiable Areal Unit Problem (MAUP) in the Relationship between Exposure to NO2 and Respiratory Health. *International Journal of Health Geographics*, 10(58): 1 – 15.

Wong, D.W.S. (2004). The Modifiable Areal Unit Problem. In B. Warf, D. Janelle, and K. Hansen (eds.) World Minds: *Geographical Perspectives on 100 Problems*, 571 – 578.

Video: Wilson, R. (2024). The Modifiable Areal Unit Problem (MAUP) – *Lecture*. 2:12:20: hh/mm/ss.

Assignment: Calculating the DAI and Assessing the Results Table

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Part IV: Basics of Regression with Geography

Thursday, April 17

Lecture: Introduction to Regression: Regression Model Basics

Lab: Interpreting Regression Output

Reading: Burt, J. E., Barber, G. M., & Rigby, D. L. (2009). Elementary Statistics for Geographers, 3rd Edition. New Guilford Press. New York, NY.
Chapter 13; Extending Regression Analysis, pp. 498 – 530.

Nau, R. (2014). Notes on Linear Regression. *Working Paper*, 1 – 18.

Wilson, R. (2014). The Neighborhood Context of Foreclosure and Crime. *Cartography and Geographic Information Science*, 42(2): 162 – 177.

Video: Section1 - Setting the State - Thinking about Statistical Models) – *Lecture*. 18:03: mm/ss.

Reference: Nau, R (2014).
Models: http://people.duke.edu/~rnau/411home.htm
Introduction: http://people.duke.edu/~rnau/regintro.htm
Mathematics: http://people.duke.edu/~rnau/mathreg.htm
Output: http://people.duke.edu/~rnau/411regou.htm
Additional Notes: http://people.duke.edu/~rnau/regnotes.htm

Assignment: None

Thursday, April 24

Lecture: Introduction to Spatial Regression: Representing Spatial Relationships

Lab: Interpreting Spatial Regression Output, with Spatial Lag and Error Specification

Reading: Anselin, L. (2002) Under the Hood - Issues in the Specification and Interpretation of Spatial Regression Models. *Agricultural Economics*, 27: 247 – 267.

Blackhurst, M., Briem, C., and Deitrick S. (2019). Contrasting Different Geographies in Fair Market Rents. *Cityscape: A Journal of Policy Development and Research*, 21(3): 187 – 206.

Hipp, J. R. & Chamberlain, A. W. (2015). Foreclosures and Crime: A City-level Analysis in the Southern California of a Dynamic Progress. *Social Science Research*, 51: 219-232.

Video: Wilson, R. (2021). Section 4: The Mechanics of Ordinary Least Squares (OLS) Regression – *Lecture*. 26:30: mm/ss.

Wilson, R. (2021). Section 5: Model Building in Ordinary Least Squares (OLS) Regression – *Lecture*. 22:30: mm/ss

Reference: Logan (2008). Spatial Regression with GeoDa. *Working Paper,* 1 – 12.

Scott, L. (2009). Answering Why Questions - An Introduction to Using Regression Analysis with Spatial Data. *Arc User*, Spring: 41 – 43.

Assignment: Interpreting Spatial Regression Output

Thursday, May 01

Lecture: Geographic Weighted Regression I - Localized Regression Models

Lab: Interpreting local regression spatially smoothed estimates and diagnostics.

Reading: Brunsdon, C., Fotheringham, A. S., and Charlton, M. (1998). Geographically Weighted Regression: Modeling Spatial Non-Stationarity. *The Statistician*, 47(3): 431 – 443.

Charlton, M. and Fotheringham, A. S. (2009). Geographically Weighted Regression: *White Paper – National Centere for Geocomputation, National University of Ireland Maynooth*, 1 – 17. March.

Park, M. (2013) Housing Vouchers as a Means of Poverty Deconcentrating and Race Desegregation: Patterns and Factors of Voucher Recipients' Spatial

Concentration in Cleveland. *Journal of Housing and the Built Environment*, 28: 451 – 468.

Xu, Y. H., Pennington-Gray, L. & Kim, J. (2019). The Sharing Economy: A Geographically Weighted Regression Approach to Examine Crime and Shared Lodging Sector. *Journal of Travel Research*, 58(7): 1193 – 1208.

Assignment: Interpreting Geographically Weighted Regression Results

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Thursday, May 08

Lecture: Geographic Weighted Regression II – Mapping Local Regression Results

Lab: Mapping local and spatially smoothed estimates and diagnostics.

Reading: Lin, C-H. & Wen, T-H. (2011). Using Geographically Weighted Regression (GWR) to Explore Spatial Varying Relationships of Immature Mosquitoes and Human Densities with the Incidence of Dengue. *International Journal of Environmental of Residential Public Health*, 8, 2,798 – 2,815.

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

Reference: Ziliak, S. T. & McCloskey, D. N. (2004). Size Matters: The Standard Error of Regressions in the American Economic Review. *The Journal of Socio-Economics*, 33: 527 – 546.

Assignment: Mapping Geographic Weighted Estimates and Diagnostics

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Appendix – University Addendums:

Students with Disabilities:

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

SDS email: disAbility@umbc.edu
SDS phone: 410-455-2459

If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

Sexual Assault, Sexual Harassment, and Gender Based Violence & Discrimination

UMBC Policy in addition to federal and state law (to include Title IX) prohibits discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment, or related retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources. The Title IX Coordinator can be reached at titleixcoordinator@umbc.edu or 410-455-1717.

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in making a report, please use the Online Reporting/Referral Form. Please note that, if you report anonymously, the University's ability to respond will be limited.