GES 673: Processing Geographic Data – Spring 2024

Professor Ronald E. Wilson
Office Hours: By appointment.
rwilson@umbc.edu

Classroom: Sondheim Hall, 007 – GIS Lab
University of Maryland, Baltimore County
1099 Hilltop Rd,
Baltimore, MD 21250

Meeting Days: Thursday 6:00 pm – 8:30 p.m.
Session Dates: February 1 – May 14, 2024

Course Description & Coverage:

Geo-processing is about the cleaning and preparation of geographic data for analytical purposes. Numerous geo-processing tools are available in any GIS, with this course covering –in detail– the use of several tools in ESRI ArcGIS Toolbox. An emphasis in this course is on developing process methods to (i) modify data and make them available for use by a broad range of users and (ii) create new data to answer analytical questions. As such, the geo-processing tools are presented in a task-oriented manner that involves following a methodical process to results in standardized data sets and basic statistical information.

While geo-processing is commonly thought of as the application of a specific set of tools to manipulate geographic data, it is often the case that several tools are used in a systematic manner to prepare existing data or create new data to solve analytical problems. As such, students will gain an understanding of how to develop a geo-processing method that uses several tools to meet an objective. GIS operation theories will be covered to give students a framework for understanding how a GIS is used to store and manipulate geographic data. Students will also learn how to document their methods for the purpose of (i) allowing replication of the method and (ii) providing transparency for data quality assessment.

The intent is to transform students into GIS "power users" who have a broad knowledge range of geo-processing tools, including the development of a flexible intellect to assemble tools into a coherent and systematic method that produces quality results.

The course is divided into three sections, with classes in each section covering a stage of an overall geo-processing method. After a method is presented in full across a series of classes, students will replicate that method with a new data set to produce a final professional product as an assessment of their abilities and knowledge. Replication of the method using the geo-processing tools covered will reinforce the understanding of the tools by requiring students to critically assess how to assemble a method that produces quality data for use by others or in their own analyses.

Section I: Geo-processing to Prepare Data for Analysis introduces basic techniques and tools that are part of a geo-processing method to clean and/or prepare data for spatial analysis. Students will use vehicle crash data from the Commonwealth of Massachusetts to select crash types, standardize areal

geogarphies, spatially combine (aggregate) observations with the areal and line geographies, and summarize spatial relationships. Basic statistics will also be calculated to record crash information by areal geography for the purpose of user reporting.

Section II: Geo-processing Tabular Records to Summarize and Connect with Geography covers how to process tabular record data, with the objective to demonstrate the processing geocoded data that is not connected with a GIS layer (geography). Students will process tabular data that contains geographic data by summarizing records by geography with California mortality data. Students will also learn how to connect these results to geography for map visualization.

Section III: Geo-processing for Descriptive Statistics covers the use of several proximity analysis techniques to geo-process data for spatial analysis. Using Subsidence Incident Reports (reported sink holes) for the state of Florida, students will create a set of distance analysis statistics, summarize the results into a table, and interpret the results. Students will gain experience in creating statistics about geographic data from geo-processing, including how to evaluate the spatial relationships identified in the results.

Required Articles:

Textbooks are not required for this course. Instead, professional articles and book chapters are used to give students a deeper understanding of what geo-processing tools do, how they work, and how to think about using those tools in a methodical manner. All reading materials are provided and listed under their respective classes in the outline below. Most readings are for the next class on the date assigned, with some being more associated with the class they are assigned.

Assignments & Assignments:

Assignments

Students are given data sets though out the class and are expected to follow the geo-processing method from the lectures and demonstrate an ability to carry out the tasks of data processing, along with describing why the tasks are carried out in the procession. As an applied course, the emphasis is on comprehension of the geo-processing tools and the reasoning for the methodological approach.

Assignment Ethos

UMBC guidelines state that for every credit, graduate students should spend about 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.

Replication Projects

There are **no** formal in-class exams for this course. As an applied course, the emphasis is on gaining a thorough understanding of the geo-processing tools by working directly with raw data as part of a series of replication projects.

Three replication projects are given during the semester, one for each section of the class. The purpose of these projects is for students to repeat the method covered across the classes in each section. Student are expected to replicate the method presented using the geo-processing techniques/tools covered as an assessment of their understanding of the material presented. Students will also provide documentation their method to reveal insight into their critical thinking skills in completing the project. The documentation will also serve as an example of how to create a data processing guide so that other analysts can reproduce the results, thus providing transparency into the quality of the data.

Student Evaluation:

To receive a letter grade of an 'A' a student must adequately demonstrate a full understanding of the (i) geo-processing techniques presented in class in a way that shows (ii) an understanding of their part in a method to meet a data processing objective. The letter grade of a 'B' will be earned if ta student is only able to demonstrate a solid understanding of one these aspects, but lacks 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. Letter grades of 'D' are rarely assigned. Anything less than an average performance of a 'C' in graduate school will receive an 'F.'

The following is the weighting rubric across the lab assignments and replication project:

Lab and Homework Assignments	15%
Replication Assignment 1: Cleaning and Processing Geographic Data for Analysis	30%
Replication Assignment 2: Geo-processing Tabular Record Data for Use in a GIS	25%
Replication Assignment 3: Analytical Geo-processing for Statistical Reporting	30%
Total	100%

Grades are based on a weighted percentage: 94-100% = A; 90-03 = A-; 87-89% = B+; 84 to 86 = B; 80 to 83 = B-; 77-79% = C+; 74 to 76 = C; 70 to 73 = C-; less than 70% = F.

SGTW Rule: Just because a student tries, it does not guarantee a passing grade.
MP Rule: Just because a student does well in a technical class, does not translate into an expectation of doing well in an analytical class.

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.

Regardless, the student will still be responsible for ensuring that all assignments are completed and for any material that we cover in class. It is the student's responsibility to identify other students, the Teaching Assistant (TA), the instructor, or any outside source that will aid in completing the assignments.

Writing Quality Expectations for Assignments and Projects

This course is part of a curriculum that awards a Masters 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 **will be evaluated** on the student's ability to write a high-quality report of 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 thoroughly defined 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 USG 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

UMBC Statement on Disabilities and Information for Obtaining Accommodations:

UMBC is committed to eliminating discriminatory obstacles that may disadvantage students based on disability. Services for students with disabilities are provided for all students qualified under the Americans with Disabilities Act (ADA) of 1990, the ADAAA of 2009, 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 reasonable

accommodations that would allow students to have equal access and inclusion in all courses, programs, and activities of the University.

If you have a documented disability and need to request academic accommodations, please register with the Office of Student Disability Services (SDS) as soon as possible. To begin the registration process, please visit the SDS website and review the registration information, including disability documentation guidelines and how to submit the SDS registration form online using the confidential software called Accommodate. https://sds.umbc.edu/accommodations/registering-with-sds/

Once accommodations are approved, you and your instructors will be notified via an emailed accommodation letter from the SDS office. Both the SDS office and Shady Grove's Center for Academic Success (CAS) will work with you to ensure you receive the approved accommodations. If you have any questions or concerns, please contact the Office of Student Disability Services via email at disAbility@umbc.edu or phone at 410-455-2459. Please note that accommodations are not retroactive and begin once SDS sends an approved accommodation letter.

For students at the Shady Grove campus, the Center for Academic Success (CAS) provides additional support. CAS provides test-proctoring services and can act as a liaison between students at USG and their home campus, as well as between students and their professors. For more information on the services CAS provides, please contact Kaitlin Mills (kmills3@umd.edu) or visit https://shadygrove.umd.edu/student-services/center-for-academic-success/dss.

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 using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations.

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.

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. 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 Program Directors 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 or AI's work as your own.
- 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, maps, 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.
- Using another person's maps as your own or using another's map as a foundation for making your own.
- Use Artificial Intelligence (AI) without reviewing and refining the output to ensure that is it correct and does not use another authors work that you are claiming to have produced.

Details about avoiding plagiarism, examples, and disciplinary policies should be reviewed to gain a clear understand prior to working on an assignment or exam. Resources are also available on campus to help students needing academic support on this subject at the Center for Academic Success.

A Note About Mac Use:

There are no versions of ArcGIS and ArcPro for Mac computers. As such, students using Macs as their personal machine must 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.** Please contact Charlie Kaylor ckaylor@umbc.edu at for help in getting set up with the Mac.

Course Structure & Outline:

Semi-Hybrid Course: *This class is primarily in-person, with up to four classes being held virtually. When classes are held virtually, we will use Collaborate in the Blackboard Course Room. Any class meeting date that is scheduled to be virtual ahead of time will be announced on Discord and listed in Blackboard. Otherwise, if there is not listing in Blackboard or announced on Discord, then 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. As such, the content of this below coverage of subjects and topics is subject to change, including the data selected for lab work.

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.

Part I: Geo-processing to Prepare Data for Analysis

Thursday, February 1

Lecture: Introduction to Geo-processing and Techniques
Geo-database Construction and Layer Management

Lab: Setting up the Working Environment and Preparing Data

Reading: Battista, B., Garrett, M., & Pirmann, C. (2019). GeoDatabase (.gdb) Data Curation Primer. *Working Paper,* pp: 1-26.

Martin, D. (1995). Chapter 4: Theories of GIS. In Martin, D., *Geographic Information Systems and their Socio-economic Applications*, pp. 44 – 64. Routledge, New York.

Thursday, February 08

Lab: Exploring Data and Basic Geometry Preparation

Reading: GeoBC & Regional Services. (2023). *Standards for Data Creation Publication, and Distribution, British Columbia Ministry of Land, Water, and Resource Stewardship*:
Chapter 3; Geodatabase Detailed File Geodatabase Standards, pp. 9 – 25.

Sui, D. & Morrill, R. (2004). Chapter 5: Computers and Geography: From Automated Geography to Digital Earth. In Martin, D., *Geography and Technology*, pp. 81 – 108. Routledge, New York.

Data: Commonwealth of Massachusetts: MassTRAC Vehicle Crashes – 2010

Thursday, February 15

Lab: Integrating Geometry to Create New Geographies, Part I

Reading: ESRI (2010) Understanding Geometric Processing in ArcGIS. *ESRI Technical Documentation*, 1 – 20.

Sylvie, S., Ubeda, T, Puricelli, A, & Laurini, R. (2000). A Methodology for Spatial Consistency Improvement of Geographic Databases. *GeoInformatica*, 4(1): 7 – 34.

Reference: GeoBC & Regional Services. (2023). *Standards for Data Creation Publication, and Distribution, British Columbia Ministry of Land, Water, and Resource Stewardship*:

Chapter 5, Applying File Geodatabase Standards – Step by Step Directions, pp. 31 – 57.

Wilson, R. (2024). Geo-processing Guide Stage I - Cleaning and Preparing Geographic Data for Analysis, pp. 1 – 8.

Data: Commonwealth of Massachusetts: MassTRAC Vehicle Crashes – 2010

Thursday, February 22

Lab: Integrating Geometry to Create New Geographies, Part II

Reading: ESRI (2010) Understanding Coordinate Management in the Geodatabase. *ESRI Technical Documentation*, 1 – 35.

Reference: Wilson, R. (2024). Geo-processing Guide Stage II - Integrating and Aggregating Geographic Data, pp. 1 – 8.

Data: Commonwealth of Massachusetts: MassTRAC Vehicle Crashes – 2010

Thursday, February 29

Lab: Aggregating Geography to Supplement Analysis

Reading: Milligram, R. J. & Wu, H. H. (2006). Ratios, Rates, Percents, and Proportions. 1 – 18.

Reference: Wilson, R. (2024). Geo-processing Guide Stage III - Spatially Aggregating Geographic Data. Documentation, pp. 1 – 16.

Data: Commonwealth of Massachusetts: MassTRAC Vehicle Crashes – 2010

Thursday, March 07

Lecture: Creating Basic Statistics from Geo-processing Data

Lab: Calculating Ratios, Rates, Percents, Proportions, & Odds

Reading: Wilson, R. and 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.

Data: Commonwealth of Massachusetts: MassTRAC Vehicle Crashes – 2010

Assessment: Replication of Geo-processing Method for Data Preparation
Florida Subsidence Incident Reports – 1980 to 2012

Part II: Geo-processing Records to Connect with Geography

Thursday, March 14

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

Lab: None – Class is Virtual on Blackboard Collaborate

Video Review: Wilson, R. E. (2023). The Modifiable Areal Unit Problem – Overview and Details.

Reading: 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 2, Census Tracts and Block Numbering Areas. In *Geographic Areas Reference Manual*. pp. 2.1 – 2.19 and 2-25 – 2.34.

Data: HUD 2016, Quarter 4 ZIP to County and ZIP to CBSA Cross-walk File

Monday, March 18

First Assessment Due: Replication of Geo-processing Method for Data Preparation

Thursday, March 21

No Class –Spring Break

Thursday, March 28

Lab: Processing and Connecting HUD Cross-walk Data to Census Tract Geography, with Interpretation of Results

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.

Grubesic, T. H. & Matisziw, T. C. (2006). On the use of ZIP Codes and ZIP Code Tabulation Areas (ZCTAs) for the Spatial Analysis of Epidemiological Data. *International Journal of Health Geographics*, 5(58), pp: 1 – 15.

Reference: Auffray, J. C., Renaud, S., & Claude, J. (2009). Rodent Biodiversity in Changing Environments. *Kasetart Journal*; 43, 83 – 93.

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. 10-1 – 10.17.

Data: HUD 2017, Quarter 4 ZIP to Census Tract Cross-walk File
New York City 311 Service Requests for Rat Sightings

Part III A: Geo-processing for Descriptive Statistics

Thursday, April 04

Lecture: Introduction to Descriptive Statistics

Lab: None – Class is Virtual on Blackboard Collaborate

Reading: Abdi, A. (2007). Z-scores. pp. 1 – 4.

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 and Geography, pp. 3 – 33.

Data: California Department of Public Health: Death Profiles – 1989 to 2022

Assessment: Replication of Cross-walking ZIP Codes to Census Tracts with the HUD Cross-walk Files with NYC COVId-19 Data – 2021

Thursday, April 11

Lab: Disaggregating Overlapping Geographies and Generating Proximities, Part I

Reading: Kwan, M-P. (2012). The Uncertain Geographic Context Problem. *Annals of the American Association of Geographers*. 102(5) pp: 958 – 968.

Data: California Department of Public Health: Death Profiles – 1989 to 2022

Monday, April 15

Second Assessment Due: Replication of Processing and Connecting the HUD Cross-walk File

---

Thursday, April 18

Lab: Disaggregating Overlapping Geographies and Generating Proximities, Part II

Reading: Grossbart, S. L., Mittelstaedt, R. A., & Murdock, G. W. (1978). Nearest Neighbor Analysis: Inferring Behavioral Processes.

Data: California Department of Public Health: Death Profiles – 1989 to 2022

Part III B: Geo-processing for Descriptive Statistics

Thursday, April 25

Lab: Proximity Analyses with Nearest Neighbor Techniques

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

Data: Florida Department of Environmental Protection: Florida Subsidence Incident Reports – 1943 to 2023

Thursday, May 2

Lab: Proximity Analyses with Buffer & Aggregation Techniques

Reading: Burt, J. E., Barber, G. M., & Rigby, D. L. (2009). Elementary Statistics for Geographers, 3rd Edition. New Guilford Press. New York, NY.
Chapter 3; Describing Data with Statistics, pp: 119 – 155.

Wilson, R. E. & Din, A. (2017). Measuring Distances to Resources. *Cityscape: A Journal of Policy Development and Research*. 19(2), 323-325,

Data: Florida Department of Environmental Protection: Florida Subsidence Incident Reports – 1943 to 2023

Thursday, May 9

Lecture: Interpreting Distance Analysis Statistics

Lab: Calculating Descriptive Ratios and Creating a Distance Table.

Reading: Burt, J. E., Barber, G. M., & Rigby, D. L. (2009). Elementary Statistics for Geographers, 3rd Edition. New Guilford Press. New York, NY.
Chapter 3; Describing Data with Statistics, pp: 119 – 155.

Data: Florida Department of Environmental Protection: Florida Subsidence Incident Reports – 1943 to 2023

Assessment: Replication of Proximity Geo-processing to Create Distance Statistics MassTRAC Vehicle Crashes – 2010

Thursday, May 15

No Class – Final Replication Assessment Work Day

Monday, May 20

Third Assessment Due: Geo-processing to Create Statistical Results

---