GIS 6125C: Geocomputation using R Programming

Dr. David Keellings   **W 12:50-3:50pm**   **3006 Turlington Hall**   **Fall 2023**

Office Hours
M/F 1-3pm, other times **BY APPOINTMENT ONLY**
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Note: For best results – utilize office hours. If you are having trouble with the course, come and see me sooner rather than later so that I can help you.

Course Description
This course is an introduction to geodata analysis using R. The course will be taught from the perspective of geographical and climate data analysis but serves as a broad introduction to the high-level programming language, R, as well as applied spatial data analysis. Students will load and manipulate data of different types, perform a variety of statistical analyses, generate graphical output, and create productive workflows using R alone. The primary outcome will be to facilitate students' use of R to analyze data of their own choosing on a final project. Students will present these methods to the class for others to critique, analyze and learn from. Code sharing and re-use is highly emphasized, as is collaboration. The course is designed as a 1-hour lecture plus 2-hour lab each week. *3 Credit Hours*

Student Learning Objectives
After completing the course, students should have developed a foundation of basic ability to program in R, be capable of performing statistical analyses using R, and generate meaningful graphical output of results. Specific learning objectives include:

- Identify common logic, flow control, and syntactic features within R code segments.

- Develop the technical ability to work with varied large and small datasets within R.

- Perform a variety of statistical analyses of geospatial data using R.

- Design informative visualizations of results that are of publishable quality.

- Apply technical skills to automate large workflows.

- Propose, execute, and defend a research project.

- Develop technical skills within R as a stand-alone software for data pre-processing, data analysis, and data visualization.

- Design detailed code segments and present these to others.

NOTE: This course is co-listed with GIS 4124 which is an undergraduate course. While the two will meet together and complete similar assignments, undergraduates and graduates will be evaluated on a different basis. Graduate students are required to present a code share to the class and lead a discussion of the code. Graduate students are also required to propose and execute a more rigorous independent data analysis project, complete a longer project report, and present their project to the class.

Course Resources

There is no required text for this course. However, you might find the following resources useful:

- Roger S. Bivand, Edzer Pebesma, Virgilio Gomez-Rubio, 2013. Applied spatial data analysis with R, Second edition. Springer, NY.
- Robin Lovelace, Jakub Nowosad, Jannes Muenchow, 2020. Geocomputation with R, 1st edition. CRC Press. https://geocompr.robinlovelace.net/index.html
- An Introduction to R manual is freely available here: https://cran.r-project.org/manuals.html

Furthermore, throughout the semester readings will be distributed and discussed. All of these readings will be free, online books or articles and will be posted on the class website.

Computer/Software Requirements

- R (http://cran.us.r-project.org) is a free command-line based statistical language.
- RStudio is a free IDE for R (http://www.rstudio.com/)

We will install these programs together at the first lab meeting. You will need to bring a laptop with these programs installed to regular class meetings. All of these programs are free and multi-platform compatible (Windows, Mac, Linux). Install R first and then RStudio. Use the latest versions of each.

Grades and Grading Scale

Labs (11 labs, lowest grade dropped): 40% (10 labs @ 4% each)
Code Share: 10%
Project Proposal: 10%
Project Presentation: 20%
Project Report: 20%

- **Labs:** Learning to program is challenging and weekly labs are reserved for in-class work and one-on-one instruction. For this reason, attendance in weekly labs is required. Labs missed without permission from the instructor will result in a zero for that week's lab assignment. Lab assignments are due by the end of the next lab period (one week after initial assignment). Late assignments will have 10 percent deducted from the possible total score for each day they are late (E.g. if you earn an 80% on the lab but are one day late you receive a 70%). The lowest lab grade will be dropped.

- **Code Share:** Students are expected to share a brief code snippet with the class. The code will perform a short task that has not been previously presented in lectures or labs. The student will lead the class through an exploration of the code and respond to questions/comments. Students will sign up for times to present their code snippets throughout the semester. Code sharing will facilitate enhanced learning of R programming by introducing students to code/concepts not otherwise covered in the class.

- **Project:** Working individually you will propose and execute an analysis of data in R. This analysis may be related to your graduate thesis/dissertation. You will be graded on the viability of your proposal i.e., is the proposed study suitable for an R workload and can the work be reasonably completed during the course of a single semester. You will present your project to the class at the end of the semester and also hand in a project report written in the form of a short paper not to exceed 10 pages, excluding references.

>=91.0% = A	90.0-90.9%= A-	87.0-89.9%= B+	81.0-86.9%= B
80.0-80.9%= B-	77.0-79.9%= C+	71.0-76.9%= C	70.0-70.9%= C-
67.0-69.9% = D+	64.0-66.9%= D	60.0-63.9%= D-	<60.0% = E

A grade threshold must be crossed in order to receive the letter grade indicated (no rounding). It is your responsibility to know your current grade. Grades will be posted to the course website. Information on current UF grading policies for assigning grade points may be found at https://catalog.ufl.edu/graduate/regulations/.

Make-Up Exams and Assignments
Students must notify the instructor as soon as possible in case of absence and provide documentation as to the reason for the absence. If deemed an excused absence, the student will be permitted one week from their return to classes in order to make up the missed work with no grade penalty. Requirements for make-up exams, assignments, and other work in this course are consistent with university policies that can be found at https://catalog.ufl.edu/graduate/regulations/

Late Work
Late assignments will have 10 percent deducted from the possible total score for each day they are late (E.g. if you earn an 80% on the work but are one day late you receive a 70%).

Canvas Course Website Information
This syllabus, announcements concerning exams, some lecture content, grades, and other course information will be posted on Canvas course management system. Access this page at https://elearning.ufl.edu/. If you miss a class, it is your responsibility to learn the material covered during your absence. Come see me if you have any questions. Students must activate their UF GatorLink account in order to use Canvas. If you need help learning how to perform various tasks related to this course or other courses that utilize Canvas, please consult the above webpage. You may also contact the UF Computing Help Desk at (352) 392- HELP(4357) or helpdesk@ufl.edu

Accommodations for Students with Disabilities
Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester. After initial arrangements are made with that office, notify me in writing as soon as possible, and a minimum of one week before an exam.

Academic Honesty
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code." On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor.

Attendance and Proper Conduct
I have no policy of mandatory attendance. You are all adults and can decide to come to class or not. But you are also the only person responsible for attaining the grade you want. When you enter the lecture room you are doing so of your own will, not because you are being forced to. When you make the choice you are also agreeing to show respect to your fellow students by allowing them to hear the lecture materials without having to compete with background chit-chat. Turn off cell phones, put away newspapers, and refrain from casual conversation once class begins. If you have a question – please raise your hand or ask at the end of class.

Recordings and Notes: It is not permitted to sell or distribute notes or recordings from this class without written consent of the instructor. Nor are students permitted to disseminate recordings of the instructor lecturing or post copies of assignments or exams on the internet.

The University of Florida is committed to an ethical, inclusive community defined by respect and civility. The University of Florida prohibits discrimination against any person. The UMatter website (https://umatter.ufl.edu/refer-or-report/) provides a list of reporting channels that can be used to report incidences of illegal discrimination, harassment, sexual assault, sexual violence, retaliation, threat assessment or fraud.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Click here for guidance on how to give feedback in a professional and respectful manner. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students here.

Your evaluations are used by faculty to improve their courses and teaching methods, and by department chairs and college deans to assess teaching effectiveness. Without your responsible input, we cannot effectively assess and improve teaching performance and student learning. Please be honest, fair, and constructive as you complete your evaluations.

Campus Resources

Health and Wellness

- U Matter, We Care: Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.
- Counseling and Wellness Center: http://www.counseling.ufl.edu/cwc, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.
- Sexual Discrimination, Harassment, Assault, or Violence: If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the Office of Title IX Compliance, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu
- Sexual Assault Recovery Services (SARS)
- Student Health Care Center, 392-1161.
- University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/

Academic Resources

- Career Resource Center, Reitz Union, 392-1601. Career assistance and counseling. https://career.ufl.edu/
- Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.
- Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

- Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.
- Student Complaints Campus: https://registrar.ufl.edu/complaint.html.
- On-Line Students Complaints: http://www.distance.ufl.edu/student-complaint-process.

Course Schedule (Subject to Change)

Week	Topics	Labs
1 Aug. 23	Introduction to R	NO LAB
2 Aug. 30	Intro to Geostatistics	Lab 1: Setting and Testing an R Programming Environment
3 Sep. 6	Programming Basics for Geodata	Lab 2: Exploring Data Using R, Basic Graphing
4 Sep. 13	Spatial Data Structures & Operations	Lab 3: Importing Data, Graphing, and Basic Analysis
5 Sep. 20	Mapping in R – Static & Interactive Maps	Lab 4: Programming Structures and Batch Processing
6 Sep. 27	Intro to Machine Learning – Random Forest for Classification & Regression	Lab 5: Controlling Program Flow and Problem Solving
7 Oct. 4	Analysis of Spatial Networks – Sustainable Transport Planning	Lab 6: Functions and Modularizing
8 Oct. 11	Time Series Analysis & Forecasting	Lab 7: Time Series Analysis
9 Oct. 18	Geomarketing – Location Analysis	Individual Project Work – **Proposal Due**
10 Oct. 25	Geostatistical Interpolation - IDW	Lab 8: Working with varied data formats
11 Nov. 1	Geostatistical Interpolation - Kriging	Lab 9: Spatial data objects and spatial data analysis
12 Nov. 8	Spatial Regression	Lab 10: Advanced analysis - spatial regression
13 Nov. 15	Extreme Value Analysis	Lab 11: Advanced analysis – extreme value analysis
14 Nov. 22	NO CLASS	NO LAB
15 Nov. 29	Project Presentations	NO LAB
16 Dec. 6	Project Presentations – **Paper Due**	NO LAB