BIOL 570-01: Statistical Programming for Biologists

Department of Biology, College of Charleston

Course and Instructor info:

- BIOL 570 Statistical Programming for Biologists
- Meeting time: 8-9:15 am TR; in RITA 271
- Instructor: Dr. Dan McGlinn
- Email: mcglinndj@cofc.edu
- Office: RITA 239
- Office hours: Tuesday 11 am or by appointment
- Course website: http://dmcglinn.github.io/quant_methods

Course Overview:

Programming and applied statistics are critical tools for scientists in this information age. This course is designed to introduce graduate students to programming and statistical analysis using the R language. Students will learn how to create reproducible workflows for importing, filtering, and statistically modeling data. This course will help students that are pursing futures in data science and graduate research.

Course Description:

The course is split into two halves. The first half focuses on gaining familiarity with R programming and version control for backing up code and developing a reproducible and robust workflow for quantitative analysis. Then we will transition into modeling with a focus on uni- and multi-variate response variables. Students will also gain familiarity with more advanced topics such as carrying out GIS operations, developing models that include spatial autocorrelation, and building simulations. The second half of the course is focused on student projects which will be evaluated on a weekly basis culminating in a peer-code review, oral presentation, and scientific paper.

Course Structure:

The course will be roughly divided in half between time spend learning about tools and time spend developing one's own project.

Student Learning Objectives:

In this course students will:

1. Learn to read and write R code using conditionals (if/else), loops, and functions.
2. Use the git version control system and be able to backup their code to the cloud.

3. Understand the assumptions and the interpretation of statistical models.
4. Be able to create and interpret graphics in the R environment.
5. Gain an understanding of data structures in GIS and how to use R to manipulate and map that data.
6. Use existing data and statistical methods to address their own research question over a multi-week research project.
7. Communicate the results of their statistical analyses in written reports, oral presentations, and a scientific paper.
8. Gain mentorship skills by engaging in peer-mentoring inclass and via peer-code review.

Student Evaluation:

Graduate Students will be evaluated based on the following criteria:

- 5% Participation including peer-mentorship
- 5% Quizzes
- 40% Assignments
- 50% Project
  - 10% project code
  - 20% oral presentation
  - 20% written description of analysis (e.g., Methods and Results section of a paper)

Project - The project in this course may span a wide range of potential topics including the analysis of data (collected by the student or a 3rd party), development of software (e.g., R shiny app or R package), and simulation modeling. The project must include a problem that can be addressed quantitatively. Students will develop their project in consultation with the instructor, and they will receive feedback early on in project development from their fellow classmates after a formal in class project pitch. At the end of the semester, the students' will submit their code for formal code review by their classmates and each student will deliver an oral presentation on their project findings.

More information on the project assignments and examples of past projects can be found on the Projects page.

Prerequisites:

- MATH 250 - Statistical Methods I or AP statistics credit
- BIOL 111/111L, 112/112L, 211/211D or 213/213D
- Permission from the instructor may be used to override missing prerequisites.
- Programming experience is not required but an interest in learning how to program is required.

Course Schedule:

Week	Date	Lecture Topic
1	Jan 11	Introduction to R
2	Jan 18	Introduction to Version Control & the Terminal
3	Jan 25	Regression and Simple Models
4	Feb 01	Project Feedback in class
5	Feb 08	Multivariate Models
6	Feb 15	Project Feedback in class
7	Feb 22	Spatial Models
8	Mar 01	Project Pitches

Week	Date	Lecture Topic
9	Mar 08	Spring Break
10	Mar 15	GIS manipulations
11	Mar 22	Project Feedback in class
12	Mar 29	Project Feedback in class
13	Apr 05	Peer Code Review and Peer Feedback
14	Apr 12	Project Feedback in class
15	Apr 19	Project Presentations; Course Evaluations

Code and Written project components due Friday of Week 14

Course Policies:

Required Materials - Access to a computer in which the free software R and Rstudio. A laptop computer will be helpful but is not required as the instructor will provide a university laptop to each student during class time as needed.

Class time - Our time in class will be used primarily for 1) learning new quantitative methods, 2) working on exercises, 3) presenting to the rest of the class, 4) developing student projects, and 5) engaging in peer-teaching.

Attendance Policy - You are expected to attend class and arrive on time and prepared for that days lesson. Failure to attend class or to be prepared will negatively impact your participation grade in the class.

Assignments - Most weeks during the first half of the semester there will be a homework assignment associated with the content learned in lecture. Your code and a written explanation of your solution are required. Although I encourage collaboration on code development, your explanation of your solution should be written in your own words. The assignment should be submitted via the appropriate OAKs dropbox. One problem from each assignment (selected at my discretion after the assignments have been submitted) will receive a thorough code review and a detailed grade. Other problems will be graded as follows:

- Produces the correct answer using the requested approach: 100%
- Generally uses the right approach, but a minor mistake results in an incorrect answer: 90%
- Attempts to solve the problem and makes some progress using the core concept: 50%
- Answer demonstrates a lack of understanding of the core concept: 0%

Typically assignments will be due on Friday morning. Late assignments will be docked 5% per day and will not be accepted after Monday night at 11:59 pm Eastern Time except in cases of genuine emergencies that can be documented by the student or in cases where this has been discussed and approved in advance. This policy is based on the idea that in order to learn how to program well students should be programming at least every other day. Time has been allotted in class for working on assignments and you are expected to work on them outside of class. It is intended that you should have finished as much of the assignment as you can based on what we have covered in class by the following class period. Therefore, even if something unexpected happens at the last minute you should already be close to done with the assignment. It also allows me to provide rapid feedback by returning assignments quickly, which is crucial to learning.

Final grades will be assigned based on the following scale:

Graduate Students

Letter	Grade	% Points	Quality Points
A	Superior	90 - 100	4
B+	Very Good	87 - 90	3.5

Letter	Grade	% Points	Quality Points
B	Good	80 - 87	3
C+	Fair	77 - 80	2.5
C	Acceptable	70 - 77	2
F	Failure	60 - 70	0
XF	Failure Due to Academic Dishonesty		0
RA-RF	Repeat; include GPA/exclude hours		

Students with Disabilities and Special Needs - Any student eligible for and needing accommodations because of a disability is requested to speak with the professor during the first two weeks of class or as soon as the student has been approved for services so that reasonable accommodations can be arranged. Center for Disability Services located in the Lightsey Center, Suite 104, 953-1431, SNAP@cofc.edu. If you have a documented disability and need accommodations, please come talk with me and bring your Professor Notification Letter (PNL) as soon as possible.

Academic integrity - Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when suspected, are investigated. Each incident will be examined to determine the degree of deception involved. Incidents where the instructor determines the student's actions are related more to misunderstanding and confusion will be handled by the instructor. The instructor designs an intervention or assigns a grade reduction to help prevent the student from repeating the error. The response is recorded on a form and signed both by the instructor and the student. It is forwarded to the Office of the Dean of Students and placed in the student's file.

Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XXF in the course, indicating failure of the course due to academic dishonesty. This status indicator will appear on the student's transcript for two years after which the student may petition for the XX to be expunged. The F is permanent.

Students can find the complete Honor Code and all related processes in the Student Handbook at: http://deanofstudents.cofc.edu/honor-system/studenthandbook/

Plagiarism - Plagiarism is any use of words or ideas produced by another person without proper attribution, and includes failing to paraphrase adequately or to cite sources properly. Plagiarism, both intentional and unintentional, is forbidden by the honor code. Please consult the instructor if you have any questions or concerns about how to use and cite sources to avoid plagiarism.

Collaboration - Many of your assignments will involve working with other students. Nevertheless, the work you submit must be completed independently and must represent your own independent ideas, unless the instructor specifically requires a joint product. Please be sure that you understand the distinction between collaborating and copying; ask your instructor if you have any doubts. Suspicions of unauthorized collaboration will be dealt with according to the honor code.

Re-using work - Please be aware that using work that you or anyone else has done for this or any other class or project, either in whole or in part, is a violation of the honor code, even if the work is revised.

OAKS - OAKS, including Gradebook, will be used for this course throughout the semester to provide the syllabus and class materials and grades for each assignment, which will be regularly posted. The official course webpage will be used for disseminating lecture materials.

Inclement Weather, Pandemic or Substantial Interruption of Instruction - If in-person classes are suspended, faculty will announce to their students a detailed plan for a change in modality to ensure the continuity of learning. All students must have access to a computer equipped with a web camera, microphone, and Internet access. Resources are available to provide students with these essential tools.

Mental & Physical Wellbeing - At the college, we take every students' mental and physical wellbeing seriously. If you find yourself experiencing physical illnesses, please reach out to student health services

(843.953.5520). And if you find yourself experiencing any mental health challenges (for example, anxiety, depression, stressful life events, sleep deprivation, and/or loneliness/homesickness) please consider contacting either the Counseling Center (professional counselors at http://counseling.cofc.edu or 843.953.5640 3rd Robert Scott Small Building) or the Students 4 Support (certified volunteers through texting "4support" to 839863, visit http://counseling.cofc.edu/cct/index.php, or meet with them in person 3rd Floor Stern Center). These services are there for you to help you cope with difficulties you may be experiencing and to maintain optimal physical and mental health.

Food & Housing Resources - Many CofC students report experiencing food and housing insecurity. If you are facing challenges in securing food (such as not being able to afford groceries or get sufficient food to eat every day) and housing (such as lacking a safe and stable place to live), please contact the Dean of Students for support (http://studentaffairs.cofc.edu/about/salt.php). Also, you can go to http://studentaffairs.cofc.edu/student-food-housing-insecurity/index.php to learn about food and housing assistance that is available to you. In addition, there are several resources on and off campus to help. You can visit the Cougar Pantry in the Stern Center (2nd floor), a student-run food pantry that provides dry-goods and hygiene products at no charge to any student in need. Please also consider reaching out to Professor ABC if you are comfortable in doing so.