EVPP 585: Quantitative Data Analysis for Environmental Scientists
Meeting Time: Wednesday 3:30 - 6:15 PM
Location: Potomac Science Center 3102
Instructors: **Dr. T. Reid Nelson,** tnelso3@gmu.edu
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                 Office hours: Wednesday 12:00 – 2:00 pm and by appointment

Course Description and Goals: This course introduces processing, visualizing, and interpreting data using scientific computing techniques widely used in environmental science and natural resources management fields. Students will gain experience with data manipulation, plotting and exporting publication-worthy plots, multiple types of regression analyses, and hypothesis testing. During the course, students will also learn how to create a reproducible workflow for all your data analysis and plotting needs. As science and the publication process become more transparent, this reproducible record is becoming a necessary component of the scientific process.

Learning Outcomes:
- Familiarity with coding-based statistics and realized benefits over GUI statistics programs, including an inherent understanding of coding and the ability to create your own functions
- Automation of data manipulation and analysis, letting the computer work for you
- Gain good data management and manipulation practices
- Applied understanding of common statistical analyses used in environmental science
- Gain the background and framework needed to implement complex analyses
- Apply tools learned in class to answer you own research questions, with considerations for design and analysis

Course Content and Instructional Methods: Each week (see the weekly breakdown below), our course will consist of a brief lecture followed by in-class coding exercises where you all will work along with me. Most weeks there will also be a homework assignment for you to complete on your own time reinforcing the skills gained during each week's class period. Each of you will also complete a project for this class analyzing your own dataset. Ideally, this will be data from your graduate work and this project will help with your dissertation or thesis research. During the last two class periods, you will present your projects in a conference style talk (~20 minutes), highlighting your research question/hypotheses, methods and data analysis, results, and conclusions. As part of this project, you will also write a manuscript style methods and results section with accompanying figures (code generated) and tables.

Grading: Your grade will come from the weekly assignments (50%) which will all be graded on a 100-point scale, your final project presentation (20%), your final project code (15%), and a paper mimicking journal style methods and results sections including accompanying figures (15%). The weekly assignments will all be weighted the same and based on the below rubric and the course is graded on the graduate regular scale.

Homework Grading Rubric
• 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: 75%
• Answer demonstrates a lack of understanding of the core concept: 50%
• No effort was made: 0%

Percentage Breakdown		Graduate Scale	
Assignments	**Percentage**	**Grade**	**Score**
Weekly Assignments	50%	A+	97 - 100
Final Project Presentation	20%	A	93 - 96
Final Project Code	15%	A-	90 - 92
Final Project Paper	15%	B+	87 - 89
		B	83 - 86
		B-	80 - 82
		C	70 - 79
		F	< 70

Weekly Lecture Topics and Assignments (Initial Plan**)**

Week	Date	Topic	Assignment
Pre		Install R, R Studio, and run your first code!	
1	1/22	Introduction to class, reading and writing data, data manipulation	
2	1/29	**On your own**, Sampling, Experimental design VC AFS Conference.	Pseudoreplication readings (Hulbert, Oksanen)
3	2/5	Data manipulation continued, logic, for loops, if/else, functions	Read/write, Manipulation
4	2/12	Plotting (**Online class over zoom, SNOW DAY**)	Publication Quality Plots
5	2/19	Simple statistics, correlations, and Linear Regression	Regression
6	2/26	Single Factor ANOVA, ANCOVA, non-parametric alternatives, and Post-hoc	ANOVA1
7	3/5	Multiple Regression & AIC Model Selection Have Final Project by this date!	
8	3/12	**Spring Break**	
9	3/19	Multiple Factor ANOVAs, BACI, Introduction to random effects	Multiple Regression
10	3/26	GLMs, GLMMs	Project Synopsis
11	4/2	GLMs continued	
12	4/9	Non-linear regression (nls function)	
13	4/16	GAM, and GAMMs (mgcv package)	
14	4/23	Final Project Prep (meet with me if needed)	
15	4/30	Final Project Presentations	
16	5/7	Final Project Presentations	

Websites to Download R and R-Studio as well as free online textbooks, code, and examples

R & R Studio - https://www.rstudio.com/products/rstudio/download/#download

Nice free online resource that starts with software download - https://bookdown.org/ndphillips/YaRrr/

Handbook written by a colleague - https://bstaton1.github.io/au-r-workshop/

Advanced R - https://adv-r.hadley.nz/introduction.html

Ecological Models and Data in R - https://ms.mcmaster.ca/~bolker/emdbook/

R Graphics Cookbook, 2nd edition - https://r-graphics.org/

R Cheat sheets - https://posit.co/resources/cheatsheets/?type=posit-cheatsheets/

Great Introductory text on R and R Studio that we will be working through in this class.
Can be accessed for free through the Mason Library
Childs, D., A. Beckerman, and O. Petchey. 2017. Getting Started with R: An Introduction for Biologists. Oxford: Oxford University Press.
https://doi.org/10.1093/acprof:oso/9780198787839.001.0001.

Great textbook for basic statistics to complete statistical shortcomings in aforementioned book.
Quinn, G. P. and M. J. Keough. 2002. Experimental design and data analysis for biologists. Cambridge University Press, Cambridge, U.K.
Can be found for free online if you google it

Honor Code: Mason is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process (see below for the student pledge). In this course the honor code applies as follows, when you are responsible for a task, you will perform that task. When you rely on someone else's work in presentations or papers, you will give proper citation to that work.

Student Pledge: To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University Community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set for this Honor Code: Student Members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.

Gender identity and pronoun use: If you wish, please share your name and gender pronouns with me and how best to address you in class and via email. I use he/him/his for myself and you may address me as Reid or Dr. Nelson in email and verbally.

Absenteeism Policy: I believe that being in the classroom is a valuable experience where a free exchange of ideas and healthy academic debate can flourish. In person presentations and discussions are also paramount to the learning process and building a sense of community. Therefore, I hope that everyone can make plans to be in class as frequently as possible. However, I understand that personal issues arise and will try to accommodate absences if they are discussed with me prior to class, or when unforeseen illnesses occur.

Disability Accommodations: Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access

to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email:ods@gmu.edu | Phone: (703) 993-2474.

Sexual Harassment, Sexual Misconduct, and Interpersonal Violence: George Mason University is committed to providing a learning, living and working environment that is free from discrimination and a campus that is free of sexual misconduct and other acts of interpersonal violence in order to promote community well-being and student success. We encourage students and employees who believe that they have been sexually harassed, sexually assaulted or subjected to sexual or interpersonal misconduct to seek assistance and support. University Policy 1202: Sexual Harassment and Misconduct speaks to the specifics of Mason's process, the resources, and the options available to students and employees.

Notice of mandatory reporting of sexual or interpersonal misconduct: As a faculty member, I am designated as a "Non-Confidential Employee," and must report all disclosures of sexual assault, sexual harassment, interpersonal violence, stalking, sexual exploitation, complicity, and retaliation to Mason's Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason's confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-993-3686 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance or support measures from Mason's Title IX Coordinator by calling 703-993-8730, or emailing titleix@gmu.edu. Unforeseen personal issues may arise and if these occur please contact me as soon as possible and we will work together to accommodate absences as needed.