

Welcome to NRES 710

Graduate Environmental Statistics

Fall 2022

Instructor

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I have no pre-scheduled office hours for this class- please email me to set up a meeting. Also note that when I am in my office and my door is propped open, as will usually be the case when I am not in a meeting or struggling to meet a deadline, you are welcome to pop in for a chat. When my office door is closed, I am not available.

Lecture: MW 2:30pm to 3:45pm in EMM 242 (Effie Mona Mack Social Sciences Building)

Course Website: <http://kevintshoemaker.github.io/NRES-710/>

Course Objectives

In this course, students will learn basic principles of statistical inference and will gain experience applying these principles to their research questions using R. In this course we focus on the concepts and implementation and we generally leave the nitty-gritty stats questions to statisticians.

Student Learning Objectives

Students will be able to:

1. Communicate, in writing or verbally, the assumptions associated with classical statistical models.
2. Understand and perform statistical tests such as T-test, ANOVAs, and linear regression.
3. Identify and perform appropriate statistical tests on data collected during their graduate program
4. Compare and contrast statistical tools and methods.
5. Import data, visualize patterns, interpret plots, and perform statistical tests using R.

Prerequisites

Curious scientific mind, broad research interests, readiness to engage with data, equations and computer programming. Students are expected to have a basic understanding of standard statistical concepts and methods, obtained through other coursework. If this is

not the case, they should be prepared to work harder to develop the necessary prerequisite knowledge.

Course materials

We will use the course website in addition to the WebCampus page set up for the course. Most course content (lecture materials) can be found on the website, which will be updated frequently. Additional readings are available via WebCampus. We will use the Discussion Board feature in WebCampus as a forum for written discussion, Q&A, and mutual support in engaging with course materials.

Readings will be provided as appropriate. Unless otherwise noted, all readings assigned for a given week should be done before our Wednesday class meetings. All readings will be posted to WebCampus at least a week before they are due.

Students will use the open source statistical software R to perform analyses. *All students should bring laptops to each class*; much of class time will be devoted to hands-on learning in R.

There are many good R books, but ultimately, most material can be found for free online. For the beginner in statistics or R, I recommend the following:

1. Discovering Statistics using R (Andy Field and Jeremy Miles)
2. Introductory R: A beginner's guide to data visualization, statistical analysis, and programming in R (Robert Knell)
3. R Graphics Cookbook (Winston Chang). This book is available for free as a PDF online.
4. Qian, Song S. Environmental and Ecological Statistics with R, Second Edition, 2nd Edition. Chapman & Hall, 2017.
5. A Primer of Ecological Statistics. (Nicholas Gotelli and Aaron Ellison). *A stats book, but not an R book.*

Course structure

Instruction will consist of lessons on general statistical concepts and specific methods commonly used to address questions in ecology and environmental science. Stats lessons will include lecture-style materials, readings, demonstrations, exercises and class discussions.

A large portion of the overall grade (25%) will be based upon periodic, relatively brief homework assignments that follow from the topics covered in class. Most assignments will involve statistical analysis and interpretation of sample data sets that are provided. There will be a final project (40% of your grade) that is designed to test your ability to understand and apply the tools that you have developed during the semester using R. The final project will involve conducting a rigorous data analysis using statistical approaches that we have learned during the semester (or other tools as approved by the instructor). You can choose whichever statistical methods are suitable to your project scope and questions, but they must be methods we covered in class and appropriate to your data.

Please turn in your own work and assignment, but you may use as many resources as you wish (class material, online material, or the insight/experience of other students) to generate the material presented. More specific instructions will come during the semester.

With roughly 5 weeks left in the semester, first drafts of your final projects will be due. These first drafts will then be subjected to anonymous peer review. At this time, the assignment itself will not be “graded,” but the assignment will be reviewed by at least two other students, and the peer reviews will be graded (20% of the overall grade). The reviews are designed to provide feedback on the statistical approach being used and whether the appropriate connections are made between research question, data, statistical model, and inferences developed from model outputs. Are the statistics relevant to the data, and appropriate for the experimental design? The reviews will be due within two weeks and will be provided to the author for their consideration and assistance in their final project.

Given the nature of graduate classes, student participation is expected.

Grading

Course component	Weight
Homeworks	30%
Final project	40%
Peer review	20%
Participation	10%

Letter grades will be assigned as follows:

Grade	Semester Average (%)
A	93-100
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
F	below 70

Course Schedule

NOTE: the course schedule is subject to change, so please check back frequently!

Week	Mon. meeting	Wed. meeting (R mini-lab)	Homework	Readings
Aug. 29 (week 1)	Overview, intro to R	P-values, statistical tests		
Sept. 5 (week 2)	No Class (labor day)	Sampling distributions; central limit theorem		Hot hand
Sept. 12 (week 3)	Central limit theorem and data simulation	R exercise: t-test, z-test	CLT and z-tests	
Sept. 19 (week 4)	Confidence intervals, probability in R	R exercise: probability distributions		
Sept. 26 (week 5)	Non-parametric analysis	R exercise: non-parametrics	permutation test	
Oct. 3 (week 6)	Chi-squared test	No class (Kevin at conference)		
Oct. 10 (week 7)	Linear regression	R exercise: linear regression	Linear regression	
Oct. 17 (week 8)	ANOVA	R exercise: ANOVA		p-values and p-hacking
Oct. 24 (week 9)	Discussion: p-values	Discussion: p-hacking	ANOVA	
Oct. 31 (week 10)	More advanced ANOVA	R exercise:		pseudoreplication
Nov. 7 (week 11)	Discussion: pseudoreplication	R exercise: power analysis	GLM	
Nov. 14 (week 12)	GLM	R exercise: GLM		
Nov. 21 (week 13)	GLMM	R exercise: GLMM	GLMM	
Nov. 28 (week 14)	More advanced GLMM	Final project peer review		

Week	Mon. meeting	Wed. meeting (R mini-lab)	Homework	Readings
Dec. 5 (week 15)	Random Forest	R exercise: Random forest		
Dec. 12 (week 16)	Next steps- multivariate, bayesian, etc.	Discussion: code and data sharing		
Dec. 19 (week 17)	Final projects due 5pm on Dec 21	Review session (optional)		

Make-up policy and late work:

If you miss a class meeting or lab period, it is your responsibility to talk to one of your classmates about what you missed. If you miss a lab meeting, you are still responsible for completing the lab activities and write-up on your own time. You do not need to let me know in advance that you are going to miss class or lab.

Students with Disabilities

Any student with a disability needing academic adjustments or accommodations is requested to speak with the Disability Resource Center (Thompson Building, Suite 101) as soon as possible to arrange for appropriate accommodations.

Statement on Academic Dishonesty

Cheating, plagiarism or otherwise obtaining grades under false pretenses constitute academic dishonesty according to the code of this university. Plagiarism is using the ideas or words of another person without giving credit to the original source; this includes copying another student in class. Always cite the source of your information. This includes copying or paraphrasing from a book, journal, or unpublished material without giving credit to the author(s), and submitting a term paper that was used in another course. Academic dishonesty will not be tolerated and penalties can include filing a final grade of "F"; reducing the student's final course grade one or two full grade points; awarding a failing mark on the coursework in question; or requiring the student to retake or resubmit the coursework. For more details, see the University of Nevada, Reno General Catalog.

This is a safe space

The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX Office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit: <http://www.unr.edu/equal-opportunity-title-ix>

Statement on Audio and Video Recording

Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded.

Statement on content accessibility

This course may leverage 3rd party web/multimedia content, if you experience any issues accessing this content, please notify your instructor.

Statement on COVID-19 Policies

Face Coverings

Pursuant to Nevada law, NSHE employees, students and members of the public are no longer required to wear face coverings while inside NSHE buildings irrespective of vaccination status.

Social Distancing

In alignment with State of Nevada guidelines, social distancing is no longer required. #### Disinfecting Your Learning Space Disinfecting supplies are provided for you to disinfect your learning space. You may also use your own disinfecting supplies.

COVID-19, COVID-19 Like Symptoms, and Contact with Someone Testing Positive for COVID-19

Students testing positive for COVID 19, exhibiting COVID 19 symptoms regardless of vaccination status will not be allowed to attend in-person instructional activities and must leave the venue immediately. Students should contact the Student Health Center or their health care provider to receive care and who can provide the latest direction on quarantine and self-isolation. Contact your instructor immediately to make instructional and learning arrangements.

Accommodations for COVID 19 Quarantined Students

For students who are required to quarantine or self-isolate due to 1) COVID 19 infection or 2) exposure while not vaccinated, instructors must provide opportunities to make-up missed course work, including assignments, quizzes or exams. In courses with mandatory attendance policies, instructors must not penalize students for missing classes while quarantined.

Failure to Comply with Policy (including as outlined in this Syllabus) or Directives of a University Employee

In accordance with section 6,502 of the University Administrative Manual, a student may receive academic and disciplinary sanctions for failure to comply with policy, including this

syllabus, for failure to comply with the directions of a University Official, for disruptive behavior in the classroom, or any other prohibited action. "Disruptive behavior" is defined in part as behavior, including but not limited to failure to follow course, laboratory or safety rules, or endangering the health of others. A student may be dropped from class at any time for misconduct or disruptive behavior in the classroom upon recommendation of the instructor and with approval of the college dean. A student may also receive disciplinary sanctions through the Office of Student Conduct for misconduct or disruptive behavior, including endangering the health of others, in the classroom. The student shall not receive a refund for course fees or tuition.

Statement on Academic Dishonesty

"The University Academic Standards Policy defines academic dishonesty, and mandates specific sanctions for violations. See the University Academic Standards policy: UAM 6,502."

Statement of Disability Services

Use either the traditional or online statement, in addition to the last sentence regarding third party materials.

For Traditional and Seated Classrooms:

"Any student with a disability needing academic adjustments or accommodations is requested to speak with me or the Disability Resource Center (Pennington Achievement Center Suite 230) as soon as possible to arrange for appropriate accommodations."

Statement on Audio and Video Recording

Student-created Recordings

"Surreptitious or covert video-taping of class or unauthorized audio recording of class is prohibited by law and by Board of Regents policy. This class may be videotaped, or audio recorded only with the written permission of the instructor. In order to accommodate students with disabilities, some students may have been given permission to record class lectures and discussions. Therefore, students should understand that their comments during class may be recorded."

Instructor-created Recordings

Class sessions may be audio-visually recorded for students in the class to review and for enrolled students who are unable to attend live to view. Students who participate with their camera on or who use a profile image are consenting to have their video or image recorded. If you do not consent to have your profile or video image recorded, keep your camera off and do not use a profile image. Students who un-mute during class and participate orally are consenting to have their voices recorded. If you do not consent to have your voice recorded during class, keep your mute button activated and only communicate by using the "chat" feature, which allows you to type questions and comments live.

Statement on Maintaining a Safe Learning and Work Environment

The University of Nevada, Reno is committed to providing a safe learning and work environment for all. If you believe you have experienced discrimination, sexual harassment, sexual assault, domestic/dating violence, or stalking, whether on or off campus, or need information related to immigration concerns, please contact the University's Equal Opportunity & Title IX office at 775-784-1547. Resources and interim measures are available to assist you. For more information, please visit the Equal Opportunity and Title IX page.

Statement for academic success services:

Your student fees cover usage of the University Math Center (<https://www.unr.edu/university-math-center>), (775) 784-4433; University Tutoring Center (<https://www.unr.edu/tutoring-center>), (775) 784-6801; and University Writing & Speaking Center (<https://www.unr.edu/writing-speaking-center>), (775) 784-6030. These centers support your classroom learning; it is your responsibility to take advantage of their services. Keep in mind that seeking help outside of class is the sign of a responsible and successful student.