Statistical Methods for Bioscience I

Statistics/F&W Ecology/Horticulture 571, Fall 2021

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office hours:	R 4:30-5:30pm (MSC 1217C)	M 2:30-3:30pm (MSC 1274)
	F 11-noon (MSC 1274)	F 10-11am (MSC 1274)

Course Objective:

The goal of this course is to provide research-oriented students in the agricultural, biological, and environmental sciences with a thorough grounding in modern statistical methods. An understanding of the concepts underlying the procedures will be stressed along with applications. Substantial use will be made of the computer in conducting analyses using the R programming language. Mathematical complexities will be kept to a minimum and the analysis of realistic data will receive considerable emphasis. The development of the ability to interpret results and to critically evaluate the methods used is of paramount importance.

COVID-19 Context:

During the global COVID-19 pandemic, we must prioritize our collective health and safety to keep ourselves, our campus, and our community safe. As a university community, we must work together to prevent the spread of the virus and to promote the collective health and welfare of our campus and surrounding community.

Information on COVID-19 is constantly changing. Students should be attentive to University communications regarding COVID-19 that may alter instruction and supersede parts of this syllabus.

Lecture time and location

Section	Where	When
001	Weeks Hall 140	T R 9:30 - 10:45
002	Soc Sci 6104	T R 11:00 - 12:15

Discussion

Attendance is strongly advised. It's the best place to ask questions in a small group, to connect with other students and form study groups, to get practice of new concepts, and get help with computing

questions. Discussions will meet the first week of class, so the first discussions will be on September 8th and 9th (depending on your section). If you have a laptop, we strongly recommend you bring one to discussion sections.

Section	TA	Where	When
311	Gao	2345 Engineering Hall	W 9:55a - 10:45a
312	Moen	2345 Engineering Hall	W 1:20p - 2:10p
313	Moen	3444 Engineering Hall	W 4:35p - 5:25p
321	Gao	2349 Engineering Hall	W 11:00a - 11:50a
322	Gao	101 Agricultural Engineering Building	W 12:05p - 12:55p
323	Moen	184 Russell Laboratories	R 8:50a - 9:40a

Homework

There will be 11 homework assignments throughout the semester. These assignments are very important and much of your learning will take place while you are working the homework problems. Often the assignments are quite time consuming, so plan ahead. Details about guidelines, expectations, and submission are below.

- Assignments will be posted to Canvas on Thursdays, and must be submitted electronically 8 days later to Canvas on Friday, by 5:00 pm.
- Credit will not be given for homework turned in late.
- We encourage you to submit your homework as pdfs generated from r-markdown files. That said, homework can be hand-written, or typed, or a combination of both, but must be well organized, neat, legible and show your work to receive full credit. Do not include superfluous material. Homework that is difficult to grade may be docked as much as 20%.
- You may discuss homework problems with others including your peers, your TA and instructor, but you must write up your homework solutions by yourself in order to receive credit. Similarly, you must write your own computer code and obtain your computer output independently.
- The two homeworks with the lowest percent scores will be dropped when computing an average score for your homework at the end of the semester. Please use this "Drop Two" policy wisely and contact the instructor if you have a concern that is not adequately covered by this policy. Note that some homeworks will be worth more points and require more effort than others.
- Submit your homework electronically on Canvas. To submit, click on the Assignments tab, then click the assignment you want to submit. Click the blue box near the top right labeled 'Submit Assignment.' On the 'Select Submission Type' screen, click on the 'File Upload' tab, then click 'Choose File' to browse for the file. You may add comments for the grader if desired, then click the 'Submit Assignment' box. Give Canvas a little time, then look in the top right for confirmation that the assignment was received.
- Your submission should be a single PDF document. If you have scanned written pages, printed output, graphs, etc., please use a program such as Adobe Acrobat to combine the separate pages into a single document before submitting. Handwritten pages can be scanned (e.g. with phone apps, such as CamScanner) and included.
- You will not be able to submit an assignment after the submission deadline, so please plan ahead. It is recommended you begin the submission process at least 5 minutes prior to the

submission deadline, since it sometimes takes some time for Canvas to accept an assignment. Any assignments that are not received by the submission deadline will earn zero points.

- Assignments will be graded electronically. You can view any comments or annotations on Canvas by clicking on Grades, then the assignment. For comments, click on the comments icon, or for annotations, click the assignment name, then 'View Feedback.'
- You must show work to receive full credit. For problems involving R, this may require providing the code and/or output obtained. Any code or output provided should be edited for neatness and readability.
- Unless otherwise specified by a problem, you can always use either R or Statistical tables (provided via Canvas) to compute probabilities.

Exams

There will be two midterm exams and a final exam. The midterms will be on Tuesday, October 19th and Tuesday, November 23th in class. The final exam is Tuesday, December 21st from 7:45am - 9:45am. Alternate dates for the in-class midterms will be offered only in extenuating circumstances. There will be no make-ups allowed for the final exam so please plan ahead. The in-class midterms and final exam will be open book and open notes, and you are allowed a calculator, but no devices (laptops, smartphones, etc.) that allow you to run R or access the Internet.

Block the time for the exams now — missed exams will not be permitted except when extenuating circumstances prevail. Vacation travel does not constitute an acceptable reason for missing an exam.

Grading

The homework will count 20%, the in-class midterm exams will count 25% each, and the final will count 30%. The exams, homework, policies, and grading will be identical for the two lecture sections.

Computing

We will be using R and an R integrated development environment (IDE) called RStudio. R is a free, open-source, and extremely flexible package, and is available for download online at: `www.cran.r-project.org/`. RStudio is available for free from `www.rstudio.com/products/rstudio/download/#download`. No prior experience with R is expected. The discussion sections during the first week will consist of an R tutorial. Access to a laptop computer is important for this class. If you do not have a laptop that can run R and Rstudio, you may use computers and laptops from the campus infolabs that have R and Rstudio installed. See: https://it.wisc.edu/services/computer-labs-infolabs/.

Communication

Most announcements will be made at the beginning of lecture. Any changes to grading or due dates will also be posted to Canvas as announcements.

Email

- I generally reply to email once or twice a day. Please expect an email reply within 24 business hours after you sent your email. If I don't reply after 48 business hours, please send a followup.

Please consider this response time and plan ahead when you contact me. If something urgent arises, you may put [URGENT] in the subject line and I will do my best to reply as soon as possible.

- If you have a question that might pertain to other students, please post it on Piazza (see below).
- If you perceive my email tone as curt, please know that really I'm very warm and fuzzy [insert cuddly emoji here]. I just get a lot of emails and I am a slow typer so I often write fewer words than are necessary to communicate a nurturing feel. If I ever offend you, please let me know so that I can try to right the wrong.

Piazza

- We will use Piazza (an app that is available through Canvas) as the main platform for asking and answering questions asynchronously.
- The Piazza forum will be the most efficient way for students to ask general questions when not in class, as it allows for asynchronous communication, and it allows for having discussions if a similar question should arise multiple times. Students are also encouraged to help other students on Piazza. Asking homework-related questions on Piazza is permitted and encouraged. However, sharing full or partial homework solutions with other students on Piazza is prohibited and may be penalized. Just ask if you don't know where the boudary between helping and giving answers is.

Online Materials

Canvas will be used to post all necessary materials, including discussion handouts and homework assignments. Canvas will also serve as a gradebook and discussion forum (via Piazza and BBCollaborate) for asking questions.

Text

Reference materials will be provided in class and online at Canvas.

Credit Information:

This course is 4 credits. The class meets for two 75-minute lecture class periods and a 50-minute discussion section each week, and carries the expectation that students will work on course learning activities (readings, homeworks, studying, etc.) for about 3 hours for every class period.

Tentative Topics List (with reference notes chapters)

1. *Introduction*: What is statistics? (Ch. 1)
2. *Descriptive Statistics*: Histograms, scatterplots, boxplots, numerical measures of location and spread. (Ch. 2)
3. *Random Variables*: Definitions, probability distributions, normal distribution. (Ch. 3)

4. *Random Sampling*: Distributions of functions of random variables, distribution of sample mean, Central Limit Theorem. (Ch. 4)

5. *Hypothesis Testing and One-Sample Inference*: Hypothesis testing framework, one-sample Z- and T-tests. (Ch. 5)

6. *Confidence Intervals*: General interpretation, intervals for means based on normal and T. (Ch. 6)

7. *Two-Sample Inference*: Comparisons of two means for paired and independent samples, with equal or unequal variances. (Ch. 7)

8. *Assumptions*: Assessment and remedial measures, some non-parametric alternatives. (Ch. 8)

9. *Study Design and Sample Sizes*: Design of experiments, rejection regions and types of errors, power, sample size determination. (Ch. 9)

10. *Analysis of Variance*: Fitting, inference, model formulation, assumptions, pairwise comparison of means, multiple comparison corrections, non-parametric tests. (Chs. 10 \ 11)

11. *Simple Linear Regression*: Fitting, interpreting, inference, prediction, assumptions and diagnostics. (Ch. 12)

Academic Integrity

By virtue of enrollment, each student agrees to uphold the high academic standards of the University of Wisconsin-Madison; academic misconduct is behavior that negatively impacts the integrity of the institution. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these previously listed acts are examples of misconduct which may result in disciplinary action. Examples of disciplinary action include, but are not limited to, failure on the assignment/course, written reprimand, disciplinary probation, suspension, or expulsion. For detailed information, please see: https://conduct.students.wisc.edu/academic-misconduct/.

Complaints:

If you have a complaint about a TA or course instructor, you should feel free to discuss the matter directly with the TA or instructor. If the complaint is about the TA and you do not feel comfortable discussing it with him or her, you should discuss it with the course instructor. Complaints about mistakes in grading should be resolved with the instructor or TA, as appropriate, in the great majority of cases. If the complaint is about the instructor (other than ordinary grading questions) and you do not feel comfortable discussing it with him or her, contact the Director of Undergraduate Studies, Professor Cecile Ane, cecile.ane@wisc.edu. If your complaint concerns sexual harassment, please see campus resources listed at https://compliance.wisc.edu/titleix/resources/. In particular, there are a number of options to speak to someone confidentially. If you have concerns about climate or bias in this class, or if you wish to report an incident of bias or hate that has occurred in class, you may contact the Chair of the Statistics Department Climate and Diversity Committee, Professor Karl Rohe (karl.rohe@wisc.edu). You may also use the University's bias incident reporting system, which you can reach at https://doso.students.wisc.edu/bias-or-hate-reporting/.

Diversity and Inclusion:

Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background - people who as students, faculty, and staff serve Wisconsin and the world.

Accommodations for Students with Disabilities:

The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform instructors of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Instructors will work either directly with the student or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.

Rules, Rights, and Responsibilities

See: https://guide.wisc.edu/graduate/

Academic Calendar and Religious Observances:

See: https://secfac.wisc.edu/academic-calendar/#religious-observances

Designations:

Level - Intermediate L&S
Credit - Counts as Liberal Arts and Science credit in L&S
Grad 50% - Counts toward 50% graduate coursework requirement

Requisites

Graduate/professional standing.

Instructional Mode

In-person lecture and discussion sections

Description

Descriptive statistics, distributions, one- and two-sample normal inference, power, one-way ANOVA, simple linear regression, categorical data, non-parametric methods; underlying assumptions and diagnostic work.