

# Statistical Methods for Bioscience II Syllabus

University of Wisconsin - Madison, Statistics/F&W Ecology/Horticulture 572, Spring 2022

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office hours:	M T W 4:00-4:30 and by appt	R 3:25-4:25 in MSC 1217C, F 1:30-2:30 in MSC 1210

## Course Objective and Learning Outcomes:

As in Statistics 571, the goal is to provide students in bioscience with a thorough grounding in modern statistical procedures. The emphasis will be on understanding underlying concepts rather than on an extensive coverage of a wide range of topics. The development of the ability to interpret results and to evaluate critically the methods used is of paramount importance. To a large extent the assignments will involve the analysis of data sets that approach the “real-world” complexity of data encountered in research. Substantial use will be made of the computer in conducting such analyses.

## 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:

Lectures are held Tuesdays and Thursdays from 11:00 am - 12:15 pm in 1227 Engineering Hall.

## 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 discussion will be on January 27th, 2022.

You may attend a discussion for which you are not officially enrolled, but try to attend the same section most of the time, and approve any switch with the TA.

Section	Where	When
311	290 Nutritional Sciences	R 1:20p - 2:10p
312	114 School of Social Work Building	R 2:25p - 3:15p
313	486 Van Hise Hall	R 4:35p - 5:25p

## Homework

There will be 10 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 **4:00 pm**.
- Homework that is less than 1 hour late will have 10 percentage points deducted. Credit will not be given for homework turned in more than 1 hour late. 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.
- 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.
- 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 (e.g. do not include output from R showing packages have been loaded). Homework that is difficult to grade may be docked as much as 20%. Ask the instructor or TA if you are having difficulty with formatting.
- 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. Putting it in an appendix may be best.
- You are encouraged to 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. This policy excludes the first homework assignment.
- Homework assignments may have different weights, depending on the effort needed to complete them.
- 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.’

- Unless otherwise specified by a problem, you can always use either R or Statistical tables (provided via Canvas) to compute probabilities.
- If, for some reason, you seek exception to any of the above policies, please email the TA and cc the instructor. The TA has authority to make decisions about homework policy exceptions. If you are not pleased with the TA's decision, you may appeal it with the instructor.

## Projects

There will be two projects which consist of solving a more open ended question and submitting a short report. These are like homework in that you may work with others, but they are more challenging, realistic, and provide less explicit guidance on how to solve them. The first project is due March 25, the second is due April 22. Please mark your calendars. The report must be fully reproducible (e.g. written in R markdown) and be written entirely by you.

The goal of this collaborative approach is to ensure that all students have greatest opportunity to learn and find the correct answer(s). That said, use the opportunity to collaborate, not to plagiarize. Do not write anything in your report that you do not completely and fully understand. If you cannot verbally explain your entire report (choice of language, statistical decisions, R code, etc.) and similar work appears in another student's report, the instructor may request an oral examination, may allege academic misconduct against you and may report the matter to the Office of Student Conduct and Community Standards. Sanctions for graduate students can be severe.

## Exams

There will be one midterm exam and one final exam. The midterm exam is on Thursday, March 10, during class. The final exam is Tuesday, May 10, 12:25pm - 2:25pm. 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

Your grade will be based on homework, projects and exams.

	Homework	Projects	Midterm Exam	Final Exam
Percent of final grade	25	20	25	30
Collaborative/Independent	Collaborative	Collaborative	Independent	Independent

## Computing:

We will be using R through an R interface called R Studio. R is a free, open-source, and extremely flexible package, and is available for download online at: [www.cran.r-project.org/](http://www.cran.r-project.org/). R Studio is available for free from [www.rstudio.com/products/rstudio/download/#download](http://www.rstudio.com/products/rstudio/download/#download). Some experience with R will be expected, as R should be familiar from 571. Project reports must be reproducible and it is recommended you use R markdown to do this.

## 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 boundary between helping and giving answers is.

## Tentative Topics:

- **Continuing Simple Linear Regression:** Assessing assumptions, examining residuals, remedies for violated assumptions. (Chs. 1 & 2)
- **Multiple Linear Regression (MLR):** Fitting, evaluating, interpreting and testing. Sums of squares, multicollinearity, polynomial regression, qualitative predictors. (Chs. 3-6)
- **Model Selection for MLR:** Measures of model quality, best subsets, sequential selection. (Ch. 7)
- **Logistic Regression:** Fitting, evaluating, interpreting, and testing. (Ch. 8)
- **Extending One-Way ANOVA:** Alternate model formulation, expected mean squares, power, contrasts. (Ch. 9)
- **Factorial Designs:** 2x2 and general designs. Estimating and interpreting main effects and interactions.(Ch. 10)

- **Block Designs:** Fitting, evaluating, interpreting. Randomized complete block designs, Latin squares, randomization. (Chs. 11 & 12)
- **Mixed Effects Models:** Fixed vs. random effects, subsampling, split-plot designs. (Chs. 13 & 14)

## **Text:**

Reference materials will be provided via Canvas files.

## **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/>. Stronger disciplinary actions are more likely for graduate students than undergraduates.

## **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](mailto: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](mailto: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/>.

## **Students' Rules, Rights & Responsibilities**

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

## **Academic Calendar and Religious Observances**

Please notify the instructor within the first two weeks of class of which dates you request relief due to a religious observance or election official responsibility.

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

In spring of 2022, there is a primary held on Tuesday, February 15th, and an election on Tuesday, April 5th. I strongly encourage all eligible students to vote.

## **Standards of Ethical Conduct in Data Analysis and Data Privacy**

The members of the faculty of the Department of Statistics at UW-Madison uphold the highest ethical standards of teaching, data, and research. They expect their students to uphold the same standards of ethical conduct. Standards of ethical conduct in data analysis and data privacy are detailed on the ASA website: <https://www.amstat.org/ASA/Your-Career/Ethical-Guidelines-for-Statistical-Practice.aspx>, and include:

- Use methodology and data that are relevant and appropriate; without favoritism or prejudice; and in a manner intended to produce valid, interpretable, and reproducible results.
- Be candid about any known or suspected limitations, defects, or biases in the data that may affect the integrity or reliability of the analysis. Obviously, never modify or falsify data.
- Protect the privacy and confidentiality of research subjects and data concerning them, whether obtained from the subjects directly, other persons, or existing records.

By registering for this course, you are implicitly agreeing to conduct yourself with the utmost integrity throughout the semester.

## **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.

## **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.

## **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.

## **Course Evaluations**

UW-Madison now uses an online course evaluation survey tool, AEFIS. In most instances, you will receive an official email two weeks prior to the end of the semester when your course evaluation is available. You will receive a link to log into the course evaluation with your NetID where you can complete the evaluation and submit it, anonymously. Your participation is an integral component of this course, and your feedback is important to me. I strongly encourage you to participate in the course evaluation.

## **Description:**

Polynomial regression, multiple regression, two-way ANOVA with and without interaction, split-plot design, subsampling, analysis of covariance, elementary sampling, introduction to bioassay.

## **Requisites:**

F&W ECOL/HORT/STAT 571 or graduate/professional standing. Proficiency with material from F&W ECOL / HORT / STAT 571 will be assumed.

## **Designations:**

Level - Intermediate L&S

Credit - Counts as Liberal Arts and Science credit in L&S

Grad 50% - Counts toward 50% graduate coursework requirement

## **Instructional Mode**

In-person lecture and discussion sections