Statistical Methods for Bioscience I

Statistics/F&W Ecology/Horticulture 571, Fall 2020

Instructors:	Sebastian Raschka	Tedward Erker
Lecture:	001	002
Office:	Online	Online
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Office Hours:	Mon 1:30p-3:30p, and by appt.	Tue 10:00a-12:00p, and by appt.

Teaching Assistants:	Elina Choi	Liam Johnston
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Sections:	In-person: 314; Remote: 315, 316	In-person: 324; Remote: 325, 326
Office Hours:	Tue 2:00-5:00p, and by appt.	Wed 1:00-4:00p, and by appt.

Note: All office hours will be held remotely. In order to make up for some of the lost interaction due to the remote asynchronous course, our office hour opportunities are extended beyond what is typical for in-person classes.

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.

UW-Madison Badger Pledge

https://smartrestart.wisc.edu/badgerpledge/

UW-Madison Face Covering Guidelines

While on campus all employees and students are required to wear appropriate and properly fitting face coverings while present in any campus building unless working alone in a laboratory or office space.

Face Coverings During In-person Instruction Statement (COVID-19)

Individuals are expected to wear a face covering while inside any university building. Face coverings must be worn correctly (i.e., covering both your mouth and nose) in the building if you are attending class in person. If any student is unable to wear a face-covering, an accommodation may be provided due to disability, medical condition, or other legitimate reason. Students with disabilities or medical conditions who are unable to wear a face covering should contact the McBurney Disability Resource Center or their Access Consultant if they are already affiliated. Students requesting an accommodation unrelated to disability or medical condition, should contact the Dean of Students Office. Students who choose not to wear a face covering may not attend in-person classes, unless they are approved for an accommodation or exemption. All other students not wearing a face covering will be asked to put one on or leave the classroom. Students who refuse to wear face coverings appropriately or adhere to other stated requirements will be reported to the Office of Student Conduct and Community Standards and will not be allowed to return to the classroom until they agree to comply with the face covering policy. An instructor may cancel or suspend a course in-person meeting if a person is in the classroom without an approved face covering in position over their nose and mouth and refuses to immediately comply.

Quarantine or Isolation Due to COVID-19

Students should continually monitor themselves for COVID-19 symptoms and get tested for the virus if they have symptoms or have been in close contact with someone with COVID-19. Students should reach out to instructors as soon as possible if they become ill or need to isolate or quarantine, in order to make alternate plans for how to proceed with the course. Students are strongly encouraged to communicate with their instructor concerning their illness and the anticipated extent of their absence from the course (either in-person or remote). The instructor will work with the student to provide alternative ways to complete the course work.

Online Materials

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

Communication

We love technology, and we are fortunate that there are so many special-purpose tools available that enrich the teaching experience. However, we aim to find a good balance between a using multitude of tools and maintaining focus. The two following subsections summarize the technologies used in this course to communicate with you effectively.

Sharing important information and announcements

Important course information and deadlines (as well as updates or changes) will be shared via the Announcements feature via Canvas – each time an instructor creates an announcement, you will receive an email notification.

Questions

As the main platform for asking and answering questions asynchronously, we are going to use Piazza (an app that is available through Canvas).

We think that the Piazza forum will be the most efficient way for students to ask general questions, because 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 will be penalized.

Virtual office hours and discussion sections

For the virtual office hours and discussion sections, we are going to use the virtual video-conferencing platform BBCollaborate through Canvas. You will be able to access the live sessions by clicking on "BB Collaborate Ultra" on the left side (navigation bar) in Canvas and then selecting the respective session.

Lecture time and location

Each week's lectures will be delivered online and be made available by Monday morning, 9 am, on Canvas. Each week's content will be made accessible using Canvas Pages. Instructors will work as a team to deliver lecture content to all student sections, but will work individually and in small groups with students from their section with non-lecture content-related questions about this class.

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 second week of class, so the first discussion will be on September 10. Two discussion sections are in person and the other four are remote synchronous. There are strict limits on the in-person discussion sections room capacity due to COVID-19. If you have a laptop, we recommend you bring one to in-person discussion sections.

Disc 314 (Choi): R 4:35p -5:25p, in 133 Service Memorial Institute (Remote after Thanksgiving)
Disc 315 (Choi): R 1:20p - 2:10p, Remote
Disc 316 (Choi): R 2:25p - 3:15p, Remote
Disc 324 (Johnston): R 11:00a -11:50, in 133 Service Memorial Institute (Remote after Thanksgiving)
Disc 325 (Johnston): R 12:05p - 12:55p, Remote
Disc 326 (Johnston): R 2:25p - 3:15p, Remote

Text

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

Homework Policy

There will be approximately 9-10 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.

- Credit will not be given for homework turned in late.

- 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.

- 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 lowest score will be dropped when computing an average score for your homework at the end of the semester. Please use this "Drop One" policy wisely and contact the instructor if you have a concern that is not adequately covered by this policy.

- 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 Tables A, C, or D (provided via Course Notes) to compute probabilities.

Exams

There will be two midterm exams and a final exam administered via Canvas. The midterms will be on Tuesday, October 6th and Tuesday, November 10th. The final exam is Saturday, December 12th at 2:45p. 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 sections.

Computing

We will be using R, and optionally, an R interface 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.

Credit Information:

This course is 4 credits. Ordinarily, this would mean 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. In the remote asynchronous format, we will provide approx. 150 minutes of recorded lectures in place of the in person lectures.

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)

Rules, Rights, and Responsibilities

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

Academic Calendar and Religious Observances

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

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/`.

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.

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 Po-Ling Loh (ploh@stat.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/`.

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

Remote asynchronous lecture, four remote synchronous discussion sections, one in-person discussion section.

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.