

Stat 3202: Statistical Inference for Data Analytics

Summer 2024 (18459), Online

Course Overview

Instructor Information

Instructor: Thomas Metzger, PhD

Email: metzger.181@osu.edu; **please do not use my Buckeyemail address.** Messages sent through Carmen often go into my spam folder; for fastest communication, use **metzger.181@osu.edu**.

Office hours: Virtual, by appointment (Monday afternoons or Tuesday/Thursday mornings/afternoons preferred)

Grader/TA: Kiljae Lee, lee.10428@buckeyemail.osu.edu

Course Delivery

Lecture videos will be posted in advance that you must watch on your own time before the required deadline. When watching these videos, it is important that you treat them as you would an in-person course: view them without distractions, and work along by taking notes and coding along with the video.

In addition to these videos, you will meet with me virtually periodically throughout the semester to check in on your progress. These meetings will be divided into 8-minute blocks where I will meet with students individually at a time you have signed up for in advance. Students will be spread out over both A and B meetings, so you only need to attend one 8-minute block at a time you have signed up for. In this time, I will ask you questions face-to-face to ensure you are actually keeping up with and participating in the material. Cameras must be turned on when meeting. Attire and background should be appropriate. These check-ins won't be high-stakes, computational problems; instead they will be general questions about the content, or I may ask you to explain your work from another assignment you submitted. You are permitted to use your notes during these meetings, but you are not permitted to use ChatGPT or other artificial intelligence resources. The purpose of this is to ensure that every single student is actually accountable for their own work and learning. **If you are not actually watching the videos, completing your own work individually, or understanding the material, you will fail this course.**

Recitation sessions will be held asynchronously on Mondays at TBD. During these sessions, the TA will host a lab tutorial session and may provide supplemental problems. Lab assignments will be due at the end of each week. Each lab will be labeled with a week number, but not every week will have a lab. For example, the week 7 lab will be Lab 7.

The purpose of office hours is to provide supplemental time for questions, discussion, or assistance that you may need. Any topics related to the course, or to college life, professional development, or personal issues affecting your academic career at Ohio State are relevant and welcome topics. Office hours will be held by appointment; I have the most availability on Tuesday/Thursday mornings and on Monday afternoons, but I understand that many students are in different time zones or are working. A Zoom link can be found on Carmen for virtual meetings. Office hour attendance is always optional but you are welcome to attend as frequently as you would like.

Faculty Rule 3335-8-24 defines a credit hour: "One credit hour shall be assigned for each three hours per week of the average student's time, including class hours, required to earn the average grade of "C" in this course." This is a 4 credit hour course, so that translates to about 12 hours per week to earn a C. An example of a student's weekly commitment might be:

- Watching video lectures (including rewatches), no more than 3 hours

- Watching lab tutorial (including rewatches), no more than 1 hour
- Lab assignment, 3 hours
- Homework assignments, 2 hours
- Content checks, 2 hours
- Attending office hours, navigating Carmen, Zoom check-ins, 1 hour

These time estimates are *very* generous - this hypothetical student would earn far better than a C.

Course Description

Foundational inferential methods for learning about populations from samples, including point and interval estimation, and the formulation and testing of hypotheses. Statistical theory is introduced to justify the approaches. The course emphasizes challenges that arise when applying classical ideas to big data, partially through the use of computational and simulation techniques. Prereq: C- or better in 3201, or permission of instructor. Not open to students with credit for 4202.

Course Learning Outcomes

By the end of this course, students should successfully be able to:

- Compare the performance of estimators via bias, mean squared error, consistency, and sufficiency
- Use Monte Carlo simulation to model the performance of estimators and testing procedures
- Propose estimators via the method of moments and maximum likelihood estimation
- Use the Central Limit Theorem to model the sample distribution of a sample mean
- Conduct hypothesis tests on mean and variance parameters, including t-tests, chi-square tests, and F tests
- Determine and interpret the power and type-II error of a test
- Use bootstrapping to conduct inference
- Perform nonparametric hypothesis tests on mean parameters

Materials

Text

- Required text: Stat 3202 Course Notes (electronic, on Carmen)
- Recommended text: Mathematical Statistics with Applications, 7th edition, by Wackerly, Mendenhall, and Scheaffer, Brooks/Cole, Cengage Learning, 2008. eBook PDFs are much cheaper and are highly encouraged.

Software

- Required software: we will extensively use the statistical software package called R (The R Project for Statistical Computing; <http://www.r-project.org/>). This software package is available for free. You can download R for Windows, Mac, and Linux, from the CRAN archive at <https://cran.r-project.org>. An in-depth introduction to R is available at <http://cran.r-project.org/doc/manuals/R-intro.pdf>. Tutorials are available in the Swirl system, which you can learn about at <http://swirlstats.com/>. “R Programming: The basics of programming in R” is an appropriate first tutorial for students who have never used R.
- Required software: we will also use the R interface RStudio. This package is available for Windows, Mac, and Linux and can be downloaded for free from <http://rstudio.org>. Note that RStudio requires R to be installed.

- Required software: Microsoft Office 365 ProPlus. All Ohio State students are now eligible for free Microsoft Office 365 ProPlus through Microsoft's Student Advantage program. Each student can install Office on five PCs or Macs, five tablets (Windows, iPad® and Android™) and five phones. Students are able to access Word, Excel, PowerPoint, Outlook and other programs, depending on platform. Users will also receive 1 TB of OneDrive for Business storage. Office 365 is installed within your BuckeyeMail account. Full instructions for downloading and installation can be found <https://ocio.osu.edu/kb04733>.

Grades and Assignments

Homework

Homework assignments will comprise 15% of your grade for the course. Assignments will only be accepted through Carmen as a .pdf file submission, with clear and organized work and relevant code and output provided. Every assigned problem should be completed, but only a subset of problems may be graded. You are encouraged to collaborate remotely on homework assignments, but ultimately the work you submit must be your own. You may be asked to explain and defend your work. **All homework assignments will be included in your final grade.**

Labs

Lab assignments will comprise 20% of your grade for the course. Most weeks a lab assignment will be introduced during recitation, incorporating recent lecture topics with coding. Labs will generally be due Fridays before 11:59 pm. You are encouraged to collaborate remotely on lab assignments, but ultimately the work you submit must be your own. Labs will be completed in R Markdown and must be compiled into organized, professional PDF documents. Relevant plots should be included and labeled, code should be organized and clear, and supporting answers and text should be properly formatted and professionally written. You may be asked to explain and defend your work. The lowest lab grade will be dropped.

Content Checks

Content checks will comprise two parts, totaling 20% of your grade.

- Zoom check-ins. For each brief check-in, you'll receive a grade from 0 to 10. The only occasion you're required to be somewhere at a specific time will be your 8-minute check-in block on either Tuesday or Thursday, whenever you signed up. If a conflict occurs or you forget a check-in, please reach out as far in advance as you can so we can schedule an alternative, but I cannot promise our availability will overlap.
- Content quizzes. The purpose of these assignments is to ensure you are keeping on schedule with the videos and to assess the content of the videos. Feel free to use your notes, rewatch videos, and retake them a second time. These short assignments should be completed by the assigned deadline. You may be asked to explain and defend your work during your Zoom check-ins. The lowest content quiz grade will be dropped. Videos and content quizzes will typically be available a week in advance to give you a chance to work ahead if you have personal obligations.

Oral Exams

Three oral exams, each comprising 15% of your grade, will take place during the semester: oral exam 1, covering videos 1-20, will take place Week 4 by appointment. Oral exam 2, covering videos 21-43, will take place Week 8 by appointment. Oral exam 3 covering videos 44-65, will take place during final exam week (Monday, July 29-Wednesday, July 31) by appointment. Oral exams will last about 10 minutes. Students

are welcome to use their notes during these exams but they cannot communicate with others or use AI tools. I will typically have flexibility within a day before or after these dates to accommodate students who are unavailable on these specific dates - please reach out ahead of time for flexibility! All exam grades will count towards your final grade.

Late Assignments

Late homeworks, labs, and Carmen quizzes will be accepted for 48 hours after the original due date with a 2% deduction per hour. **After this, no late assignments will be accepted.** Do not wait until the last moment to begin working on assignments. Unexpected obstacles will occur in life - it is your responsibility to be prepared for them. If something unexpected comes up 2 hours before an assignment is due that impedes your ability to submit on time, then you should have started the assignment earlier. Submitting the wrong document - such as the blank assignment template, an incomplete version, or a corrupted version of the file - is not a valid excuse. It is your responsibility to ensure you have submitted the proper document in the proper format.

For an emergency, each student can have one late waiver throughout the semester, no questions asked. **You still have to turn in the assignment within 48 hours, but I'll waive the late penalty for one assignment of your choosing if something unexpected comes up and submit it within 48 hours of the due date.**

Academic Integrity

I take academic integrity very seriously. There is no place at The Ohio State University for academic misconduct, and I have submitted many students in the past for violations including copying other students' work and receiving unauthorized assistance on exams.

- Content checks: you are encouraged to collaborate with other students in small groups if you are comfortable doing so, but ultimately the work you submit must be your own. Directly copying another student's work is not permitted. AI tools such as ChatGPT are permitted to summarize ideas or provide context, but you may not copy answers directly.
- Labs: you are encouraged to collaborate on lab assignments, but ultimately the work you submit must be your own. Directly copying another student's code, work, or file is not permitted. AI tools such as ChatGPT are permitted to suggest code ideas or provide context, but you may not copy code or answers directly.
- Check-ins and oral exams: you may use your own personal notes during check-ins and even during oral exams, but be careful to not be too reliant on these resources. You may not use AI tools such as ChatGPT during these assignments.
- Reusing past work: In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with me.
- Falsifying research or results: All research you will conduct in this course is intended to be a learning experience; you should never feel tempted to make your results or your library research look more successful than it was.
- Collaboration and informal peer-review: The course includes many opportunities for formal collaboration with your classmates. While study groups and peer-review of major written projects is encouraged, remember that comparing answers on an exam is not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct <http://studentlife.osu.edu/csc/>.

Health, Safety, and Accommodations

In the event you are unable to attend class for an extended period of time, please reach out to me as soon as possible. If it is reasonable for you to continue participating remotely, all materials will remain accessible for you. In the event I am unable to participate for an extended period of time, I will let students know as soon as possible. A replacement instructor will be available through the Department of Statistics.

If a health issue prevents you from participating in course material for multiple days, please obtain documentation from a health care provider, Student Advocacy, or SLDS.

Title IX Policy

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at <http://titleix.osu.edu> or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu.

Student Services and Accessibility Accommodations for Students with Disabilities

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

If you have accommodations, it is your responsibility to communicate these with me in a timely and efficient manner.

Student academic services: <http://advising.osu.edu/welcome.shtml>

Student support services: <http://ssc.osu.edu>

Diversity and Inclusion

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you

know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org.

Disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

This syllabus should be taken as a fairly reliable guide for the course content. However, you cannot claim any rights from it and in particular we reserve the right to change due dates or the methods of grading and/or assessment if necessary. Any changes will be communicated to you through official course announcements.