SYLLABUS: STAT 3202 SP 2024
Statistical Inference for Data Analytics

Course overview

Instructor

Instructor: Dr. Steephanson Anthonymuthu
Email address: anthonymuthu.1@osu.edu
Office: Cockins 321
In-person - Office hours: Tuesdays and Thursdays 12:30 pm– 01:30 pm, or by appointment.
Zoom office hours: Mondays and Wednesdays 09:00 – 10:00 am
Zoom link: Available on Carmen

Graders

Grader: Jae Chang.
Email address: chang.2090@osu.edu

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.

Prerequisite: C- or better in 3201, or permission of instructor. Not open to students with credit for 4202.

Course delivery

Course Lectures:

Lectures will be delivered in person during the scheduled class meeting times. Students are expected to attend and participate in these in-person class meetings. Class meetings will be used to provide in-depth investigation of the topics for the week using a lecture format. Students will participate in these class sessions by engaging in discussions prompted by the instructor and by asking and answering questions. Students should plan to take notes during class.

Lecture attendance is mandatory. If you cannot attend due to illness, contact tracing, or another reasonable health-related reason, please let me know in advance and follow all of Ohio State's guidelines on health and safety. Lecture notes will be posted on Carmen and the Lectures may be recorded and posted to Carmen. This is for your benefit to review content and to accommodate students whose health may prevent attendance, but this is not a substitute for in-person attendance.

Labs:

Lab tutorials and supplemental problems will be provided during your corresponding recitation time. Lab assignments will be due roughly at the end of each week. These lab meetings will take place in Pomerene 155.

Carmen

This class will use Carmen. In Carmen, you will find copies of the syllabus, lab and homework assignments, lecture notes and other important documents. Carmen will also be used to keep track of your assignment grades. Additionally, materials for lectures will be uploaded to Carmen.

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.

Course materials

Required

- 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.

Course technology

Necessary 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 AndroidTM) 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 .

This class requires the use of the (free) R Markdown authoring framework to complete assignments. Information about R Markdown will be provided in class; an online guide with overview information can be found at https://rmarkdown.rstudio.com.

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at https://ocio.osu.edu/help/hours, and support for urgent issues is available 24x7.

- **Self-Service and Chat support:** http://ocio.osu.edu/selfservice
- **Phone:** 614-688-HELP (4357)

- **Email:** 8help@osu.edu
- **TDD:** 614-688-8743

Technology skills necessary for this specific course

- Basic computer and web-browsing skills
- Navigating Carmen
- Collaborating in CarmenWiki

Necessary equipment

- Computer: current Mac (OS X) or PC (Windows 10+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed (if virtual office hours)
- Microphone: built-in laptop or tablet mic or external microphone

TopHat

- We may use TopHat for quizzes. Students are also required to register with TopHat, which is free for Ohio State University students. Please go to the TopHat home page (https://tophat.com/) and either login (https://app.tophat.com/login) or signup for an account (https://app.tophat.com/register/). Make sure you are using the latest version of the app or are accessing it through a browser.
- TopHat is already connected to the CarmenCanvas course, so it should be listed as one of your courses when you sign in. If not, you can use the join code **(code TBA)**. Please contact your instructor if you have difficulty accessing TopHat. You are expected to own a device (phone, tablet, laptop, etc.) that can access TopHat.

Grading and faculty response

Grades

Assignment or category	Percentage
Quizzes	10
Homework	20
Labs	20
Midterm 1	15
Midterm 2	17.5
Final Exam	17.5
Total	100

Quizzes will be given frequently during the lectures and outside of classroom using **Carmen** and/or, **TopHat**, and you **must** be in the classroom to take the quizzes for in-class quizzes. These short quizzes are meant to motivate you to participate actively in classroom activities and keep you up with the material introduced during class. Also, it gives you incentivize attendance and participation. These quizzes will not be made up and if you do not attend lecture, you cannot attempt, submit, or receive credit for these assignments. The quizzes are open book / open notes, and **you are strongly encouraged to work together with your neighbors in the classroom**. I will drop your two lowest quiz score when computing your quiz grade for the semester. The lowest 2 assignments are dropped to cover all work that is not turned in for any other reason.

Homework will be assigned periodically and will be due on Carmen. The due date will be announced with the homework assignments. Homework should be completed in R Markdown and a knitted pdf file should be uploaded. **You are encouraged to work together on homework; however, each student must produce their own assignment to be handed in. Do not copy any part of another student's homework.** All homework assignments will be included in your final grade, so be sure they are all submitted.

Labs /Recitation

Labs will be conducted every week. Most weeks a **lab** assignment will be introduced during recitation, incorporating recent lecture topics with coding. You are encouraged to collaborate 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.

Recitation Assignment and Recitation Attendance:

These are activities that we hope you will be able to work through each week, with your peers and your assigned teaching assistant, during recitation. We don't expect you to complete lab activities during recitation, but we will always allow time during recitation for you to get started on lab activities, talk through the activities with your peers, and get immediate assistance from your teaching assistant. You will then submit your final work through Carmen on the following Saturday, by 11:59pm.

The recitations will be graded out of 20 points based on both completion and accuracy and you can find the instruction in each assignment sheet posted on Carmen. At the end of the semester, the two lowest recitation grades will be dropped. Late work is not accepted unless there are extenuating long-term circumstances that are documented. The lowest 2 assignments are dropped to cover all work that is not turned in for any other reason. 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 correct document in the correct format to the correct Carmen submission location.

Recitation questions will include R cording and answering questions. Make sure you bring completely filled-in lecture notes before recitation. We do not have time to explain material from scratch and will not be able to do so in recitation.

Please note that attendance is **mandatory** for submitting recitation activities. If you fail to attend the recitation session, you will not be able to get credit for your submission of recitation activity.

We DO NOT make up missed recitations, nor do we excuse them. Save your drops for when you absolutely need them.

Late assignments

Late assignments (Homework and Labs) will be accepted for 24 hours after the original due date with a **1% 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 correct document in the correct format to the correct Carmen submission location.
"Can I please have an extension on my assignment?"

Yes! You may have up to 24 extra hours, with a 1% deduction per hour. Beyond that, no late assignments will be accepted.

However, in case of an emergency or exceptional circumstances (sudden onset of illness, unexpected family situations, etc.) arise and you are unable to submit by the original due data, contact the instructor to discuss the possibility of an extension.

Exams:
There will be two midterms and one final exam administered during the semester to assess your understanding of the course material as the semester progresses. The final exam will take place at the time and date established by the University. Information about the exams will be posted well in advance on Carmen. **Exams must be completed without any external help or communication.** The information about the exams given below.

Midterm Exam 1:
Thursday February 08, 2024

Midterm Exam 2:
Thursday March 07, 2024

Final exam:
Thursday April 25, 2024, at 6:00 pm in Ramseyer 0059

Generally, make-up exams will not be given. However, make-up exams may be given in case of an emergency or exceptional circumstances (sudden onset of illness, unexpected family situations, etc.) or due to conflicts with other university activities with proper documentation which must be submitted. If for some reason you are unable to make the exams, please contact me as soon as possible. Late requests may be denied, or penalties may be assessed.

If you find a discrepancy in the grading of a midterm exam (e.g., incorrect addition/subtraction, correct answer marked incorrect, etc.) then you must bring it to my attention (through email) no later than **one week** from the day the exams are returned. After that grades will typically not be changed.

Grade Disputes

It is extremely important that you pay attention to your grades on a regular basis. If you feel that an assignment has been graded incorrectly or unfairly, you must speak with your instructor within **one week** of getting your grade on that assignment. We will not re-grade assignments at the end of the semester or offer any extra credit if you are not satisfied at that time with your final course grade, especially since you will have known all semester what is expected of you to earn your desired grade in this course.

We believe strongly that grades are earned, not given. If you need to achieve a certain grade in this course, be careful to complete all assignments, plan appropriate time for studying, come to office hours/tutor room and ask questions, review feedback you receive on graded activities so

you can talk to us about any problems you missed, and get help as needed in order to achieve your goal. We hope your grade in the course will be just as important to you on Day 1 as it is at the end of the semester, especially since you will have known the expectations of this course all semester and are in control of deciding what grade to earn. We do not bump grades at the end of the semester, we do not have extra credit and we cannot change grades based on a person's circumstances. Do not expect your exams to be curved; they may or may not depending on how the class does. We do not curve the final total points at the end.

IMPORTANT! Keep track of your grades!!

Faculty feedback and response time

I am providing the following to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** if you have a technical problem.)

Grading and feedback

For large weekly assignments, you can generally expect feedback within **7 days**.

E-mail

I will reply to e-mails within **24 hours on school days**. Specific technical questions about the course material that require significant back-and-forth communication are not well suited for e-mail; while I will do my best to answer such questions, I may ask that you attend office hours if your question isn't easily answerable over email.

Grading scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70 –72.9: C-
67 –69.9: D+
60 –66.9: D
Below 60: E

Attendance, participation, and discussions

Student participation requirements

The following is a summary of everyone's expected participation:

- **Attending in-person class meetings**: **TWO TIMES PER WEEK**

  Students are expected to attend and participate in the in-person class meetings.

- **Logging in**: **AT LEAST ONCE PER WEEK**
  Be sure you are logging in to the course in Carmen each week, including weeks with holidays. You will need to log in to Carmen to complete quizzes, view lecture content and upload homework assignments. (During most weeks you will probably log in many times.) If you have a situation that might cause you to miss an entire week of class, discuss it with me as soon as possible.

- **Office hours**:
  Yor are encouraged to attend office hours for assistance. If you need to speak with me privately about a topic that cannot be easily discussed during office hours, please contact me to schedule a time to meet.

Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style**: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. Informality (including an occasional emoticon) is fine for non-academic topics.

- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.

- **Citing your sources**: When we have academic discussions, please cite your sources to back up what you say. (For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.)

- **Backing up your work**: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

Other course policies

Health and safety

The Ohio State University Wexner Medical Center's Coronavirus Outbreak site (https://wexnermedical.osu.edu/features/coronavirus) includes the latest information about COVID-19 as well as guidance for students, faculty and staff.

I expect that you will read and follow the guidelines and requirements for campus safety, which are available at https://safeandhealthy.osu.edu.

Student academic services

Student academic services offered on the OSU main campus http://advising.osu.edu/welcome.shtml.

Student support services

Student support services offered on the OSU main campus http://ssc.osu.edu.

Academic integrity policy

Policies for this course

- **Exams**: You must complete the midterm and final exams yourself, without any external help or communication.
- **Written assignments**: Your written assignments, should be your own original work. In formal assignments, you should cite the ideas and words of your research sources. You are encouraged to ask a trusted person to proofread your assignments before you turn them in, but no one else should revise or rewrite your work.
- **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.
- **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 a quiz or assignment is not permitted. If you're unsure about a particular situation, please feel free to ask the instructor.

Ohio State's academic integrity policy

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/.

Copyright 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. **No course materials provided by the instructor (notes, videos, recordings, computer code, homework assignments, homework solutions, quizzes, exams, etc.) may be distributed publicly or privately to anyone outside of the class.**

Statement on title IX

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, Kellie Brennan, at titleix@osu.edu

Accessibility accommodations for students with disabilities

"The university strives to maintain a healthy and accessible environment to support student learning in and out of the classroom. 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.

If you are isolating while waiting for a COVID-19 test result, please let me know immediately. Those testing positive for COVID-19 should refer to the Safe and Healthy Buckeyes site for resources. Beyond five days of the required COVID-19 isolation period, I may rely on Student Life Disability Services to establish further reasonable accommodations. You can connect with them at slds@osu.edu; 614-292-3307; or slds.osu.edu."

Accessibility of course technology

This course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- [Carmen (Canvas) accessibility](#)
- Streaming audio and video
- Synchronous course tools

Your 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

Weather or other short-term closing University

Should in-person classes be canceled, I will notify you as to which alternative methods of teaching (Zoom lectures or other modes) will be offered to ensure continuity of instruction for this class. Communication will be via Carmen, email or other mode of communication.

Religious Accommodations

Our inclusive environment allows for religious expression. If you need to request accommodations based on faith, religious or a spiritual belief system in regard to examinations, other academic requirements or absences, please provide your course instructor with written notice of specific dates for which you need alternative accommodations at the earliest possible date.

It is Ohio State's policy to reasonably accommodate the sincerely held religious beliefs and practices of all students. The policy permits a student to be absent for up to three days each academic semester for reasons of faith or religious or spiritual belief.

Students planning to use religious beliefs or practices accommodations for course requirements must inform the instructor in writing no later than 14 days after the course begins. The instructor is then responsible for scheduling an alternative time and date for the course requirement, which may be before or after the original time and date of the course

requirement. These alternative accommodations will remain confidential. It is the student's responsibility to ensure that all course assignments are completed.

For more information about religious accommodations at Ohio State, visit *odi.osu.edu/religious-accommodations*.

Disclaimer

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.

Course Schedule (tentative)

The following tentative course schedule is subject to change.

Red: no meeting   *Italics: recitation meeting*

Date	Meeting	Topic
Monday, January 08	*Recitation 1*	**Creating R Markdown reports**
Tuesday, January 9	Lecture 1	**Course intro; statistics vocab; expectation and variance**
Thursday, January 11	Lecture 2	**Common probability distributions**
Monday, January 15	*Holiday*	*No Recitaiton - Martin Luther King Jr. Day*
Tuesday, January 16	Lecture 3	**Frequently used statistics and sampling distributions; the CLT**
Thursday, January 18	Lecture 4	**Monte Carlo and custom R functions; intro to estimators**
Monday, January 22	*Recitation 2*	*Simple Monte Carlo and sampling distributions lab*
Tuesday, January 23	Lecture 5	**Bias and Mean Squared Error**
Thursday, January 25	Lecture 6	**Common unbiased point estimators**
Monday, January 29	*Recitation 3*	*Illustrating the CLT, Bias, and MSE lab*
Tuesday, January 30	Lecture 7	**Consistency**
Thursday, February 1	Lecture 8	**Likelihood I**
Monday, February 5	*Recitation 4*	*Exam 1 review; no lab assignment*
Tuesday, February 6	Lecture 9	**Sufficiency**
Thursday, February 08	Exam 1	**Exam 1 (Lectures 1-8)**
Monday, February 12	*Recitation 5*	*Consistency lab*
Tuesday, February 13	Lecture 10	**Method of moments estimation**
Thursday, February 15	Lecture 11	**Maximum likelihood estimation**
Monday, February 19	*Recitation 6*	**Computational maximum likelihood lab**
Tuesday, February 20	Lecture 12	*Introduction to statistical inference and confidence intervals*
Thursday, February 22	Lecture 13	**Small-sample CIs for a mean and for paired data**
Monday, February 26	*Recitation 7*	**Mean confidence interval coverage lab**
Tuesday, February 27	Lecture 14	*Small-sample CIs for a difference in means*
Thursday, 'February 29	Lecture 15	**CIs for proportions and differences in proportions**
Monday, March 4	*Recitation 8*	**Exam 2 review; no lab**
Tuesday, March 5	Lecture 16	*CIs for variances and ratios of variances*
Thursday, March 7	Exam 2	**Exam 2 (Lectures 9-15)**
Monday, March 11	*No Recitation*	*Spring Break*
Tuesday, March 12	No Lecture	*Spring Break*
Thursday, March 14	No Lecture	**Spring Break**
Monday, March 18	*Recitation 9*	*Small-sample Confidence intervals lab*
Tuesday, March 19	Lecture 17	**One-sided confidence intervals and practice**
Thursday, March 21	Lecture 18	**Introduction to hypothesis testing**
Monday, March 25	*Recitation 10*	*One-sided confidence intervals lab*
Tuesday, March 26	Lecture 19	**Rejection regions and p-values**
Thursday, March 28	Lecture 20	**Type-I error**
Monday, April 1	*Recitation 11*	*Type-I error lab*
Tuesday, April 2	Lecture 21	**P-values, Power and type-II error**
Thursday, April 4	Lecture 22	**Hypothesis tests on variances and ratios of variances**

Monday, April 8	*Recitation 12*	**P-values, type-I error and type-II error**
Tuesday, April 9	**Lecture 23**	**Hypothesis tests on variances and ratios of variances**
Thursday, April 11	**Lecture 24**	**Hypothesis tests on variances and ratios of variances**
Monday, April 15	*Recitation 13*	*Power and type-II error lab*
Tuesday, April 16	**Lecture 25**	**Hypothesis tests continued**
Thursday, April 18	**Lecture 26**	**Bootstrapping**
Monday, April 22	*Recitation 14*	*Exam 3 review; no lab*