

Syllabus: STAT 3202

Introduction to Statistical Inference for Data Analytics

Autumn 2020

Course overview

Instructor: Kumar Somnath

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Office hours: Virtual Hours via Carmen Zoom, Mondays, Wednesdays and Fridays 1 - 2pm, or, by appointment

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:

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

- (Time permitting) Define Bayesian statistics and investigate some simple problems involving inference on a proportion

Course materials

Required

Stat 3202 Course Notes (electronic, on Carmen)

Optional (recommended) materials

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

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

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Carmen

Technology skills necessary for this specific course

- CarmenZoom
- Recording a slide presentation with audio narration
- Recording, editing, and uploading video

Necessary equipment

- Computer: current Mac (OS X) or PC (Windows 10+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed

- Microphone: built-in laptop or tablet mic or external microphone

Necessary software

- This class requires you to use the statistical software package called R (The R Project for Statistical Computing; <http://www.r-project.org/>). This software package is available as 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>
 - Hands-on tutorials are available in the Swirl system, which you can learn about at <http://swirlstats.com/>. In particular, “R Programming: The basics of programming in R” is an appropriate first tutorial for students who have never used R.
- An easier to use interface to R is available in the software package 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.**
- [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>.

Course delivery

Hybrid section (CRN 23681): Lectures will be held in-person, twice weekly, if it is reasonable and safe for you to do so per the university’s guidelines. Supplementary lecture videos will be posted corresponding to each lecture in case students are unable to attend in-person lecture for health reasons. It is strongly encouraged that you join the lectures in real-time. Although attendance is strongly encouraged if it is reasonable and safe for you to do so, lecture videos will be designed to provide an acceptable alternative to in-person attendance. A lecture check assignment must be completed after each lecture so please keep on schedule with the content.

Remote/Online section (CRN 25449): Each week several lecture videos, totaling approximately 165 minutes of lecture, will be posted on the course website. You are responsible

for watching the videos and studying the material that is assigned each week. A lecture check assignment must be completed after each lecture so please keep on schedule with the content.

All students: Labs will be conducted remotely. Remote lab tutorial sessions will be held at the beginning of each week at a reasonable time to be determined. These sessions will be recorded and posted in the event students are unable to reasonably or safely log on. Office hours will be held remotely at consistent times each week, or, via appointment. Exams and assessments will be held remotely. All submissions, such as homework assignments, will be virtual through Carmen.

In an effort to maintain some semblance of normalcy, live CarmenZoom meetings may also take place with advance notice. However, **the vast majority of this course may be completed asynchronously and remotely, should your personal circumstances necessitate this.**

Grading and faculty response

Grades

Assignment or category	Percentage
Homeworks	20%
Labs	20%
Lecture checks	20%
Exam 1	10%
Exam 2	10%
Final project	20%

Total

100%

Grade Disputes: if you believe an error has been made in grading, you have one week from the time the grade was posted to dispute the grade. Only the following will be considered grounds for a dispute:

- The grader simply didn't add up the points correctly.
- The grader did not see a correct answer that is on your submission.
- Your answer is the same as the correct answer, but in a different form; for instance, you said $p < \alpha$, but the grader was looking for $\alpha > p$;
- Your answer to a free response question is essentially correct but stated slightly differently than the grader's interpretation.
- The points deducted from your work do not match the guidelines set by the grader's rubric.

Assignment Information

Lecture Checks: after each lecture, whether you attended the in-person section in Scott Lab E001 or watched the corresponding videos posted to Carmen, you are responsible for completing a brief lecture check assignment covering that lecture's materials. Typically, lecture checks will take 10-15 minutes. Lecture checks should be completed before 11:59 pm the same day. You are encouraged to collaborate remotely on lecture check assignments, but ultimately the work you submit must be your own.

Homeworks: tentatively, there will be six homework assignments. Assignments should be submitted to Carmen as a .pdf file and organized according to the homework template. 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.

Labs: each week a lab assignment will incorporate the recent topics with coding. Labs will 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.

Exams/assessments: You must work independently on exams. You may not solicit help from other students or other online resources. Last semester, I submitted several students to the Committee on Academic Misconduct (COAM) for posting my exams on Chegg. Despite our unusual circumstances, **I take academic integrity very seriously and will submit any students who gain unauthorized aid to COAM.**

Late Assignments

I understand that this semester will pose many unexpected obstacles in your academic lives. Late assignments will only be accepted at the instructor's discretion. Please keep some things in mind:

- The sooner I know of a potential problem, the better. If something is going to prevent you from submitting an assignment on-time, please reach out immediately.
- Please do not take advantage of this flexibility. Students who are habitually late submitting assignments may lose the benefit of the doubt other students may get.
- Do your best to anticipate the issues that may arise this semester. In a normal semester, it might be easy to get away with procrastination from time to time. I have a feeling that this semester, unexpected delays and problems will pop up frequently for all of us. Please be proactive with your academic responsibilities.

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

Faculty feedback and response time

I will make reasonable efforts to provide feedback in a timely manner.

Grading and feedback: For large weekly assignments, you can generally expect feedback within 7 days.

Email: I will reply to e-mails within **24 hours on school days**.

Discussions: I will check and reply to messages in the discussion boards every **24 hours on school days**.

Attendance, participation, and discussions

Student participation requirements

Because this is a hybrid or distance education course, your attendance is based on your online activity and participation. The following is a summary of everyone's expected participation:

- **Logging in: at least three times per week**
Be sure you are logging in to the course in Carmen at least three times each week, including weeks with holidays or weeks with minimal online course activity. (During most weeks you will probably log in many times.) **If you have a situation that might cause you to miss an extended period of class, discuss it with me as soon as possible.**
- **Office hours and live sessions: optional/flexible**
All live, scheduled events for the course, including my office hours, are optional. For live presentations, I will provide a recording that you can watch later. If you are required to discuss an assignment with me, please contact me at the beginning of the week if you need a time outside my scheduled office hours.

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:** Please remember to use appropriate grammar, spelling, and punctuation. Your written comments on Carmen discussions are visible to all students, and emails are visible to me, so please make efforts to communicate professionally.
- **Tone and civility:** Please maintain a supportive learning community where everyone feels safe and where people can disagree amicably.
- **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 pasting 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.

Guidelines and requirements for campus safety from the University's COVID-19 Transition Task Force were published on July 1 on the Safe and Healthy website (<https://safeandhealthy.osu.edu>). They include the following:

- “A daily health check to report body temperature and health status will be required for all faculty, staff and students each day they intend to be on Ohio State’s campuses in the autumn.”
- Face masks must be worn in indoor settings, including classrooms. Noncompliant students will be asked to leave. I will have no patience whatsoever with students who put myself and others at risk.
- Members of the campus community will be required to sign a pledge “to affirm their understanding of what is needed to help fight the spread of the virus and their intention to do their part.”
- “Accountability measures will be in place for those who refuse to abide by required health and safety guidelines.”

Potential disruptions to instruction

My goal is that in the event of disruptions, your transition to remote learning will be minimal. All materials will be available remotely even before issues arise.

In the event you are unable to participate for an extended period of time because of positive diagnosis, symptoms, or quarantine required following contact tracing, please reach out to me as soon as possible. If it is reasonable for you to continue participating remotely, all materials will be accessible for you.

In the event I am unable to participate for an extended period of time because of positive diagnosis, symptoms, or quarantine required following contact tracing, I will let students know as

soon as possible. A replacement instructor will be available through the Department of Statistics.

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 online course

- **Lecture checks:** You are encouraged to collaborate remotely on lecture check assignments, but ultimately the work you submit must be your own.
- **Labs:** You are encouraged to collaborate remotely on lab assignments, but ultimately the work you submit must be your own.
- **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.

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.

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 make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process, managed by Student Life Disability Services. 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; <http://slds.osu.edu>; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online 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

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)

Week	Dates	Topics, Readings, Assignments, Deadlines
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1 T 8/25 – F 8/28 Optional foundation material: summations and products, derivatives and differentiation, exponent and logarithm rules, indefinite integrals; read course notes TBD

Week 1 Content:

Statistics vocabulary, expectation and variance, frequently used probability distributions, assessing normality; read course notes TBD; read Wackerly and Mendenhall TBD

Week 1 Assignments:

Lecture Checks: 1A and 1B

Lab 1: R Markdown introduction due Friday, August 28

2 M 8/31 – F 9/4

Week 2 Content:

Frequently used statistics, Monte Carlo simulation, custom R functions, sampling distributions, the Central Limit Theorem; read course notes TBD; read Wackerly and Mendenhall TBD

Week 2 Assignments:

Lecture Checks 2A and 2B

Lab 2: Monte Carlo and custom R functions due Friday, September 4

Homework 1: due Friday, September 4

- 3 T 9/8 – F 9/11 Week 3 Content:

Estimators, bias, mean squared error; read course notes
TBD; read Wackerly and Mendenhall TBD

Week 3 Assignments:

Lecture Checks 3A and 3B

Lab 3: sampling distributions from MC; CLT illustration due
Friday, September 11
- 4 M 9/14 – F 9/18 Week 4 topics: consistency; read course notes TBD; read
Wackerly and Mendenhall TBD

Week 4 Assignments:

Lecture Checks 4A and 4B

Homework 2: due Friday, September 18

Lab 4: bias and MSE due Friday, September 18
- 5 M 9/21 – F 9/25 Week 5 topics: likelihood and sufficiency; read course notes
TBD; read Wackerly and Mendenhall TBD

Week 5 Assignments:

Lecture Checks 5A and 5B

Lab 5: consistency due Friday 9/25

Exam/Assessment 1: date TBD
- 6 M 9/28 – F 10/2 Week 6 topics: method of moments; read course notes TBD;
read Wackerly and Mendenhall TBD

Week 6 Assignments:

Lecture Checks 6A and 6B

Lab 6: working with likelihood functions

Homework 3: due Friday, October 2

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| 7 | M 10/5 – F 10/9 | <p>Week 7 topics: maximum likelihood estimation; read course notes TBD; read Wackerly and Mendenhall TBD</p> <p>Week 7 Assignments:</p> <p>Lecture Checks 7A and 7B</p> <p>Lab 7: Comparing estimators (bias, MSE, consistency review)</p> |
| 8 | M 10/12 – F 10/16 | <p>Week 8 topics: Hypothesis testing and hypothesis tests on a single mean, paired tests; read course notes TBD; read Wackerly and Mendenhall TBD</p> <p>Week 8 Assignments:</p> <p>Lecture Checks 8A and 8B</p> <p>Lab 8: maximum likelihood: due Friday, 10/16</p> <p>Homework 4: due Friday, 10/16</p> |
| 9 | M 10/19 – F 10/23 | <p>Week 9 topics: hypothesis tests on a difference of means, hypothesis tests on proportions; read course notes TBD; read Wackerly and Mendenhall TBD</p> <p>Week 9 Assignments:</p> <p>Lecture Checks 9A and 9B</p> <p>Lab 9: power and type-I error in hypothesis tests on a mean; data analysis due Friday 10/23</p> |

- 10 M 10/26 – F 10/30 Week 10 topics: hypothesis tests on a single variance; hypothesis tests on two variances; read course notes TBD; read Wackerly and Mendenhall TBD
- Week 10 Assignments:
- Lecture Checks 10A and 10B
- Lab 10: power and type-I error in hypothesis tests on differences of means and proportions; data analysis due Friday 10/30
- Homework 5: due Friday 10/30
- 11 M 11/2 – F 11/6 Week 11 topics: power and type-II error; read course notes TBD; read Wackerly and Mendenhall TBD
- Week 11 Assignments:
- Lecture checks 11A and 11B
- Lab 11: power and type-I error summary; data analysis due Friday 11/6
- Exam/Assessment 2: date TBD
- 12 M 11/9 – F 11/13 Week 12 topics: Bootstrapping; read course notes TBD
- Week 12 assignments:
- Lecture checks 12A and 12B
- Lab 12: bootstrapping
- Homework 6: due Friday 11/13

- 13 M 11/16 – F 11/20 Week 13 topics: Nonparametric tests, Wilcoxon Signed-Rank test, Mann-Whitney U test; read course notes TBD; read Wackerly and Mendenhall TBD
- Week 13 assignments:
- Lecture checks 13A and 13B
- Lab 13: nonparametric tests due Friday 11/20
- 14 M 11/23 – W 11/25 Week 14 topic: Analysis of Variance; read course notes TBD; read Wackerly and Mendenhall TBD
- Week 14 assignments:
- Lecture check 14A
- Lab 14: ANOVA due Friday 11/15
- (shorter lab due to less content, Thanksgiving week)
- 15 M 11/30 – 12/4 Week 15 topics: Bayesian statistics; read course notes TBD; read Wackerly and Mendenhall TBD
- Lecture check 15A and 15B
- Lab 15: Bayesian statistics due Friday 12/4
- Homework 7: due Friday 12/4
- Finals M 12/7 – F 12/11 Final Exam date TBD