



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 4301

ADVANCED STATISTICAL INFERENCE

AUTUMN 2022

Course overview

Instructor

Instructor: Radu Herbei

Email address: herbei.1@osu.edu

Office hours: Virtual Hours via Carmen Zoom: Tuesdays 10:00-11:00am and by appointment.

Office Location: CH 223.

Course description

STAT 4301 is a course on advanced statistical theory and is intended for statistics majors in their senior year. Students will learn about advanced probability and statistical methods. They will work with univariate and multivariate distributions, will formulate statistical models, construct confidence intervals and perform hypothesis tests. Statistical procedures will be motivated by examples and backed by formal theoretical arguments.

Course learning outcomes

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

- Work with and derive univariate and multivariate distributions.
- Derive distributions of transformed random variables.
- Formulate, construct and interpret confidence intervals about parameters in a statistical model.
- Formulate statistical hypotheses, construct appropriate hypotheses tests and interpret results.
- Construct distribution-free hypotheses testing procedures.
- Construct formal mathematical proofs for certain claims.

Course materials

Required

Probability and statistics by Morris H. DeGroot and Mark H. Schervish
(Pearson, ISBN: 978-0321500465)

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
- Collaborating in CarmenWiki
- 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

- [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>.
- Although this class is mostly theoretical, on occasion, I may use the statistical software package called R (The R Project for Statistical Computing; <http://www.r-project.org/>) to illustrate certain aspects. However, this software is not a strict requirement for this class. If you wish to download it, here is the information.
 - 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.**

Course delivery

The class meets on MWF from 9:10am – 10:05am in JR0239. The class is offered **in-person**. Unless mandated by the University, the class will not have a parallel online content-delivery system. At the instructor's discretion, certain lectures may be recorded and/or delivered online only.

The instructor will hold weekly office hours via CarmenZoom as indicated above. When appropriate, the instructor will also initiate and manage active discussion boards, also via Carmen.

Grading and faculty response

Grades

Assignment or category	Percentage
Homework	10%
Exam 1	30%
Exam 2	30%
Exam 3	30%
Total	100%

Assignment information

Homework: There will be weekly homework assignments posted on the course website. Homework is due once per week, with dates and times provided as needed. Homework assignments will be submitted for grading via Carmen.

Exams: There will be three exams. All exams will be delivered in person, during class time. Information about the exams will be posted well in advance through the course website. If mandated, exams will be delivered online, through Carmen. For online exams, **Proctorio** may be used as a security tool.

Exam I – Wednesday, 09/28/22.

Exam II – Wednesday, 11/02/21.

Exam III – Wednesday, 12/07/22.

Late assignments

Generally, late assignments are not accepted, and **written documentation is required** for missed assignments. If you are unable to complete an assignment on time, please get in touch with me *as soon as possible* so we can discuss your situation.

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 am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time 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**.

Discussion board

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

Attendance, participation, and discussions

Student participation requirements

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

- Since the class is offered in-person, students are required to attend class **in person**. However, attendance will not play a factor in your final grade.
- **Logging in to Carmen: AT LEAST ONCE PER WEEK**
Be sure you are logging in to the course in Carmen each week, including weeks with holidays or weeks with minimal course activity. (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: OPTIONAL OR FLEXIBLE**
My office hours, are optional. If you wish to discuss an assignment with me, please contact me if you need a time outside my scheduled office hours.

- **Participating in discussion forums: OPTIONAL, SEVERAL TIMES PER WEEK**
You are encouraged to participate in discussion forums, if you choose to do so.

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 online course

- **Exams:** You must complete exams yourself, without any external help or communication.
- **Written assignments:** Your written assignments, including discussion posts, should be *your own original work*. You are encouraged to join a study group and *discuss* homework problems with your peers. You are also 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.
- **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 opportunities for collaboration with your classmates. While study groups are encouraged, remember that you must submit your own original work. 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. You must obtain my permission before sharing any of the materials associated with this course with others not enrolled in 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 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, I 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.

Tentative Schedule

Week	Dates	Topics, Readings, Assignments, Deadlines
1	8/22/22 – 8/28/22	Review of probability, basic probability distributions
2	8/29/22 – 9/4/22	Conditional probability: conditional and marginal distributions; Bayes theorem
3	9/5/22 – 9/11/22	Functions of random variables
4	9/13/22 – 9/18/22	Functions of random variables
5	9/19/22 – 9/25/22	Expected values
6	9/26/22 – 10/2/22	Expected values, moments.
7	10/3/22 – 10/9/22	Special distributions.
8	10/10/22 – 10/16/22	Large sample theory.
9	10/17/22 – 10/23/22	Estimation.
10	10/24/22 – 10/30/22	Sufficiency.
11	10/31/22 – 11/6/22	Bayesian estimation
12	11/7/22 – 11/13/22	Confidence intervals
13	11/14/20 – 11/20/20	Hypothesis testing
14	11/21/20 – 11/27/20	Hypothesis testing
15	11/28/20 – 12/4/20	Non-parametric statistics
16	12/05/22 – 12/07/22	Review