



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 4301

ADVANCED STATISTICAL INFERENCE

AUTUMN 2020

Course overview

Instructor

Instructor: Radu Herbei, PhD. (please call me Dr. Herbei, or Prof. Herbei)

Email address: herbei.1@osu.edu

Office hours: via Carmen Zoom on Mondays and Wednesdays 9:00am – 10:00am.

Office Location: CH223

Grader

Renxiong Liu (liu.6732@osu.edu)

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 textbook:

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

- 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 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.**
- [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

The class is scheduled to meet on MWF from 9:10am – 10:05am. For the Autumn 2020 offering, the course will be taught fully online, and no in-person meetings will take place.

Each week I will post videos for you to watch and learn from. Such videos will contain new course material and worked examples. You will be responsible for watching the videos, studying the new material and working through the examples presented in the videos or assigned as an exercise. Links for the Zoom meetings will be posted well in advance on Carmen.

On Mondays and Wednesdays, I will hold office hours via Zoom, at the regularly scheduled class times: from 9:00am – 10:00am. If necessary, additional office hours may be scheduled.

The vast majority of the course can be completed asynchronously, meaning that you will be able to study materials and work on assessments according to your own schedule. Throughout the

course, the balance between synchronous (live lectures) and asynchronous (posted videos) may change, based on the specific topic we are covering, or other factors.

Weekly office hours will be held via CarmenZoom, at the times given above (see Instructor section).

Grading and faculty response

Grades

Assignment or category	Percentage
Homework	10
Quizzes	10
Midterm 1	25
Midterm 2	25
Final Exam	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.

Quizzes: There will be weekly quizzes. These will be administered online, through Carmen. There will be a sufficiently large time window, but once you begin taking the quiz there will be a time limit for you to complete it. **Proctorio** will be used during the quizzes.

Exams: There will be two midterm exams and one final exam. All exams will be delivered remotely, via Carmen. 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 through the course website. **Proctorio** will be used during exams.

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

Because this is a 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 ONCE PER WEEK**
 Be sure you are logging in to the course in Carmen 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 entire week of class, discuss it with me *as soon as possible*.

- **Office hours and live sessions: OPTIONAL OR 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.
- **Participating in discussion forums: SEVERAL TIMES PER WEEK**
As participation, each week you can expect to post several times as part of our substantive class discussion on the week's topics.

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

- **Quizzes and exams:** You must complete the midterm and final exams yourself, without any external help or communication. Weekly quizzes are included as self-checks without points attached.
- **Written assignments:** Your written assignments, including discussion posts, 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.
- **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 a quiz or assignment 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. 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.

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