



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 7303

BAYESIAN ANALYSIS AND DECISION THEORY

SPRING 2021

Course overview

Instructor

Instructor: Yunzhang Zhu

Email address: zhu.219@osu.edu

Phone number: 614-247-6931

Office hours: Virtual Hours via Carmen Zoom

- Tuesday 8:30am – 9:30am
- Thursday 8:30am – 9:30am
- By appointment

Grader

Ruo Chen Huang (huang.3172@osu.edu)

Course description

This course covers basic elements of decision theory and Bayesian inference. In particular, we will cover the following core topics: basic elements of decision theory; Bayesian expected loss, frequentist risk, Bayes risk; statistical foundations and principles; loss functions; prior distributions; posterior distributions; Bayes inference; Bayes decision theory; empirical Bayes analysis. As time permits, we may also cover hierarchical Bayes models and exchangeability of random variables.

Course learning outcomes

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

- understand basic elements of decision theory

- derive Bayes rules and compute Bayes risk and frequentist risk
- understand basic statistical principles
- understand basic methods for constructing prior distributions
- understand basic Bayes inference procedures
- understand empirical Bayes analysis and hierarchical Bayes models

Course materials

Required

The required textbook for this course is:

Statistical Decision Theory and Bayesian Analysis, second edition, by Jim Berger. The eBook is freely available for download from the OSU library website: <https://library.ohio-state.edu/record=b8694733>.

Optional materials

Other useful references will be provided at the end of each lecture notes.

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

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>.

Course delivery

The course will be a mix of synchronous and asynchronous content. Synchronous content will be presented live over CarmenZoom, and asynchronous content will be delivered by recorded lectures posted on the class website. Details of the weekly schedule will be announced at the start of each week.

Each week we will cover approximately 165 minutes of content in total. You will be responsible for watching any live content or recorded videos and studying the material that is assigned. In addition to the lecture videos, assignments will be posted on the class website. You will be given ample time to complete the assignments.

The instructor may elect to deliver live CarmenZoom lectures in place of videos for certain topics. In this case, the lecture will be recorded and posted on the class website soon after. The instructor will hold weekly office hours via CarmenZoom. The times are provided above.

Grading and faculty response

Grades

Assignment or category	Percentage
Homework	40
Midterm	25
Final	35
Total	100

See course schedule, below, for a tentative exam schedule

Assignment information

Each assignment includes 2-5 problems. All assignments will be posted on Canvas, and must be submitted online as a PDF file through Canvas. Each student must produce his/her own homework to be handed in. Feel free to ask me for help after you have made an attempt of the questions. Put your name and the homework assignment number on the top right-hand corner of every page, and submit the problems in order.

Late assignments

Typically, no late homework assignment will be accepted. However, 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**.

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:

- **In live lectures:**
Students will be expected to participate. If you miss class for reasons related to COVID-19, please stay in contact with the instructor so that we can discuss accommodations.
- **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.

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. 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>).

Potential disruptions to instruction

Contingencies to be addressed:

- Student is unable to attend class because of positive diagnosis, symptoms, or quarantine required following contact tracing
- Entire class is required to quarantine following contact tracing
- In-person classes are suspended at the university
- Instructor is unable to be present in person because of positive diagnosis, symptoms, or quarantine following contact tracing

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 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.
- **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 (Recommended)

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
1	Jan 11, 13, 15	Basic elements of Decision Theory
2	Jan 20, 22	Bayes expected loss, frequentist risk, Bayes risk
3	Jan 25, 27, 29	Likelihood principle, Conditionality principle
4	Feb 1, 3, 5	Utility theory, loss functions
5	Feb 8, 10, 12	Admissibility of Bayes rules
6	Feb 15, 17, 19	Complete Class Theorem
7	Feb 22, 24, 26	Minimax rules and Minimax Theorem
8	Mar 1, 3, 5	Admissibility of generalized Bayes rules
9	Mar 8, 10, 12	Relationships between minimax, Bayes, and admissible rules; Midterm exam (March 10 1:50pm-2:45pm)
10	Mar 15, 17, 19	James-Stein estimator, prior distributions overview
11	Mar 22, 24, 26	Subjective prior, conjugate prior, noninformative prior, maximum entropy prior
12	Mar 29, Apr 2	Empirical Bayes analysis (parametric, and nonparametric)
13	Apr 5, 7, 9	Hierarchical models, exchangeability
14	Apr 12, 14, 16	Exchangeable random variables, finite exchangeable Bernoulli random variables, De Finetti's theorem
15	Apr 19, 21	De Finetti's theorem (extended coverage)
16	Apr 30	Final exam (April 30 4:00pm-5:45pm)