



THE OHIO STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

SYLLABUS: STAT 3303 BAYESIAN ANALYSIS AND STATISTICAL DECISION MAKING - SPRING 2025

Course overview

Instructor

Instructor: Dr. Steephanson Anthonymuthu

Email address: anthonymuthu.1@osu.edu

Office: Cockins 321

In-person - Office hours: Thursday 11:15am -12:15pm, or by appointment

Virtual office hours via Zoom: Thursday 08:15am - 9:15pm, or by appointment

Zoom link for office hours: Available on Carmen

Graders

TA: Yeming Lin

Email address: lin.4466@buckeyemail.osu.edu

Course description

This course is an introduction to Bayesian analysis and statistical decision theory, the theory of making decisions in the presence of uncertainty. Topics covered include the formulation of decision problems and the quantification of their components, optimal decisions, Bayesian modeling, simulation-based approaches to obtaining Bayesian inferences (including MCMC algorithms), and hierarchical modeling.

Prerequisite: C- or better in 3202 and 3301, or permission of instructor.

Course delivery

Course Lectures:

This class will take place in person. Lectures will include a mix of slides and software demonstrations. Partial slides will be provided via Carmen to be filled in by students during the lectures. All assignments will be posted on the Carmen course page. Office hours will be held in person.

In case of instructor illness or other emergency, a lecture may be changed to online delivery. The instructor will provide as much notice as possible of any such changes via email and on Carmen. Every attempt will be made to provide a synchronous online lecture, which will also be recorded and posted online.

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 annotated 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.

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:

- Formulate the inputs to a decision problem including potential actions, losses and gains, and quantification of uncertainty.
- Develop Bayesian statistical models to quantify uncertainty and obtain inferences on unknown model parameters.
- Use posterior distributions to obtain optimal decisions based on available information.
- Assess the impacts of departures from model assumptions on inferences and decisions.
- Explain Bayesian statistical analyses to others, such as managers and other decision makers.

Course materials

Required

Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan, 2nd Edition, by John K. Kruschke, ISBN: 978-0-12-405888-0. (Available in electronic format through the library).

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 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>.

We will also be using the Just Another Gibbs Sampler (JAGS) software, accessed through an interface with R. No prior experience with JAGS is expected. Students will have to demonstrate that they have the required software, including JAGS, within the first week of class or they risk being dropped from the course.

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

Grading and faculty response

Grades

| Assignment or category | Percentage |
|---------------------------------|------------|
| Homework | 17.5 |
| Quiz | 15 |
| Midterm 1 | 25 |
| Midterm 2 | 25 |
| Final Project | 17.5 |
| Total | 100 |
| Extra-Credit Quizzes (Optional) | 5% |

Quizzes

Quizzes will be administered frequently in the class. These short quizzes are designed to help you stay engaged with the material covered in the lectures. There will be around 8 Quiz assignments that you will complete during the semester inside the class.

In general, make-up quizzes are not permitted. However, to allow for unforeseen circumstances, your lowest quiz score will be dropped when calculating your overall quiz grade for the semester.

Homework

Homework will be assigned periodically and submitted through Carmen. Due dates will be announced alongside each homework assignment. It will consist of mostly textbook- style problems, problems motivated by real-world applications, and analyses requiring the use of statistical software. You may work together on assignment problems, but each student must hand in his or her own work, written in his or her own words. Do not copy any part of another student's homework including computer code or output.

Homework must be uploaded to Carmen by the due date. The solutions may be handwritten and scanned, entered directly into a tablet, or typed. All software output must be included in the submission. **All work and software output must be uploaded as a single pdf file.** Please be sure that the questions are clearly labeled, all supporting work (including software output) can be easily identified, and that all figures/tables are referenced and interpreted in the text.

Note: Use of homework solutions distributed in previous offerings of the course or available on the web constitutes academic misconduct and will be handled according to university rules. Sharing or disseminating solutions, or in any way knowingly enabling others to commit academic misconduct also constitutes academic misconduct and will be reported.

Extra Credit TopHat Quizzes

You may receive extra credits for class participation up to 5% for your final class grade.

These extra credits you may receive by answering questions through TopHat during the class time. These quizzes will be graded based on participation and correctness.

Please note that this is an **extra credit** opportunity, and if you do not participate for these quizzes, it will not affect the grade distribution of this class. **So, please do NOT send me an email if you did not participate for these quizzes as there are again extra credit.**

Please refer the following information to find the class in TopHat platform:

- 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 (**787043**). 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.

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 project 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:
Friday February 13, 2026

Midterm Exam 2:
Friday March 13, 2026

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 you have a documented class conflict, there will be a make-up exam scheduled. If you have an emergency or extended illness and are going to miss an exam, please notify Dr. Anthony Muthu as soon as possible so arrangements can be made. Please also have documentation (doctor's note, etc.) that says you were too sick to take the exam (not just that you visited the doctor). Your documentation must be approved prior to your being allowed to take a make-up exam.

Any missed exams with no communication to us within 24 hours (except for extreme emergencies) may receive a 0. If you missed the exam for an unexcused reason, you might not be allowed to make it up and may receive a zero. However, for some excused reasons, there may be an opportunity to make-up exams with a penalty of up to 25% of the total points you received from the exam.

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:**

You 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 Younkun 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.

Course Schedule (tentative)

The following tentative course schedule is subject to change.

| Week | Topics, Readings, Assignments, Deadlines |
|--------------|---|
| 1 | Review of probability and decision making |
| 2-4 | Principles of Bayesian inference |
| 5-6 | Bayesian prediction |
| 7-8 | <i>Bayesian regression and hierarchical models</i> |
| 9-10 | Bayesian Computation |
| 11-13 | Markov chain Monte Carlo (MCMC) and JAGS |
| 14-15 | <i>Bayesian Linear Models</i> |

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.