SYLLABUS
STAT 3303

Bayesian Analysis and Statistical Decision Making
Spring 2022 (full term)
3 credit hours

COURSE OVERVIEW

Instructor

Instructor: Dr. Andrew Richards

Email address: Richards.1227@osu.edu (preferred contact method)

Phone number: TBD

Office hours: MWF 1-2 in Cockins 325

Prerequisites

C- or better in STAT 3202 and 3301, or permission of instructor

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.

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.

HOW THIS COURSE WORKS

Mode of delivery: This course is designed to be in person. In the event that circumstances force a change, we will adapt. Details of the adaptation will depend on the circumstances.

The instructor will hold weekly office hours in person. I am usually available to meet either in person or online by appointment if arrangements are made in a timely manner.

Attendance of lectures is **highly encouraged**. There will be no recording of lectures except as required by a shift to online instruction. Material covered in the text should be read **in advance of the lecture**.

If you are unable to attend due to COVID-19 or for other reasons, let me know. If you test positive for the virus or believe that you have symptoms, it is best that you take care of health concerns before worrying about this class. Let me know of the situation promptly and we will make special arrangements.

The tutor hours of the TAs can be accessed through the Data Analytics Learning Center(DALC). The Data Analytics Learning Center (DALC) will be open beginning the second week of classes. Details about how Zoom tutoring will work through the DALC, along with the DALC Zoom link, will be posted on Carmen when available. Hours in which STAT 3303 assistance will be available through the DALC will be posted on Carmen before the start of Week 2 of the semester. Essentially, you can think of the DALC hours as times when our teaching assistants will be available to provide you with one-on-one assistance with the course content. We strongly encourage you to take advantage of this resource.

Credit hours and work expectations: This is a **3-credit-hour course**. According to Ohio State policy (go.osu.edu/credithours), students should expect around 3 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 6 hours of homework (reading and assignment preparation, for example) to receive a grade of (C) average.

POTENTIAL DISTRUPTIONS TO INSTRUCTION

The planned instruction for this course may be disrupted for a number of reasons. Such disruptions may affect individual students for a brief period of time, the entire class, the instructor, or the entire university. If the class is disrupted, we will adjust as needed. The adjustments may include changes to course delivery, assignments, grading of assignments, and determination of final course grade.

COURSE MATERIALS AND TECHNOLOGIES

Textbooks

Required

- *Doing Bayesian Data Analysis: A Tutorial with R, JAGS, and Stan*, 2nd edition, by John K. Kruschke, ISBN: 978-0-12-405888-0.

Course technology

Technology support

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** ocio.osu.edu/help
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu
- **TDD:** 614-688-8743

Technology skills needed for this course

- Basic computer and web-browsing skills
- Navigating Carmen (go.osu.edu/canvasstudent)
- CarmenZoom virtual meetings (go.osu.edu/zoom-meetings)
- Recording a slide presentation with audio narration (go.osu.edu/video-assignment-guide)
- Recording, editing, and uploading video (go.osu.edu/video-assignment-guide)

Required 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 Software.

   o 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/Rintro.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.

Carmen access

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions (go.osu.edu/add-device).
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application (go.osu.edu/install-duo) to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357(HELP) and IT support staff will work out a solution with you.

GRADING AND FACULTY RESPONSE

How your grade is calculated

ASSIGNMENT CATEGORY	POINTS
Homework	30
Exam 1	20
Exam 2	20
Final Project	30

Total	**100**

See course schedule below for due dates.

Descriptions of major course assignments

Homework

Description: There will be six homework assignments throughout the semester. It will consist of mostly textbook-style problems, problems motivated by real-world applications, and analyses requiring the use of statistical software. Homework must be uploaded to Carmen by the due date. The solutions may be handwritten and scanned, entered directly into a tablet, or typed. Any software output must appended to the homework file prior to 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.

Academic integrity and collaboration: You may work together on assignment problems, but each student must hand in their own work, written in their own words. Do not copy any part of another student's homework including computer code or output. 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. If you have any questions about what is allowed, **please ask.**

Exams

Description: There will be two midterm exams.

Academic integrity and collaboration: You must complete the midterm exams yourself, **without any external help or communication**. Students are **strongly advised** to prep a formula highlight sheet in advance.

Final Project

Description: Students will have a take-home individual final exam project rather than an in-class exam. The individual final exam project will be assigned several weeks prior to the end of the semester.

Academic integrity and collaboration: You must complete the midterm exams yourself, **without any external help or communication**. If you have any questions about what is allowed, **please ask.**

Late assignments

Assignment solutions will be posted shortly after submission. No late assignments will be accepted without prior permission or formal documentation. Please refer to Carmen for due dates. Accommodations can be made in case of severe illness, so please notify me as soon as possible if this situation arises.

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

Instructor 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 **614-688-4357(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**.

- **Email:** I prefer to communicate via email (Richards.1227@osu.edu **not** @buckeyemail.osu.edu). **Please write "STAT 3303" somewhere in the subject line**, as this will help me to quickly identify and reply to class emails. It is reasonable to expect a response within **one business day**.

OTHER COURSE POLICIES

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. A more conversational tone 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.

Academic integrity policy

See **Descriptions of major course assignments**, above, for my specific guidelines about collaboration and academic integrity in the context of this online class.

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/**.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- Committee on Academic Misconduct web page (go.osu.edu/coam)
- Ten Suggestions for Preserving Academic Integrity (go.osu.edu/ten-suggestions)

Student Services and Advising

University Student Services can be accessed through BuckeyeLink. More information is available here: https://contactbuckeyelink.osu.edu/

FOR UNDERGRAD COURSES: Advising resources for students are available here: http://advising.osu.edu

Copyright for instructional materials

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. A good faith effort has been made to cite work inherited from previous instructors, where the source is known. Citations may not appear on graded work (to avoid students looking up answers).

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 at titleix@osu.edu

Commitment to a diverse and inclusive learning environment

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Your mental health

As a student you may experience a range of issues that can cause barriers to learn, 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. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, on-demand resources are available at go.osu.edu/ccsondemand. 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

Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org. The Ohio State Wellness app is also a great resource available at go.osu.edu/wellnessapp.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Requesting accommodations

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; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online course requires use of CarmenCanvas (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.

- Canvas accessibility (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- CarmenZoom accessibility (go.osu.edu/zoom-accessibility)
- Collaborative course tools

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.

ACKNOWLEDGEMENT

COURSE SCHEDULE

Refer to the Carmen course for up-to-date assignment due dates.

Week	Dates	Topics	Readings
1	1/10-1/14	Intro, probability review	Ch. 1,4
2	1/17-1/21	Joint distributions; decision theory	Ch. 4
3	1/24-1/28	Bayes Theorem	Ch. 2,5
4	1/31-2/4	Bayesian paradigm; posteriors	Ch. 6
5	2/7-2/11	Priors	Ch. 6, 16.1
6	2/14-2/18	Conjugacy examples	Ch. 6, 16.1
7	2/21-2/25	Variance priors; predictive inference	Ch. 6, 16.1
8	2/28-3/4	Hierarchical models	Ch. 7
9	3/7-3/11	Monte Carlo; M-H algorithm	Ch. 7
10	3/14-3/18	SPRING BREAK	
11	3/21-3/25	Markov Chains	Ch. 9
12	3/28-4/1	MCMC examples	Ch. 9
13	4/4-4/8	MCMC diagnostics	Ch. 9
14	4/11-4/15	Multidimensional MCMC; Gibbs sampling; posterior predictive distributions	Ch. 9
15	4/18-4/25	JAGS, advanced topics	Ch. 15.1-15.3, 17.1-17.3, 18.1-18.2, 19.2-19.3

Tentative homework and exam dates:

HW1: 2/7

HW2: 2/21
MT1: 2/28
HW3: 3/3
HW4: 3/28
MT2: 4/1
HW5: 4/11
HW6: 4/25
Final Project: 4/26