Syllabus for STAT 3303: Bayesian Analysis and Statistical Decision Making
Spring 2023 – 3 credit hours

Instructor: Dr. Andrew Richards
Office: Cockins Hall 325
Office Hours: MWF 1:15-2:15 and by appointment
E-mail: richards.1227@osu.edu **not buckeyemail**

Course meeting times and locations: MWF 9:10-10:05 or MWF 10:20-11:15 in Cockins 240

Prereq: C- or above in 3301, or permission of instructor.

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

Required software:

- This class requires you to use the free statistical software package called R (The R Project for Statistical Computing; `http://www.r-project.org/`).
  - 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.
- 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.**

Website: Please visit `http://www.carmen.osu.edu/`. Carmen is used extensively for this course, so you should check daily for announcements about the class and other class material. Contact the IT Service Desk at 614-688-4357 (HELP) for help with access.

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.

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.

Homework:
Description: There will be seven 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. A sheet with basic information about common distributions will be provided.

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 final project yourself, **without any external help or communication**. If you have any questions about what is allowed, **please ask**.

Late assignments policy:
Assignment solutions will be posted shortly after submission. No late assignments will be accepted without **prior permission** and/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. Deadlines are crucial in order, among other things, to:

- Get grading done and provide feedback in a timely manner
- Grade all assignments at the same time to maintain consistency and fairness

- Provide a mechanism to help ensure students keep up with the material and are prepared for follow-on lectures
- Protect students from their inability to predict their own future behavior – "I'll somehow manage to catch up at the end of the semester."

Course attendance policy: You are expected to attend all lectures. Formal attendance records will not be kept, and students are responsible for all material covered in class. I intend to simulcast lectures on zoom and record them, however, **I am not responsible for the quality of these recordings** and all students are recommended to attend in person. Exams must, of course, be taken in person. Office hours should not be used for instruction on material that has already been covered in class.

Course technology: In addition to R software, students are expected to have a basic working knowledge of The Microsoft Office suite of products. All Ohio State students are now eligible for free Microsoft Office 365. Visit the `go.osu.edu/office365help` help article for full instructions.

Final Grade: Your final course grade will be based on the following weighting of assessment components:

Category	Points
Homework	28
Exam 1	21
Exam 2	21
Final project	30
Total	100

Grading Scale:
Grades will be assigned according to the scale below, with course components weighted as listed above.

93-100 = A
90-92.9999 = A-
87-89.9999 = B+
83-86.9999 = B
80-82.9999 = B-
77-79.9999 = C+
73-76.9999 = C
70-72.9999 = C-
67-69.9999 = D+
60-66.9999 = D
< 60 = E

E-mail Correspondence: In order to protect your privacy, all course email correspondence must be done through a valid OSU name.nn account. Please use the correct email address. (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.

Academic Misconduct: 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/`.

Special Accommodations: 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; `slds.osu.edu`; 098 Baker Hall, 113 W. 12th Avenue.

Other information: Other standard university policy statements can be found here: `https://asccas.osu.edu/curriculum/syllabus-elements`.

Copyright: 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.

Disclaimer:
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. Please pay special attention to announcements in class and over Carmen. **Failure to address every possible scenario in this syllabus does not override your responsibility to exercise basic common sense. If in doubt about any course policy, ask in advance!**

Acknowledgemnt:
Thank you to Drs. Oksana Chkrebtii and Matt Pratola for their kind sharing of advice and course materials in preparation for this semester.

Tentative Course Schedule

Week	Dates	Topics, (Chapters), Holiday, Homework, and Exam Dates
1	1/9-1/13	Intro and basic probability (1,4)
2	1/16-1/20	Bayes Theorem and random variables (4) MLK Day 1/16
3	1/23-1/27	Decision theory (2,5) HW1 1/25
4	1/30-2/3	Posterior distributions (6)
5	2/6-2/10	Priors (6,16.1) HW2 2/8
6	2/13-2/17	Conjugacy examples (6,16.1)
7	2/20-2/24	Inference on variance (6,16.1) HW3 2/20 MT1 2/24
8	2/27-3/3	Predictive inference (7)
9	3/6-3/10	DAGs; MH algorithm (7) HW4 3/8
10	3/13-3/17	SPRING BREAK
11	3/20-3/24	Markov Chains (9)
12	3/27-3/31	MCMC examples (9) HW5 3/31
13	4/3-4/7	MCMC diagnostics (9) MT2 4/5
14	4/10-4/14	Multidimensional MCMC and Gibbs (parts of 15,17,18, and 19)
15	4/17-4/21	JAGS (8) HW6 4/17
16	4/24	Advanced topics HW7 4/24

Final project due: Tuesday, April 25, 11:59pm.