SYLLABUS & COURSE INFORMATION

SCHOOL OF PUBLIC HEALTH
UNIVERSITY OF MINNESOTA

PUBH 8442, SECTION 001

Bayesian Decision Theory and Data Analysis
Spring 2024

COURSE & CONTACT INFORMATION

Credits: 3.0
Meeting Day(s): Mon/Wed
Meeting Time: 9:45 am – 11:00 am
Meeting Place: Mayo 1250

Instructor: Dr. Eric F. Lock
Email: elock@umn.edu
Office Phone:
Fax:
Office Hour: Mondays 1pm – 2pm
Office Location: UOP 238
TA: Jiuzhou Wang
TA Office Hour: 4:30-5:30 pm Thursdays aver Zoom
Course website: http://ericfrazerlock.com/pubh8442.html

COURSE DESCRIPTION

This course will introduce students to contemporary Bayesian statistics, and decisions theory. As such, the emphasis will be on data analysis using probability models. We will cover specification, estimation, and model diagnosis. Homework will require use of R, and other Bayesian modeling software (openBUGS, JAGS) will be introduced in the class.

COURSE PREREQUISITES

[Some familiarity with computing (e.g., R or C), statistics at the level of Stat 5101-5102 (Theoretical Statistics), PubH 8401 (Linear Models) or equivalent, or consent of the instructor.

COURSE GOALS & OBJECTIVES

After taking the course, the student should be able to conceive of, conduct, and interpret Bayesian inference for a variety of statistical problems.

METHODS OF INSTRUCTION AND WORK EXPECTATIONS

Classes will be primarily lecture-based and in-person (potentially with Zoom availability). Participation and discussion are encouraged. Lectures will be recorded and posted to the course site on canvas. Homework sets will be due roughly every 1-2 weeks. There will a final project, a midterm exam held during class-time, and a final exam. Discussing homework assignments with other students in the course is permitted, but copying the work of another student is a violation of course policy.

In this course, students are expected to engage with each other in respectful and thoughtful ways. Like other work in the course, all student to student communication is covered by the Student Conduct Code (https://z.umn.edu/studentconduct).

For COVID-19 related policies and recommendations, see
https://docs.google.com/document/d/1sc_wcOe3fmhVcAvaoyoJaKbTxKL7rdh699BlbWrGYBA

COURSE TEXT & READINGS

The lecture notes for this course will be self-contained and there is no required textbook. However, we will reference accompanying sections from the following textbooks for optional additional reading:

Carlin, B., and Louis, T. (2008), *Bayesian Methods for Data Analysis: Third Edition*, Chapman and Hall.

Gelman, A., Carlin, J.B., Stern, H.S., Dunson, D.B., Vehtari, A. and Rubin, D.B. (2013) *Bayesian Data Analysis,* Third Edition. Chapman and Hall.

Berger, J. (1980), *Statistical Decision Theory and Bayesian Analysis.* Springer, New York.

Robert, C.P. and Casella, G. (2005). *Monte Carlo Statistical Methods*, Second Edition. Springer, New York.

These textbooks are all available from the Biostatistics Division reading room (Mayo A460)

COURSE OUTLINE/WEEKLY SCHEDULE

The schedule below is tentative and subject to change.

Week	*Topics*
1	**Introduction to Bayes rule, Bayesian statistics and prior selection**
2	**Introduction to decision theory**
3	**Bayesian inference: interpreting posteriors, point estimation, and interval estimation**
4	**Bayesian inference: hypothesis testing, model comparison,**
5	**More on model comparison and Bayes factors; multiplicity**
6	**Bayesian hierarchical modeling and the Bayesian linear model**
7	**Empirical Bayes Methods**
	*****MIDTERM*****
8	**Computing: asymptotic methods and approximations**
9	**Computing: exact sampling methods**
10	**Computing: Metropolis-Hastings, Gibbs sampler**
11	**More on MCMC; computing considerations for big data**
12	**Bayesian approaches to experimental design and clinical trials**
13	**Bayesian meta-analysis and model averaging**
14	**Bayesian mixture models and Bayesian nonparametrics**
15	**Research problems and case studies**
	*****Final project due*****
May 4th, 2024 Final Exam Due	*****FINAL EXAM*****

SPH AND UNIVERSITY POLICIES & RESOURCES

The School of Public Health maintains up-to-date information about resources available to students, as well as formal course policies, on our website at www.sph.umn.edu/student-policies/. Students are expected to read and understand all policy information available at this link and are encouraged to make use of the resources available.

The University of Minnesota has official policies, including but not limited to the following:

- Grade definitions
- Scholastic dishonesty
- Makeup work for legitimate absences
- Student conduct code
- Sexual harassment, sexual assault, stalking and relationship violence
- Equity, diversity, equal employment opportunity, and affirmative action
- Disability services
- Academic freedom and responsibility

Resources available for students include:

- Confidential mental health services
- Disability accommodations
- Housing and financial instability resources
- Technology help
- Academic support

EVALUATION & GRADING

Final course grades will be based on homework scores (30%), the midterm exam (20%), the final project (20%), and the final exam (30%).

Grading Scale
The University uses plus and minus grading on a 4.000 cumulative grade point scale in accordance with the following, and you can expect the grade lines to be drawn as follows:

% In Class	Grade	GPA
93 - 100%	A	4.000
90 - 92%	A-	3.667
87 - 89%	B+	3.333
83 - 86%	B	3.000
80 - 82%	B-	2.667
77 - 79%	C+	2.333
73 - 76%	C	2.000
70 - 72%	C-	1.667
67 - 69%	D+	1.333
63 - 66%	D	1.000
< 62%	F	

- A = achievement that is outstanding relative to the level necessary to meet course requirements.
- B = achievement that is significantly above the level necessary to meet course requirements.

- C = achievement that meets the course requirements in every respect.
- D = achievement that is worthy of credit even though it fails to meet fully the course requirements.
- F = failure because work was either (1) completed but at a level of achievement that is not worthy of credit or (2) was not completed and there was no agreement between the instructor and the student that the student would be awarded an I (Incomplete).
- S = achievement that is satisfactory, which is equivalent to a C- or better
- N = achievement that is not satisfactory and signifies that the work was either 1) completed but at a level that is not worthy of credit, or 2) not completed and there was no agreement between the instructor and student that the student would receive an I (Incomplete).

Evaluation/Grading Policy	Evaluation/Grading Policy Description
Scholastic Dishonesty, Plagiarism, Cheating, etc.	You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis (As defined in the Student Conduct Code). For additional information, please see https://z.umn.edu/dishonesty The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: https://z.umn.edu/integrity. If you have additional questions, please clarify with your instructor. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam. Indiana University offers a clear description of plagiarism and an online quiz to check your understanding (http://z.umn.edu/iuplagiarism).

CEPH COMPETENCIES

Competency	Learning Objectives	Assessment Strategies
3. Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software as appropriate	-Specify an appropriate Bayesian model for a variety of different applied settings. -Use data to infer unknown parameters in a Bayesian model.	These objectives will be assessed via in-class exams, homeworks, and the final project.
4. Interpret results of data analysis for public health research, policy or practice.	-Interpret the results of a Bayesian analysis	This learning objective will be assessed via homework assignments and the final project.
19. Communicate audience-appropriate public health content, both in writing and through oral presentation.	-Communicate the results of a Bayesian analysis to a broader audience through writing and oral presentation	This learning objective will be assessed via the final project.