Course Introduction

PUBH 8442: Bayes Decision Theory and Data Analysis

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Course description and goals

- Comprehensive introduction to Bayesian statistics.
  - Specification, estimation, and model diagnosis.
  - Philosophical and theoretical foundations
  - Computing using R, BUGS/JAGS
- GOAL: to conceive of, conduct, and interpret Bayesian inference for a variety of statistical problems.

Intended audience

- Students are expected to have:
  - Some familiarity with computing (R, C, etc.)
  - An understanding of core theoretical statistics (STAT 5101-5102)
  - An understanding of linear models (PUBH 8401)
- Students should wish to gain a deep understanding of Bayesian inference.
- Alternatively, PUBH7440 teaches Bayesian analysis in less theoretical depth and with less prior knowledge assumed.

Work expectations

- Mid-term exam 20%
  - In class, in the middle of the semester
- Final exam : 30%
  - May 12th, 2025
- Final project: 20%
- Homework sets: 30%
  - Due every 1-2 weeks
  - Submitted via Canvas
  - Discussion allowed, not copying.

Office Hours

- Eric's office hours: 1-2pm Mondays in UOP 238 and Zoom
- Dipto (TA) office hours: 2-3 Fridays in UOP and via Zoom.

Final project

- Conceive of and perform a Bayesian analysis of real data.
- Potential datasets will be provided, or choose your own.
- 3-5 page written report
- Short (10 min) in class presentation

Course notes

- Course material posted on website
  - http://ericfrazerlock.com/pubh8442.html
- Will reference relevant sections and chapters in various texts, and articles, but no required textbook.
- All required material will be in course notes
- Marked up notes (from a previous class) will be posted after lectures.

Topics

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*****