

EPSE 581C: Bayesian Methods

Winter 2019/20 Term 1

Instructor: Ed Kroc

Neville Scarfe Building, Room 2526 (5th floor, take south elevator)
2125 Main Mall
Email: ed.kroc@ubc.ca
Website: ekroc.weebly.com
Office hours: Mondays, 4:30 - 5:30 PM

Credits and prerequisites:

Credits: 3

Prerequisite: EPSE 596 or equivalent (basically, one course in regression)

Meeting times and locations:

Section 074: Monday, 1:00 - 4:00 PM, Scarfe 204A

Course webpage:

All course notes and other handouts will be posted on the course webpage accessible from my main webpage:

<https://ekroc.weebly.com>

Email policy:

Email is the best way to get ahold of me outside of class. I generally respond within 24 hours; however, I will usually **not** respond to messages on weekends and statutory holidays. Thus, if you send me a message Friday evening, don't expect to receive a reply until Monday morning (or until Tuesday morning if Monday is a holiday).

Course overview:

This course will cover the basics of Bayesian methodology. We will compare and contrast the Bayesian approach to estimation and inference with the traditional frequentist approach you are all familiar with from previous statistics-based courses. The paramount role of prior information in Bayesian methodology will be emphasized throughout. Although you will work on a variety of applied data problems, this course is about concepts and methodology, *not* computation. There will also be regular emphasis on practical applications for applied researchers in a variety of disciplines.

Software:

We will use the free, omnibus statistical software **R** for our analyses. A somewhat user-friendly platform for R is **RStudio**. Download the software here:

<https://www.rstudio.com/products/rstudio/download/>

RStudio is *not* a "point and click" or "drop-down menu" based platform. However, since this course is not computational or programming based, I will provide you with the code that you will need to solve HW problems. Occasionally, you will need to make minor adjustments to the code

(e.g. changing variable names) to implement it yourself. The coding in this course will be kept to as small of a minimum as possible.

Assessment:

***In-class quizzes: 25%**

- We will start each class (except the first) with a short 2-3 question quiz covering material from the previous week. You will have 10 minutes to complete these quizzes. There will be 10 quizzes total and your individual best 7 scores will be used to calculate this component of your final grade.

***Written homeworks: 50%**

- There will be three written homework assignments throughout the term, one due every four weeks. Each assignment will be worth 16.7% of your final grade. New questions (1-2) that are germane to the material just covered will be added each week. Tentative due dates are as follows:

- Week 5: Sep. 30
- Week 9: Oct. 28
- Week 13: Nov. 25

***Take-home final exam: 25%**

- The take-home final exam will be comprehensive. The format will be similar to the homework assignments and in-class case study discussions. The exam will be due by 5 PM on Dec. 13.

Tentative schedule of classes:

- Week 1, Sep. 2: **Labour Day - no class**
- Week 2, Sep. 9: Introduction to Bayesian reasoning: priors, likelihoods, and posteriors; simple comparisons to the traditional frequentist framework
- Week 3, Sep. 16: Mathematics of the Bayesian framework
- Week 4, Sep. 23: Single parameter models
- Week 5, Sep. 30: Multi-parameter models, nuisance parameters
- Week 6, Oct. 7: Model checking, building, and validation
- Week 7, Oct. 14: **Thanksgiving - no class**
- Week 8, Oct. 21: The problem of computation: Markov chain Monte Carlo, Metropolis-Hastings
- Week 9, Oct. 28: The problem of the prior: informative vs. "uninformative", etc.
- Week 10, Nov. 4: Estimation vs. inference; hypothesis testing as obsolete
- Week 11, Nov. 11: **Remembrance Day - no class**
- Week 12, Nov. 18: Hierarchical/multilevel models, GLMs
- Week 13, Nov. 25: Other applications: missing data, measurement error modelling, spatio-temporal modelling

Recommended textbook(s):

There is ***no*** required textbook for this course. In addition to our course notes, I will post other useful notes on course topics from various open sources.

However, there are several excellent textbooks I would strongly recommend referring to in the library, or purchasing if (1) you find the textbook helpful, and (2) you plan to use Bayesian methods in your research (now or in the future).

- *Bayesian Data Analysis*, Andrew Gelman, John B. Carlin, Hal S. Stern, David B. Dunson, Aki Vehtari, and Donald B. Rubin. This is an excellent textbook written by a swath of luminaries in the field. It contains much of the relevant mathematics of the subject, is full of applied examples (with R code), and is relatively easy to read.

- *Statistical Rethinking*, Richard McElreath. A soft textbook written for applied scientists. A softer textbook (in terms of mathematics), full of applied examples (with R code).

Academic integrity:

Make sure you are familiar with standard UBC policy. See the below website for more details:

<http://www.calendar.ubc.ca/Vancouver/index.cfm?tree=3,54,111,959>

Academic honesty is essential to the continued functioning of the University of British Columbia as an institution of higher learning and research. All UBC students are expected to behave as honest and responsible members of an academic community. Breach of those expectations or failure to follow the appropriate policies, principles, rules, and guidelines of the University with respect to academic honesty may result in disciplinary action.

It is the student's obligation to inform himself or herself of the applicable standards for academic honesty. Students must be aware that standards at the University of British Columbia may be different from those in secondary schools or at other institutions. If a student is in any doubt as to the standard of academic honesty in a particular course or assignment, then the student must consult with the instructor as soon as possible, and in no case should a student submit an assignment if the student is not clear on the relevant standard of academic honesty.

If an allegation is made against a student, the Registrar may place the student on academic hold until the President has made his or her final decision. When a student is placed on academic hold, the student is blocked from all activity in the Student Service Centre.