Late HW and Final Project Policy:

- Everyone is allowed a total of **three** late HW submissions throughout the semester;
- Each late submission can have up to 4-days extension (till **Sunday evening,** 11:59pm);
- One lowest-scored HW will be dropped.
- If you think you have a suitable project that you want to use in the place of the one I will give you, please come to talk to me and get the permission.

Sections (starting from Jan 29):

- Monday 4:45-5:45 pm (SC 316): Jane;   Wednesday 5:45-6:45 pm (SC 706): Jane

Office hours:

- ***Jun's OHs:*** Tu 8:30-9:30pm via zoom; Mon, Wedn 1:30-2:30pm in SC 715;
- ***Jane's OHs:*** Mon 5:45-6:45 pm (SC 316);   Wedn 4:45-5:45 pm (SC 706)

Lecture Notes Available For Download Below:

- Lecture 25 slides the detailed lecture notes are available. We will discuss variational approximation methods and their utility in complex models.
- Lecture 24 slides and the detailed lecture notes are available. We will discuss an application example: text analysis and topics modeling.
- Lecture 23 slides and the detailed lecture notes are available. We will discuss Bayesian model selection methods, as well as their frequentist counter-parts. We highlight their similarities and key differences.
- Lecture 22 slides and the detailed lecture notes are available. We will quickly go over hierarchical linear models, and then discuss the challenging question: How man words did Shakespeare know?
- Lecture 21 slides and the detailed lecture notes are available. We will review the Stein's lemma and how he used it to prove that the JS estimator dominates the MLE, and then talk about hierarchical modeling.
- Lecture 20 slides and the detailed lecture notes are available. We will start introducing hierarchical models and James-Stein phenomena using the Normal means model.
- Lecture 19 slides and the detailed lecture notes are available. We will work on details of Dirichlet process-based mixture models.
- Lecture 18 slides and the detailed lecture notes are available. We will start to learn about Bayesian mixture modeling and its related computations.
- Lecture 17 slides and the detailed lecture notes are available. We will finish introducing nonparametric Bayes (NB) via Dirichlet process (DP) and explain some related objects, such as the Chinese restaurant process and clustering.
- Lecture 16 slides and the detailed lecture notes are available. After finalizing some topics in multinomial inference, we will introduce the idea of nonparametric Bayes (NB) via Dirichlet process (DP). I will show that NB is a natural extension of multinomial and DP is a natural extension of Dirichlet process.
- Lecture 15 slides and the detailed lecture notes are available. We will finish the GP regression part introduced in Lecture 14. Then we will start on multinomial data and Dirichlet distributions. The key to an intuitive and in-depth understanding of related topics is to get familiar to a convenient system of notations!
- Lecture 14 slides and the detailed lecture notes are available. We will wrap up Bayesian linear regression with some demonstrations to show effects of different priors. Then we will introduce **Gaussian process regression** --- an important machine learning method for fitting nonlinear relationships.
- Lecture 13 slides and the detailed lecture notes are available
- Lecture 12 slides and the detailed lecture notes are available. We will look at the linear regression problem and see how it is a special case of the MVN inference.
- Lecture 11 slides and the detailed lecture notes are available. We will show the two-sample simulations, and then move on to multivariate Normal (MVN) inference problems.
- Lecture 10 slides and the detailed lecture notes are available. We will work on multi-parameter Bayesian interference, starting from the normal distribution with unknown mean and variance. This is a canonical case, for which many theoretical results have been derived.
- Lecture 9 slides and the detailed lecture notes are available. I will give an introductory class on

statistical decision theory.

- Lecture 8 slides and the detailed lecture notes are available. We will continue the discussion about the advantages of the Bayesian method over the frequentist approach.
- Lecture 7_slides and the detailed lecture notes are available. We will discuss location family estimation, noninformative priors, Fisher information, etc.
    - I have also uploaded some notes about **Monte Carlo methods** under the name "lecture_7.1_MC_notes.pdf"
- Lecture 6_slides and the detailed lecture notes are available. We will finish up the normal case with unknown variance, and some other one-parameter models.
- Lecture 5_slides and the detailed lecture notes are available. We will review the binomial case and the numerical methods; then we will talk about the normal mean model.
- Lecture 4_slides and the detailed lecture notes are available. We will discuss in a few numerical methods Lecture 4_slides and the detailed lecture notes are available. We will discuss in a few numerical methods (a) mode-finding algorithms, and (b) Monte Carlo methods for approximating integrals.
- Lecture 3_slides and the detailed lecture notes are available. We will discuss in more details how to use the posterior distribution, and how to approximate.
- Lecture 2_slides and the detailed lecture notes are available. We will discuss the binomial case.
- Lecture 1_slides and the detailed lecture notes are available.
    - *Supplemental reading: Efron's paper and its related discussions in Readings folder*
    - *Gelman and Shalizi on philosophy and practice of Bayesian statistics*

The full course syllabus is available at Files folder

The course syllabus is available here!

Course goals:

The course begins with basic statistical models, whose Bayesian answers are often similar to classical ones, followed by hierarchical, mixture, hidden-Markov models, and some modern twists. We will discuss Bayesian philosophy, difficulties of statistical inference, frequentist and Bayesian comparisons, model checking/selection, sensitivity analysis, variable selections. During the course, we will also touch upon some research topics in Markov chain Monte Carlo, bioinformatics, Bayesian learning, high-dimensional inference, etc.

Course format:

The course will meet twice a week in the regular lecture format, and there will also be sections, office hours, homework, midterm example, and final project.

Typical enrollees:

The course is designed for first or second-year graduate students wishing to learn about the fundamental logic of statistical inference and a coherent inferential system. Many advanced senior or junior college students majoring in statistics/data science/machine learning have also chosen to take this course. Be prepared to think and operate beyond your typical comfort zone!

When is course typically offered?

Typically spring semester.

What can students expect from you as an instructor?

I am not a good joke teller, although I try (I may write better jokes than telling). But my goal is to affect you with my enthusiasm about Bayesian statistics, and to try to show/persuade you that some "dirty" (or laborious) math (as opposed to "elegant" math) is often necessary to push things forward and to enable you to reach an elegant state. In this sense, I will need your willingness to put in efforts in order to get most out of this course.

Assignments and grading:

More details are in the syllabus.

Sample reading list:

If you are interested, you can read my "prelude" (which will be revised later) with some notations and a list of my favorite quotes.

Absence and late work policies:

As stated earlier.