Syllabus for: MAT 302, Introduction to Applied Bayesian Statistics

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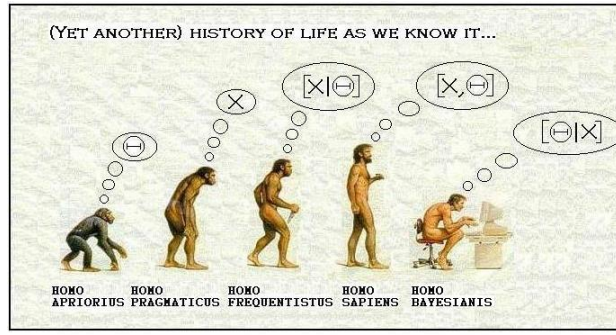
Professor: Nicholas Petraco
Room: XXXXX
Contact hours: Fridays 4:30pm and Open Door Policy
E-mail address: npetraco@gmail.com
Course website: https://npetraco.github.io/MAT302/

Course Description:

The classical "work horse" statistical methods learned in a first year statistics course are known as "frequentist" and "Fisherian" methods. They are extremely useful and have been successfully applied for almost one hundred years. They have well known limits and flaws however. Complementary sets of statistical tools are known as "Bayesian" based methods. Related to Bayes Theorem and relying on a definition of probability as "belief", they offer very intuitive interpretation and a naturally "coherent" methodological framework for inference. Within the last 25 years, as computing power has increased Bayesian methods have become practical for standard scientific applications.

The purpose of this hands-on course is to acquaint science and computing undergraduate students with Bayesian statistical tools that are applicable to the problems they will encounter in their career. The course will also pay special attention to the relationship between Bayesian methods and classical methods, as well as issues and pitfalls to be aware of when applying these methods.

Course Learning Goals:
1. Recognize the importance of accuracy and objectivity in collecting/sampling data for applications to the law.

2. Acquire an understanding of the types of data that can be recorded and analyzed for quantitative trace, fire debris, toolmark, and spectrochemical evidence analysis.

3. Acquire an understanding of Bayesian statistical tools that can be used to analyze collected forensic data.

4. Understand the limitations of the Bayesian statistical methods used for data analytics and how not to misrepresent the capabilities of these methods to the courts or clients (ethics).

5. Obtain skill with the general computing/statistical software **R** (http://www.r-project.org/), parametric Bayesian software **Stan** (http://mc-stan.org/), and **JAGS** (http://mcmc-jags.sourceforge.net/).

6. Develop oral and written communication skill as to how to present the results of sophisticated quantitative analysis to officers of the course and lay juries, in terms that are understandable to them.

Required Electronic Resources:

- Webassign: Can be purchased at:

   o **https://webassign.com/**

   o In order to purchase click on "**Enter Class Key**":
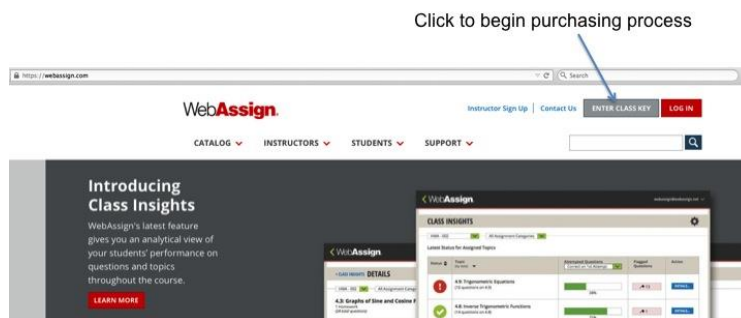
- **You should see a place to enter the class key**:
   o Class Key: **jjay.cuny 3168 5930**

- After logging in/creating-account, select your class and the website will prompt you to purchase the required materials:

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Required textbook:
A Student's Guide to Bayesian Statistics
ISBN-10: 1473916364
Author: Ben Lambert
Soft cover should be about $40

Web resources:
Stan: http://mc-stan.org/documentation/
  https://mc-stan.org/rstanarm/

Grading:

The grades for this course are based on home works (100%).

Topics:

Lecture	Date	Topic
1		Overview of Bayesian Methodology
2		Probability, R tutorial/review, common distributions
3		Conditional Probability, Bayes Theorem and Independence
4		Parametric methods: Conjugate and Integrable Models
5		General Parametric models: Intro to Stan
6		More general models: Intro to Stan/rstan/rstanarm
7		Jacobians and how to implement them in Stan
8		Workhorse Bayesian modeling: Regression Hierarchical Models
9		Model Checking and comparison: Bayes factors and what we actually do…
10		More tricks
11		Review

Keeping Up and Studying
This course is packed with information and our schedule will be tight. If you do R practice and a little home work every night you should be fine.

YOU FAIL THIS COURSE IF YOU DO NOT COME TO LECTURE/LAB AND DO NOT DO THE FINAL PROJECT.

Academic Honesty:
Cheating and plagiarism will not be tolerated. If a student is suspected of either of these offenses he or she will be turned into the Provost. I encourage you to collaborate and help each other on projects, however the work you develop and present must be yours. Upon being found guilty a grade of F will be recorded for the course.