Stat 610: Statistical Computing

Meeting time: Tuesdays and Thursdays, 1:15-2:30pm   Meeting location: PH017
Website: jfukuyama.github.io/teaching/stat610

Instructor: Prof. Julia Fukuyama   jfukuyam at iu dot edu
Office hours: Mondays 10:30am-12:30pm   Myles Brand E218

Associate Instructor: Mr. John Koo   johnkoo at iu dot edu
Office hours: Wednesdays 5-7pm

Occasional lab: Fridays 11:15-12:30, PH019

Course Overview

As a statistician, you will need to manipulate data, optimize, and simulate. You will also need to know enough about how the methods you use work to diagnose problems when they arise and to be able to implement modified versions when the standard implementations don't suit your purposes.

You also need to write accurate, clean, maintainable, demonstrably correct code. To that end, the first half of the class will be devoted to how to program well, with statistical tasks giving us the computational problems.

Once we have the software engineering down, we will move on to the algorithms used in applied statistics. These can be roughly broken up into optimization methods and stochastic simulation methods.

Textbooks

The primary textbook for the first half of the course with be *The Art of R Programming*, by Norman Matloff. *The R Cookbook*, by Paul Teetor, will also be useful. The primary textbook for the second half of the course will be *Numerical Analysis for Statisticians*, by Kenneth Lange. Additional readings will be posted on the course website.

Class Schedule

Dates and topics subject to change.

Week 1

- Data types and data structures

Week 2

- Flow control and looping
- Regular expressions

Week 3

- Text representations and data frames
- Writing and calling functions

Week 4

- More functions
- Split/apply/combine I

Week 5

- Split/apply/combine II
- Shape changing/merging/transformations

Week 6

- Debugging
- Testing

Week 7

- Top-down design
- Version control/git I

Week 8

- Version control/git II
- Performance enhancement and code profiling

Week 9

- Fitting and using statistical models
- Newton's method

Week 10

- Newton's method II/IRLS

- – Modifications of Newton's method

Week 11

- – EM
- – Generating random deviates

Week 12

- – Monte Carlo integration
- – ABC

Week 13

- – Markov chains/Metropolis Hastings

Week 14

- – MCMC Applications
- – Neural nets

Week 15

- – Final project presentations/code review

Assessment

Assessment will be based on a combination of homework and a final project. Final grades will be based on:

- – 50% homework
- – 40% final project
- – 10% participation

For in-person students, full points for participation can be obtained by participating in class or by sending me mail (3x over the course of the semester) about mistakes in the notes.

There will be homeworks assigned most weeks. Homeworks will be graded out of 5 points, with one point for a good-faith effort at all the problems, 5 points for correct answers with clean code, and an intermediate number of points otherwise.

Homeworks will be assigned on Mondays and due the Thursday (10 days later). At the time the homework is assigned, we will generally not have covered all the material needed to complete the homework, but we will have covered everything by the week before the due date. The idea is to give you the homework early enough that you can think about it while the material is being covered in lecture. Therefore, it will generally be a good idea to take a look at the homework when it is assigned even if you aren't able to complete all the problems yet.

Course Policies

Late Policy

Each student has four "free" late days to use on assignments. After that, homework is penalized at one point (out of five, remember!) per 24 hours. Special accommodations may be granted if you ask very early or if there are extenuating circumstances.

Academic Integrity

You are expected to abide by the guidelines of the IU Code of Student Rights, Responsibilities, and Conduct (http://studentcode.iu.edu/responsibilities/academic-misconduct.html) regarding cheating and plagiarism. Any ideas or materials taken from another source must be fully acknowledged and cited.

Disability Accommodation

Please contact me if you require assistance or academic accommodations for a disability. You should establish your eligibility for disability support services through the Office of Disability Services for Students in Wells Library W302, 812-855-7578.