Stat 580: Statistical Computing

Lecture location: Molecular Biology Building 1424

Lecture times: TH 11:00am–12:20pm

Instructor: Raymond Wong
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Office hours: TH 12:20–1:20pm, or by appointment

Teaching assistant: Lindong Zhou
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Office hours: W 3:10-4:00pm

Prerequisites: Stat 579 (An introduction to R); Stat 447 (Statistical theory for research workers) or Stat 542 (Theory of probability and statistics I)

Course description: Introduction to scientific computing for statistics using tools and concepts in R: programming tools, modern programming methodologies, modularization, design of statistical algorithms. Introduction to C programming for efficiency; interfacing R with C. Building statistical libraries. Use of algorithms in modern subroutine packages, optimization and integration. Implementation of simulation methods; inversion of probability integral transform, rejection sampling, importance sampling. Monte Carlo integration.

Core topics:

- Computing:
  - C programming (introductory level)
  - Profiling R code
  - Interfacing R with C
  - Building R packages
- Computational statistics:
  - Simulation methods
  - Numerical integration
  - Optimization

Learning objectives: The learning objective of this course is to help students develop an understanding of scientific computing for statistics using both R and C. In particular, this course focuses on various topics in computational statistics, including simulation methods, integrations and numerical optimizations. By the end of this course, students should have basic knowledge of these topics and be able to implement them in R, C or their combination (through interfacing R with C), with the help of various modern scientific computing packages.

Text and references: There is no required textbook for this class, but there are several recommended texts/references:

- *Essential C* by Nick Parlante, 2003. `http://cslibrary.stanford.edu/101/EssentialC.pdf`
- *The C Programming Language (second edition)* by Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall, 1988.

- *Advanced R* by Hadley Wickham, Chapman & Hall/CRC, 2014.
- *Simulation (third edition)* by Sheldon M. Ross, Academic Press, 2002.
- *Numerical Analysis for Statisticians (second edition)* by Kenneth Lange, Springer, 2010.
- *Computational Statistics* by James E. Gentle, Springer, 2009.
- *Statistical Learning with Sparsity: The Lasso and Generalizations* by Trevor Hastie, Robert Tibshirani and Martin Wainwright, Hall/CRC, 2015.

Course webpage: Blackboard (`bb.its.iastate.edu`)

Assessment: Your final course grade is computed based on the following proportions: 60% homework, 20% in-class presentation and 20% final project.

Homework: Homework will be assigned throughout the semester. Late homework submissions may not be accepted. Homework is to be completed and submitted individually. Group work is encouraged but all answers must be unique to the student.

In-class presentation: Students will form groups and give an oral presentation in the last two teaching weeks (including dead week). Topics of the oral presentation will be announced after spring break.

Final project: Group project will be assigned in around 4-5 weeks (depending on the progress) before the final teaching week. The same grouping used in the in-class presentations will be used. Each group will need to submit a written report in the final examination week.

Dead Week: This class follows the Iowa State University Dead Week policy as noted in section 10.6.4 of the Faculty Handbook:

`http://www.provost.iastate.edu/resources/faculty-handbook`

There will be an oral presentation during Dead Week.

Academic dishonesty: Academic Dishonesty The class will follow Iowa State University's policy on academic dishonesty. Anyone suspected of academic dishonesty will be reported to the Dean of Students Office:

`http://www.dso.iastate.edu/ja/academic/misconduct.html`

Disability Accommodation: Iowa State University complies with the Americans with Disabilities Act and Sect 504 of the Rehabilitation Act. If you have a disability and anticipate needing accommodations in this course, please contact me to set up a meeting within the first two weeks of the semester or as soon as you become aware of your need. Before meeting with me, you will need to obtain a SAAR form with recommendations for accommodations from the Disability Resources Office, located in Room 1076 on the main floor of the Student Services Building. Their telephone number is 515-294-7220 or email `disabilityresources@iastate.edu`. Retroactive requests for accommodations will not be honored.

Harassment and Discrimination: Iowa State University strives to maintain our campus as a place of work and study for faculty, staff, and students that is free of all forms of prohibited discrimination and harassment based upon race, ethnicity, sex (including sexual assault), pregnancy, color, religion, national origin, physical or mental disability, age, marital status, sexual orientation, gender identity, genetic information, or status as a U.S. veteran. Any student who has concerns about such behavior should contact his/her instructor, Student Assistance at 515-294-1020 or email `dso-sas@iastate.edu`, or the Office of Equal Opportunity and Compliance at 515-294-7612.

Religious Accommodation: If an academic or work requirement conflicts with your religious practices and/or observances, you may request reasonable accommodations. Your request must be in writing, and

your instructor or supervisor will review the request. You or your instructor may also seek assistance from the Dean of Students Office or the Office of Equal Opportunity and Compliance.