STAT 675 Spring 2022

Statistical Computing

Text: *Statistical Computing with R* 2nd. edn., by M.L. Rizzo (Chapman & Hall/CRC Press, 2019).

Course Web Site: http://math.arizona.edu/~piegorsch/675/STAT675.Spring22.html

Instructor: Professor Walter W. Piegorsch

Office Hours: Tu/Th 11:00 – 12:15 pm
online. Send an email to piegorsch@math.arizona.edu if you would like me to set up a Zoom session with you and I will send you a link. If possible, please do so in advance of your desired time. All replies to other emails will be made within 2 weekdays while classes are in session.

Grading:

Homework:	As assigned	50 points
Mid-Term Exam:	Friday, March 18 ("take-home")	100 points
Final Exam (Comprehensive)	Friday, May 6 ("take-home")	100 points
Total		250 points

A = 225–250
B = 200–224
C = 175–199
D = 150–174
E = 0–149

Homework: Required. Due as assigned. No exceptions.

Make-Up Exams: Not considered, as the class is completely online.

Work and course requirements are subject to change at the discretion of the instructor, with appropriate prior notice.

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, https://drc.arizona.edu) to establish reasonable accommodations.

The regulations in the Student Code of Conduct and Code of Academic Integrity prohibit all forms of student academic dishonesty, including but not limited to cheating, fabrication, and plagiarism. Violations can result in serious penalties, including expulsion from the University. For in-class sessions, students should turn off all electronic devices during class unless prior arrangements are made with the instructor. This includes, but is not limited to cell phones, recording devices, mp3 players, PDAs, and computers.

Information on these Codes is available at http://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity and http://policy.web.arizona.edu/threatening-behavior-students. It is assumed that all students are familiar with and will abide by these Codes. Note: the Student Code of Conduct (5-308.F.11) dictates that no person or organization may interfere with University-sponsored classroom activities. This policy will be enforced as necessary.

Course Syllabus for STAT 675

April 2022

Description: **Statistical Computing** (3 units) – Techniques of advanced computational statistics. Numerical optimization and integration pertinent for statistical calculations; simulation and Monte Carlo methods including Markov chain Monte Carlo (McMC); bootstrapping; smoothing/density estimation; and other modern topics.

Prerequisite(s): STAT 566/MATH 566, or equivalent, and knowledge of a computer programming language such as R, FORTRAN, C/C++, or Python.

Purpose of Course: To acquaint advanced graduate students in statistics, biostatistics, mathematics, and related fields with the modern methodologies and issues associated with computational statistics.

Current Textbook: Rizzo, M. L. (2019). *Statistical Computing with R*, second edition. Boca Raton, FL: Chapman & Hall/CRC Press.

Topics:	**Book Sections**	**Time**
Review of R Review of the **R** computing environment; workspaces; data entry; calculation; graphics	1	1 week
Numerical Methods Root finding; numerical integration	13.1–13.3	1 week
Optimization Numerical maximization/minimization; EM (Expectation-Maximization) algorithm	14.1–14.2, 14.4–14.5	1 week
Pseudo-Random Numbers Random number generation: Inverse-transform; acceptance-rejection; transformations; multivariate probability calculations	3.1–3.6	3.5 weeks
Random Processes Stochastic processes; random walks	4.1	0.5 week
Monte Carlo Integration Simulation and Monte Carlo integration; variance reduction; antithetic variables/control variates; importance sampling; stratified sampling	6.1–6.7	3 weeks
Bootstrap & Jackknife Resampling Bootstrapping; jackknife resampling; percentile confidence intervals	8.1–8.5	2 weeks
Markov chain Monte Carlo (MCMC) Markov chains; Metropolis-Hastings algorithm; Gibbs sampling; convergence	2.8, 11.1–11.4	2 weeks
Density Estimation Univariate density estimation; kernel smoothing	12.1–12.3	1 week
		15 weeks