STAT 3560 STATISTICAL COMPUTING (3 credit hours)

Elmira College

SPRING 2025

Required Text:
***Computational Statistics,* Second Edition by Geof H. Givens and Jennifer A. Hoeting.**

Pre-requisites: STAT 1100 Introduction to Statistics

Course Description

This course serves as an introduction to statistical computing utilizing the R programming language. The primary focus is on statistical programming, graphical representation, elementary Monte Carlo methods, simulation studies, and basic optimization techniques in R. Students will explore classic methods such as the bootstrap and delve into modern Bayesian inference. By the end of the course, students will have a comprehensive understanding of R and its capabilities, along with a basic proficiency in key computational methods in statistics, including optimization, numerical analysis, Markov Chain Monte Carlo (MCMC) techniques, and simulation methods.

Course Objectives and Goals

- Demonstrate proficiency in statistical programming using R.
- Create informative graphical representations of statistical data.
- Apply exploratory data analysis techniques to summarize and visualize datasets.
- Utilize R programming for data manipulation, visualization, and analysis.
- Understand key computational methods in statistics including optimization, numerical analysis, MCMC techniques, and simulation methods.

Evaluation of Performance

Your grade will be based upon your performance on exams, assignments, and participation.

5 Assignments	20%
3 Quizzes	30%
Midterm Exam	15%
Final Project	15%
Final Exam	20%
Total	100%

Grades will be assigned as follows:

A	93% and above	B-	80 - 82%	D+	67 - 69%
A-	90 - 92%	C+	77 - 79%	D	63 - 66%
B+	87 - 89%	C	73 - 76%	D-	60 - 62%
B	83 - 86%	C-	70 - 72%	F	59% or below

Withdrawal Policy: Please see Elmira College Bulletin for information on this policy.

Academic Honesty: Please read the section on Academic Honesty in the **Code of Conduct**. Briefly, academic dishonesty includes: cheating, fabrication, facilitating academic dishonesty, and plagiarism. Ask if you have any questions on whether something constitutes as academic dishonesty. All work must be original and new. Past assignments from current or other courses will not be accepted. Academic dishonesty will not be tolerated. It will result in zero on the assignment, and a report will be filed with the school. Continued practice will result in failure of the class. Institutional penalties may also apply with repeated acts of academic honesty.

Student Responsibility:

- It is your responsibility to keep track of assignments and due dates.
- You should ask questions concerning assignments and lectures, if you need any clarifications.
- If you are struggling in class, have concerns, and/or unsure about expectations, please stop by during office hours or make an appointment for another time.

Tentative Schedule of Topics

Topic	Materials	Tasks & Evaluations
Statistical Computing for Scientific Research	Chapter 1	
Optimization and Solving Nonlinear Equations	Chapter 2	
Combinatorial Optimization Case Study	Chapter 3	Assignment 1
Simulated Annealing	Chapter 4	
Genetic Algorithms/Tabu Algorithms	Chapter 5	Quiz 1
The EM Algorithm Case Study	Chapter 6	
EM Variants	Chapter 7	Assignment 2
General Numerical Integration	Chapter 8	
Introduction to the Monte Carlo Method	Chapter 9	Midterm Exam
Exact Simulation	Chapter 10	
Approximate Simulation Case Study	Chapter 11	Assignment 3
Variance Reduction Techniques	Chapter 12	
Metropolis–Hastings Algorithm	Chapter 13	Quiz 2
Gibbs Sampling	Chapter 14	
Implementation Case Study	Chapter 15	Assignment 4
Extending R with add-on packages and the R ecosystem	Chapter 16	Quiz 3
Graphics Case Study	Chapter 17	Assignment 5
Advanced MCMC	Chapter 18	
Bootstrapping	Chapter 19	Final Project
Machine Learning	Chapter 20	Final Exam