Mathematical Statistics
STAT 301 / Spring 2025

Instructor: Adam Childers / childers@roanoke.edu

Office: Trexler 270G

Phone: 540-375-2449

Office Hours: 11:00 AM -12:00 PM, Tuesday, Thursday, and by appointment. Please email me to schedule an appointment if you need to meet at another time.

Meeting Time: 8:30 – 9:30 AM, Monday, Wednesday, Friday

Meeting Place: Trexler 374

Required Text: Mathematical Statistics with Application 7th Edition, by Wackerly, Mendenhall, and Scheaffer.

Course Objective: The objective of this course is to apply calculus to the subject of probability to form a strong foundation for statistical methods. We will learn about discrete and continuous random variables including expectation and moment generating functions. We will discuss multivariate distributions and functions of serval random variables and their applications to estimation. While developing a strong understanding of the theoretical aspects of statistical methods we will concurrently work on applied problems and handle real data sets.

Intended Learning Outcomes: By the end of this course, students will understand:

- Probability
- Discrete Random Variables and Their Distributions
- Continuous Random Variables and Their Distributions
- Expectation
- Moment Generating Functions
- Multivariate Distributions
- Covariance
- Conditional and Marginal Distributions
- Functions of Random Variables and Their Distributions
- The Central Limit Theorem
- Confidence Intervals
- Point Estimation
- Bias
- Efficiency
- Consistency

Homework: At the end of each class period during which content is discussed, practice problems will be assigned. In addition to daily practice problems, problem sets will be assigned on Inquire to be turned in and graded for correctness and completeness.

Quizzes: There will be short quizzes at the beginning of many classes.

Tests: Tests will assess students' understanding of the material covered in class, take-home readings, and homework assignments. The tests will be on

February 7th
February 26th
March 26th
April 21st

Final Exam: The final exam is cumulative and will be on Tuesday, April 29th at 2:00 PM.
Grading: Grades will be assigned based on written assignments, tests, and a final exam.

Tests	50%
HW/Assignments/Quizzes	30%
Final Exam	20%

A tentative guideline for the determination of grade will then be:

A > 93 B 83 – 86.9 C 73 – 76.9 D 63 – 66.9
A- 90 – 93 B- 80 – 82.9 C- 70 – 72.9 D- 60 – 62.9 B+ 87 – 89.9 C+ 77 – 79.9 D+ 67 – 69.9 F < 60

Missed Test: If you miss a test and have discussed it with me before the class takes the test, we can work together to reschedule the test up to two days after the scheduled date. If it is not possible to take the test in that period, I will replace that test grade with your final exam grade.

Make-up Work: Make-up work will be accepted within two days of the due date if discussed with the professor before the due date has passed. There will be a 25% penalty for late work.

Expected Hours of Work: This course expects you to spend at least 12 hours of work each week inside and outside of class.

Attendance: Attendance is required and expected and is crucial to be successful in this course. An absence that is not discussed with the instructor before class is considered unexcused. Regardless of whether the absence is excused or not, you are responsible for all the material covered in class.

Technology: Scientific calculators, Mathematica, Desmos, R, and Minitab will be used throughout the semester in the classroom and on assignments. Cell phones are expected to be turned off before entering the class and computers will be used in the classroom exclusively for academic purposes. All of the software is free for you to download.

- R - https://cloud.r-project.org/
- Rstudio - https://rstudio.com/products/rstudio/download/
- Minitab and Mathematica are available through the college –
  - https://www.roanoke.edu/softwaredownload
  - app.minitab.com

Academic Integrity System: Students are expected to adhere to the Academic Integrity policies of Roanoke College. All work submitted for a grade is to be your work! I encourage collaboration on homework but when you write up your solutions you should never be looking at someone else's work. Note that looking at or using your cell phone during a test or quiz is considered a violation of Academic Integrity regardless of your purpose or intent in doing so. If you use generative AI in any way on an assignment, you need to specify exactly how you used it, or it will be considered an Academic Integrity Violation.

Schedule: This is the intended schedule but could change. Please check Inquire for any updates or changes.

Day	Date	Topic
M	13-Jan	Introduction
W	15-Jan	3.1 Random Variables, 3.2 Discrete Random Variables
F	17-Jan	3.3 Expected Value
M	20-Jan	
W	22-Jan	3.4 Binomial Distribution,3.5 Geometric Distribution
F	24-Jan	3.8 Poisson Distribution
M	27-Jan	3.9 Moment Generating Functions
W	29-Jan	4.2 Continuous Random Variables
F	31-Jan	4.2 Continuous Random Variables
M	3-Feb	4.3 Expected Value
W	5-Feb	Review
F	7-Feb	Test #1
M	10-Feb	4.4 Uniform Distribution
W	12-Feb	4.5 Normal Distribution
F	14-Feb	4.6 Gamma Distribution
M	17-Feb	4.9 Moment Generating Functions - Continuous
W	19-Feb	5.2 Multivariate Distributions
F	21-Feb	5.2 Multivariate Distributions
M	24-Feb	Review
W	26-Feb	Test #2
F	28-Feb	5.3 Marginal and Conditional Distributions
M	3-Mar	Spring Break
W	5-Mar	Spring Break
F	7-Mar	Spring Break
M	10-Mar	5.7 Covariance
W	12-Mar	5.8 Expected Value and Variance of Linear Functions
F	14-Mar	6.3 The Method of Distribution Functions
M	17-Mar	6.4 The Method of Transformations
W	19-Mar	6.5 The Method of Moment Generating Functions
F	21-Mar	6.7 Order Statistics
M	24-Mar	Review
W	26-Mar	Test #3
F	28-Mar	7.2 Sampling Distributions
M	31-Mar	7.2 Sampling Distributions
W	2-Apr	7.3 The Central Limit Theorem
F	4-Apr	8.2 Bias and MSE

M	7-Apr	8.4 Confidence Intervals
W	9-Apr	8.6 Large Sample Confidence Intervals
F	11-Apr	8.8 Small Sample Confidence Intervals
M	14-Apr	9.2 Efficiency, 9.3 Consistency
W	16-Apr	Wrap Up
F	18-Apr	Good Friday – No Class
M	21-Apr	Test #4
T	22-Apr	Review
T	29-Apr	Exam