MATH 4601 ADVANCED PROBABILITY THEORY(3 credit hours)

Elmira College

SPRING 2025

Required Text:
Ross, Sheldon M. (2005). ***A First Course in Probability***, 7/e. Prentice Hall.

Pre-requisites: MATH 2245 Multivariable Calculus

Course Description

This course provides an in-depth study of probability theory and its advanced concepts. Key topics include combinatorial analysis, axioms of probability, conditional probability and independence, random variables, continuous random variables, jointly distributed random variables, properties of expectation, limit theorems and simulation.

Course Objectives and Goals

- Understand and apply the axioms of mathematical probability;
- Perform advanced combinatorial analysis for solving probability problems;
- Analyze and interpret key probability distributions, including binomial, Poisson, and normal distributions;
- Work with random variables, probability distributions, and their expectations;
- Prove and apply fundamental limit theorems in probability theory.

Evaluation of Performance

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

7Assignments	35%
4 Quizzes	30%
Midterm Exam	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
The Basic Principle of Counting，Permutations	Chapter 1	
Combinations，Multinomial Coefficients	Chapter 1	Assignment 1
Sample Space and Events	Chapter 2	
Axioms of Probability	Chapter 2	Assignment 2
Conditional Probability and Independence	Chapter 3	
Bayes's Formula	Chapter 3	Quiz 1
Discrete Random Variables	Chapter 4	
Expectation of a Function of a Random Variable	Chapter 4	
Variance	Chapter 4	Assignment 3
The Bernoulli and Binomial Random Variables	Chapter 4	
The Poisson Random Variable	Chapter 4	Quiz 2
The Geometric Random Variable The Negative Binomial Random Variable The Hypergeometric Random Variable	Chapter 4	Assignment 4
Continuous Random Variables	Chapter 5	
Normal Random Variables Exponential Random Variables	Chapter 5	
The Gamma Distribution The Cauchy Distribution The Beta Distribution	Chapter 5	Midterm Exam
Joint Distribution Functions	Chapter 6	
Independent Random Variables	Chapter 6	
Conditional Distributions	Chapter 6	Assignment 5
Properties of Expectation	Chapter 7	
Moments of the Number of Events that Occur	Chapter 7	Quiz 3
Covariance, Variance of Sums, and Correlations	Chapter 7	
Moment Generating Functions	Chapter 7	
The Multivariate Normal Distribution The Joint Distribution of the Sample Mean and Sample	Chapter 7	Assignment 6

Variance		
Limit Theorems	Chapter 8	Quiz 4
The Poisson Process	Chapter 9	
Markov Chains	Chapter 9	Assignment 7
Coding Theory and Entropy	Chapter 9	
Simulation	Chapter 10	Final Exam