

MATH 5128: Applied Probability I

Syllabus

Book: *Introduction to Probability Models*, 11th edition by Sheldon M. Ross

- Chapter 1: Probability
 - Sample spaces, events, and axioms of probability
 - Conditional probability and Bayes' Rule
- Chapters 2: Random Variables
 - Discrete and continuous random variables, expectation and variance
 - Joint distributions, expectation of a function of several random variables, and covariance
 - Variance of linear combinations of random variables
- Chapter 3: Conditional Probability and expectation
 - Discrete and continuous cases
 - Conditional expectation as a random variable
 - Computing probability, expectation, and variance by conditioning
 - Random sums of random variables
- Chapter 4: Markov Chains
 - Basic definitions
 - Classification of states, transient vs. recurrent states, absorbing states, periodicity
 - Regular Markov chains, stationary and limiting distributions, Law of Large number for regular MCs
 - Fundamental Matrix, Number of visits to transient states
 - Absorbing MCs
- Chapter 5: Exponential Distribution and Poisson Processes
 - Memoryless property of the exponential
 - Counting processes
 - Relation between the Poisson process and the gamma process
 - Thinning Poisson processes
 - Compound Poisson process
 - Nonhomogeneous Poisson process
- Additional Topic: Poisson point processes
 - Poisson point processes in 2 and 3 dimensions
 - Mean functions
 - Homogeneous and nonhomogeneous cases
 - Thinned Poisson point processes