

COURSE SYLLABUS

Course: Probability Theory
Number: Math 341
Units: 4 Credits

Course Description: Discrete and continuous probability – basic concepts, standard distributions, and the central limit theorem.

Prerequisite: Math 265 - Multivariable Calculus, or equivalent. Math 265 may be taken concurrently.

Detailed Syllabus:

1. Simulations
 - a. Uniform Distributions
 - b. Monte Carlo Methods
 - c. Random Walks
 - d. Shooting craps; Iterated Fractals.
2. Data Analysis
 - a. Frequency
 - b. Expected Value
 - c. Cumulative Distributions
 - d. Variance
 - e. Histograms
 - f. Related formulas for Expected Values and Variance
3. Probabilities
 - a. Calculating Probability
 - b. Union and Intersection and Probability
 - c. Conditional Probability Formula
 - d. Independence
 - e. Indicator functions
4. More Data Analysis
 - a. Markov's Inequality
 - b. Chebyshev's Theorem
 - c. Laws of Large Numbers
 - d. One-Sided Chebyshev Theorem

5. Normal and Exponential Distributions
 - a. Approximately Normally Distributed Sets
 - b. Normal Distribution
 - c. Approximately Exponentially Distributed Sets
 - d. Exponential Distribution
 - e. Memoryless Property of Exponential Distributions

6. Random Variables
 - a. "Random Variables"
 - b. Discrete Random Variables
 - c. Continuous Random Variables
 - d. Probability Density Functions
 - e. Cumulative Distribution Functions
 - f. Expected Values and Variance
 - g. Markov, Chebyshev, and Law of Large Numbers Revisited
 - h. Mean, Median, and Mode

7. Joint Distributions
 - a. Joint Probability Calculations
 - b. Discrete & Continuous
 - c. Expected Values, Covariance, and Correlation.
 - d. Conditional Probability Calculations
 - e. Conditional Expectations
 - f. The Law of Total Probability

8. Central Limit Theorem
 - a. Generating Functions for Discrete Random Variables
 - b. Generating Functions for Continuous Random Variables
 - c. Generating Functions and Independence
 - d. Central Limit Theorem
 - e. Fourier Transforms
 - f. Chi-squared and Gamma random variables

Additional Optional Modules:

9. Counting
 - a. Binomial and Poisson counting
 - b. Binomial and Poisson Distributions

10. Statistics
 - a. Sampling
 - b. Confidence Intervals
 - c. Hypothesis testing