



## Math 461: Introductory to Probability Theory (3 credit hours)

### Course Description

This is an introduction to mathematical probability. Topics for this course include the calculus of probability, combinatorial analysis, random variables, expectation, distribution functions, moment-generating functions, and the central limit theorem.

Prerequisite: Calculus III

### Course Objectives

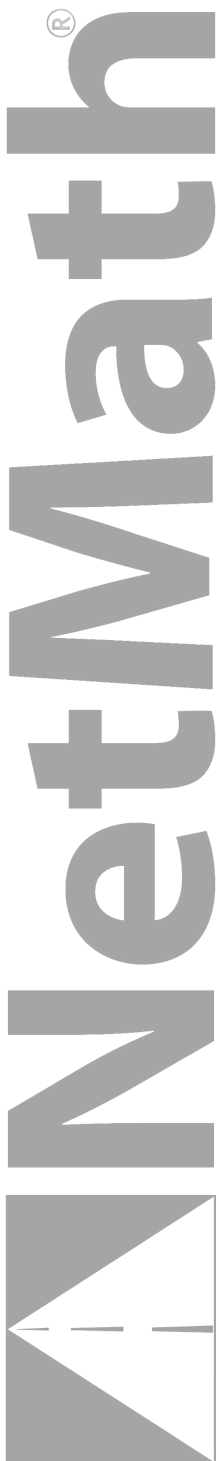
After completing this course a successful student will be able to understand and apply the topics listed above. He/she will also be able to apply numerical, computational, and estimation techniques. Through exploration, a successful student will be able to use probability models to analyze physical phenomena. He/she will also have the necessary tools to formulate and solve problems in mathematical situations and connect concepts to other disciplines. Most importantly, a student completing this course will be able to communicate ideas through descriptive language as well as mathematical symbols.

### Course Content and Format

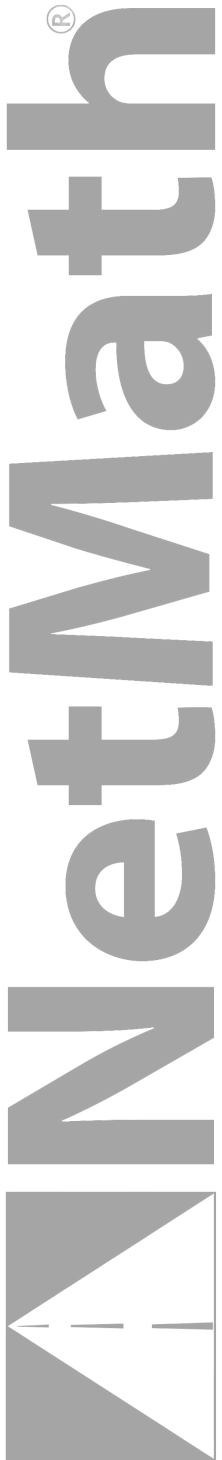
#### *Content*

A brief outline of topics for this course appears below:

- Tools for Data Analysis
  - Frequency plots
  - Expected value and variance of a data set
  - Cumulative distribution function
- Probabilities
  - Conditional probability
  - Independence of two events
  - Applications of probability
- Advanced Data Analysis
  - Markov's Inequality
  - Chebyshev's Theorem
  - Law of Large Numbers
  - Monte Carlo simulations



DEPARTMENT OF MATHEMATICS



- Normal and Exponential distribution
  - Approximating distributions
  - Quartiles
- Random Variables
  - Probability density functions
  - Various probability distributions
- Joint Distributions
  - Joint probability
  - Conditional expectations
  - Bivariate normal probability density functions
  - Minimizing conditional expected value
- Central Limit Theorem
  - Generating functions
  - Sample means
  - Fourier Transform application
- Binomial and Poisson distributions
  - Poisson counting process
  - Probability applications
  - Sampling with/without replacement
- Some Statistics
  - Estimate expected values and variance
  - Confidence intervals
  - Hypothesis testing

*Format*

Course content is drawn from *Probability and Statistics* written by Bill Davis, Horacio Porta and Jerry Uhl ©2006-2010.

Math 461 utilizes the CAS-ILE system. See <https://cas-ile.illinois.edu/> for more information. This online system helps students learn math topics through dynamic exploration and visualization.

Exams for Math 461 are taken with pencil and paper.