

**NetMath Online Math Courses, University of Illinois**Course Syllabus for **MATH 461** (Introduction to Probability Theory)

**Course description:** Introduction to mathematical probability; includes the calculus of probability, combinatorial analysis, random variables, expectation, distribution functions, moment-generating functions, and central limit theorem.

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**Credit:** 3 hours.

**Prerequisite:** MATH 241 or equivalent.

**Required Material:** Please Visit - <https://cas-ile.illinois.edu/>

**Syllabus:****Prob. 01 Monte Carlo Simulations**

Estimating probabilities and measurements by Monte Carlo simulation.

**Prob. 02 Data Analysis**

Frequency, cumulative distribution functions and histograms for data sets of numbers. Expected value and variance for data sets and functions of data sets.

**Prob. 03 Probabilities**

Probabilities of unions and intersections of data sets. Conditional probability and independence. Series wiring versus parallel wiring. Drug testing. Birthday problem. Probability of winning at craps. Gambler's ruin.

**Prob. 04 More Data Analysis**

Markov's inequality, Chebyshev's inequalities and standard deviation. Law of large numbers. Random Walks, Outliers.

**Prob. 05 Normal and Exponential**

Normal distribution and the bell curve. Exponential distribution and the exponential curve. Recognizing data sets that are approximately normally or exponentially distributed. The memoryless property of the exponential distribution. Monte Carlo generation of normally or exponentially distributed data sets. Experiments with sample averages and the normal distribution.

Prob. 06      Random Variables

Continuous versus discrete random variables. Approximation of continuous random variables by discrete random variables. Probability density functions and cumulative distribution functions. Brand name continuous distributions: uniform, normal, exponential, Weibull, chi-square, gamma and beta. Sample uses of each. Monte Carlo generation of data sets following a specified distribution.

Prob. 07      Joint Distributions

Joint distributions: Discrete and Continuous. Independence, conditional probability and conditional expectations. Corellation.

Prob. 08      Generating functions and the Central Limit Theorem

Central limit theorem. Generating functions. Special attention to sums of independent normal and exponential random variables.

Prob. 09      Counting

Permutations, combinations, Bernoulli, Binomial, and Poisson distributions. Approximations by normal distributions.

Prob. 10      Statistics

Sampling for the mean and variance. Acceptance testing.