**MATH 3307 – Probability & Statistics**

**Student Learning Outcomes**

**1. Students will demonstrate factual knowledge of the mathematical notation and terminology used in this course.** Students will demonstrate the ability to read, interpret, and use the vocabulary, symbolism, and basic definitions of probability theory, including permutations and combinations, sample space, event, conditional probability, discrete and continuous random variables, expected value, mean, variance, probability density functions and distribution functions.

**2. Students will be able to describe the fundamental principles, laws, and theorems arising from the basic definitions of probability theory.** Students will be able to identify and use the postulates of probability, the basic properties of random variables, and laws and formulas that result from them, such as Bayes' Theorem, Chebyshev's Theorem, independence, mean and variance of linear combinations of random variables, and the Central Limit Theorem.

**3. Students will apply course material along with techniques and procedures covered in this course to solve problems.** Students will use the facts, formulas, and techniques learned in this course to solve problems involving elementary counting processes and ones related to special probability distributions, such as the binomial, hypergeometric, Poisson, exponential, and normal distributions.

**4. Students will develop specific skills, competencies, and thought processes sufficient to support further study or work in this field or related fields.** Students will acquire a level of proficiency in the fundamental concepts and applications necessary for further study in academic areas requiring a background in probability theory. These fields might include business, the social sciences, and the physical sciences and engineering, as well as mathematics.

**Course Content**

**Textbook:** *Introduction to Probability, Statistics, and Random Processes*, by Hossein Pishro-Nik.

**Chapter 1** - Introduction: What is Probability?, Venn Diagrams, Set Operations, Cardinality, Functions, Random Experiments, Probability, Finding Probabilities, Discrete Probability Models, Continuous Probability Models, Independence, Law of Total Probability, Bayes’ Rule, Conditional Independence.

**Chapter 2** - Ordered Sampling with Replacement, Permutations, Combinations, Unordered Sampling with Replacement.

**Chapter 3** - Random Variables, Discrete Random Variables, Probability Mass Function, Independent Random Variables, Cumulative Distribution Function, Expectation, Functions of Random Variables, Variance.

**Chapter 4** - Probability Density Function, Expected Value and Variance, Functions of Continuous Random Variables, Uniform Distribution, Exponential Distribution, Gaussian Distribution, Gamma Distribution, Other Distributions, Mixed Random Variables, Using the Delta Function.

**Chapter 5** - Joint Probability Mass Function (Discrete), Joint Cumulative Distribution Function (Discrete), Conditioning and Independence, Functions of Two Random Variables, Conditional Expectation and Conditional Variance, Joint Probability Density Function (Continuous), Joint Cumulative Distribution Function (Continuous), Functions of Two Continuous Random Variables, Covariance and Correlation, Bivariate Normal Distribution.

**Chapter 7** - Law of Large Numbers, Central Limit Theorem, Convergence of a Sequence of Numbers, Sequences of Random Variables, Different Types of Convergence for Sequences of Random Variables, Convergence in Distribution, Convergence in Probability, Convergence in Mean, Almost Sure Convergence.

**Chapter 8** - Random Sampling, Point Estimation, Interval Estimation (Confidence Intervals), Hypothesis Testing, Linear Regression.