Mathematics 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: *A Course in Probability* (1st ed., ©2006), by Neil A. Weiss, ISBN-13: 9780201774719. The following sections are included:

Ch. 1, Probability Basics: Introduction; From Percentages to Probabilities; Set Theory.

Ch. 2, Mathematical Probability: Sample Spaces and Events; Axioms of Probability; Specifying Probabilities; Basic Properties.

Ch. 3, Combinatorial Probability: The Basic Counting Rule; Permutations and Combinations; Application to Probability.

Ch. 4, Conditional Probability and Independence: Conditional Probability; The General Multiplication Rule; Independent Events; Bayes's Rule

Ch. 5, Discrete Random Variables and Their Distributions: From Variables to Random Variables; Probability Mass Functions; Binomial Random Variables; Hypergeometric Random Variables; Poisson Random Variables; Geometric Random Variables; Functions of a Discrete Random Variable.

Ch. 6, Jointly Discrete Random Variables: Joint and Marginal Probability Mass Functions; Conditional Probability Mass Functions; Independent Random Variables; Functions of Two or More Discrete Random Variables;

Ch. 7, Expected Value of Discrete Random Variables: From Averages to Expected Values; Basic Properties of Expected Value; Variance of Discrete Random Variables; Variance, Covariance, and Correlation; Conditional Expectation.

Ch. 8, Continuous Random Variables and Their Distributions: Introducing Continuous Random Variables; Cumulative Distribution Functions; Probability Density Functions; Uniform and Exponential Random Variables; Normal Random Variables.

Ch. 9, Jointly Continuous Random Variables: Joint Cumulative Distribution Functions; Joint Probability Density Functions; Marginal and Conditional Probability Density Functions; Independent Continuous Random Variables; Sums of Independent Normal Random Variables.

Ch. 10, Expected Value of a Continuous Random Variable: Expected Value of a Continuous Random Variable; Basic Properties of Expected Value; Variance, Covariance, and Correlation; Conditional Expectation.

Ch. 11, Limit Theorems and Applications: The Central Limit Theorem

Optional Sections (one or more of these sections may be included as time permits)
Ch. 5 – Other Important Discrete Random Variables; Ch. 6 – Sums of Discrete Random Variables; Ch. 8 – Other Important Continuous Random Variables, Functions of a Continuous Random Variable; Ch. 9 – Functions of Two or More Continuous Random Variables, Multivariate Transformation Theorem; Ch. 10 – The Bivariate Normal Distribution; Ch. 11 – Generating Functions and Limit Theorems; Ch. 12 – Applications of Probability Theory.