MATH 441 - Probability and Statistics I

Course description: Axiomatic probability; conditional probability; random variables/vectors; distribution functions; expectations; moment-generating functions; special distributions; functions of random variables/vectors; random sampling and sampling distributions; central limit theorem; weak law of large numbers.

Prerequisite or corequisite: MATH 233.

Schedule: Fall and, when demand is sufficient, summer. 3 credit hours.

Textbook: *Introduction to Mathematical Statistics and Its Applications*, 4th edition, Larsen and Marx, Prentice Hall.

Overview of the MATH 441/442 sequence:

Math 441 is the first course in a two-course sequence in mathematical statistics for undergraduate students in mathematics, statistics and actuarial science. This sequence also provides an excellent preparation for undergraduate students who are preparing for graduate study in statistics or statistically based areas such as econometrics, psychometrics, or biostatistics. It lays the essential mathematical basis for graduate-level courses in statistics or statistically based courses and many graduate programs from a variety of disciplines require or strongly recommend it for prospective students. The sequence is vital for Actuarial Science students.

The topics in MATH 441 are primarily from probability and distribution theory and lay the foundation for a mathematical treatment of statistics in the second course MATH 442. This grounding in probability also provides a good foundation for other undergraduate course in statistics, and stochastic processes (MATH 445). This course should also impart to the student the important idea that real phenomena can be modeled stochastically using random variables/vectors and their distributions. These modeling aspects, which can be imparted through computer simulations, real experiments, and the use of historical data, should make the course very useful to students in the physical, engineering, biological and social sciences. The prerequisite makes it possible to develop the theory of discrete and continuous distributions. Calculus-level proofs of important results will be presented or outlined.

Topics covered (Chapters 1 – 4, 7):

1. Introduction

A Brief History. Some Examples. A Chapter Summary.

2. Probability

Sample Spaces and the Algebra of Sets. The Probability Function. Conditional Probability. Independence. Combinatorics. Combinatorial Probability.

3. Random Variables

Binomial and Hypergeometric Probabilities. Discrete Random Variables. Continuous Random Variables. Expected Values. The Variance. Joint Densities. Combining Random Variables. Further Properties of the Mean and Variance. Order Statistics. Conditional Densities. Moment Generating Functions. Odds and Ends.

4. Special Distributions

The Poisson Distribution. The Normal Distribution. The Geometric Distribution. The Negative Binomial Distribution. The Gamma Distribution.

7. The Normal Distribution

Inferences about a population mean. Normal, t, χ^2, F distributions.