Syllabus – Math 471 – Probability (3)

Course Description:

> Probability spaces, random variables, distributions, expectations, moment–generating and characteristic functions, limit theorems. Continuous probability emphasized. Pre: 244 (or concurrent) or 253A (or concurrent); recommended 305 or 371 or 372; or consent.

Possible Texts:

- *A First Course in Probability* by S. Ross
- *Probability: An Introduction* by G. Grimmet and D. Welsh
- *A Course in Probability* by N. Weiss

Outline of Course:

Math 471 is a rigorous introduction to mathematical probability, including discrete and continuous distributions, with emphasis on the continuous case. Combinatorics should be deemphasized. Topics covered should include most of the following (drawn from Chapters 1–8 of Ross, or Chapters 1–8.3 of Grimmett and Welsh):

1. Axioms of probability: Sample spaces (both finite and infinite), event (σ-)algebras, probability measures, continuity and σ-additivity.
2. Independence, conditional probabilities, Bayes Theorem.
3. Random variables, distributions (both discrete and contiuous), probability mass/density functions, cumulative distribution functions, expected value, variance, and n^{th} moments, distributions of functions of random variables.
4. Jointly distributed random variables: independence, marginal and conditional distributions, conditional expectation.
5. Functions of jointly distributed random variables; sums of random variables.
6. Moment-generating functions, probability generating functions, and/or characteristic functions.

7. Inequalities: Markov, Chebyshev, and Jensen inequalities.
8. Limit theorems: Weak Law of Large Numbers, Strong Law of Large Numbers, Central Limit Theorem.

Course Objectives and Student Learning Outcomes. Upon successful completion, the student will have a foundation in the basic topics of the theory of Probability listed above in the syllabus. Emphasis on rigor will provide students the understanding needed for graduate work, and in the study of the logical foundations of mathematics.

Program Objectives. Math 471 is a senior level course in Probability, an important subject with many applications in Statistics, the physical and biological sciences, and Engineering. This course promotes our goal that our students learn, understand, and be able to apply several mathematical topics at the junior and senior level, and that our students acquire the ability and skills to apply mathematics to other fields.