Applied Probability Theory: Math 60850
Andrew Sommese (Instructor)

This first-year graduate course is a solid introduction to Applied Probability. Though the only strict requirements are a full sequence of calculus with some linear algebra, and a willingness to learn what is needed, having had an undergraduate probability course and the equivalent of a mathematical methods course (including the rudiments of one complex variable; and Fourier and Laplace transforms) will help a lot. Topics covered will include:

1. Basic setup of probability theory (including sample spaces, conditional probability, independence). Random variables (including the elements of measure and integration theory).
2. Discrete random variables (including random walks).
3. Continuous random variables, the basic distributions, sums of random variables.
4. Generating functions, branching processes, basic theory of characteristic functions, central limit theorems.
5. Markov chains (embedding, birth and death processes, Poisson processes)
6. Monte Carlo simulations
7. More "laws of large numbers," including the law of the iterated logarithm, Martingales, filtered sigma algebras, and the simplest martingale convergence theorems.
8. Various stochastic processes, including Brownian motion, queues, and applications.
9. Martingales, including stopping times and optimal stopping.
10. The rudiments of stochastic integration (including Ito's formula and the Black-Scholes differential equation).

Grimmett and Strizaker [1] will be used as a text. A good elementary book is [3]. Feller [2] is a classic. Williams [4] is an excellent graduate text for more depth on some of the material we cover in the first half of the semester.

References

[1] G. Grimmett and D. Strizaker, Probability and random processes, Oxford, 3rd edition, 2005.

[2] W. Feller, An Introduction to Probability Theory and Its Applications, Volume 1, Wiley.

[3] S. Ross, A first course on probability, 6th ed., Prentice Hall (2002).

[4] D. Williams, Probability and Martingales, Cambridge, 1991.