

SYLLABUS FOR *INTRODUCTION TO PROBABILITY THEORY FOR GRADUATE ECONOMICS*

BRENT HICKMAN and YIĞIT SAĞLAM,
with Contributions by TIM HUBBARD

FALL 2009

This course is designed to introduce students to various topics in probability and uncertainty that they will encounter in economic theory. The concepts are illustrated with actual examples from the economics literature. Exercises are designed to encourage the student to begin thinking about probability and uncertainty within a theoretical economics context.

Chapter 0: MATLAB and Computation in Economics (continued from summer math camp)

- Various topics covered through mid October
 - Debugging and Speeding up Code
 - Algorithmic Design: Naive Search vs. Divide and Conquer
 - Selection of a Stopping Criterion in Numerical Convergence Routines
 - Root Finding: Bisection
 - Multi-Dimensional Root Finding: Newton's Method
 - Adaptive Step-Size Control
 - Derivative-Free Optimization: Golden Search and Nelder-Mead
 - Introduction to Non-Linear Optimization in AMPL

Chapter 1: Foundations of Probability

- Probability Axioms
- Sample Spaces, Events
- Mutually Exclusive Events
- Law of Total Probability
- Conditional Probability, Bayes' Rule
- Independent Events
- Counting techniques

Chapter 2: Random Variables

- Definition of a Random Variable
- Cumulative Distribution Functions
- Probability Density Functions and Probability Mass Functions
- Other Related Functions: Hazard Function, Survivor Function, Reverse Hazard Function
- Notions of Stochastic Dominance
- Discrete Random Variables: Bernoulli, Binomial, Multinomial, Poisson, and Uniform

- Continuous Random Variables: Uniform, Exponential, Normal, and Pareto
- Moments and Moment Generating Functions

Chapter 3: Jointly Distributed Random Variables

- Joint Distributions
- Marginal Distributions
- Independent Random Variables
- Conditional Distributions
- Joint Moment Generating Functions
- Covariance, Correlation, and Affiliation Among Random Variables

Chapter 4: Functions of Random Variables

- The CDF Technique
- One-to-One Transformations
- Transformations of Multivariate Random Variables
- Sums of Random Variables
- Moments of Transformed Random Variables
- The Probability Integral Transformation
- Application: Random Number Generation and model Simulation
- Applications of the Probability Integral Transformation to Economics

Chapter 5: Stochastic Processes

- Definition of a Stochastic Process
- Poisson Processes
- Discrete Time, Discrete Space Markov Processes
- Continuous Time, Continuous Space Stochastic Processes
- Dynamic Programming Under Uncertainty
- Brownian Motion and Stochastic Calculus