Professor Jushan Bai
Monday and Wednesday 10:30 am, Carney 2
Office Hours: Monday and Wednesday 10:30-11:30AM, and by appointment
Phone: (617) 552-3689, email: jushan.bai@bc.edu}

(Course Objectives}

This course is designed for first-year Economics Ph.D. students. Its primary objective is to provide the basic probability theory and statistical methodology that are necessary for further study of econometrics. No prior preparation in probability and statistics is required, but familiarity with basic algebra and calculus is assumed. This course is followed by Econometrics I in the spring semester, where the fundamentals of statistical theory are presented.

(Required Text}

DeGroot, M.H.: {Probability and Statistics,} Addison-Wesley, 1986.
The book is available in the Bookstore.

(Alternative Textbooks}

The material covered in the course can also be found in a number of textbooks. Two of them are listed below:

(Introduction to Probability Theory and Statistical Inference}, by Harold, J. Larson, 1982.

(An Introduction to Mathematical Statistics and its Applications}, by Richard Larsen and Morris Marx, 1986.

(Requirements and Grading}

There will be weekly assignments. Late assignments will not be accepted as written answers will be passed out. It is essential to attempt all problems by yourself, even though you are allowed to work together on the assignments.

There will be one mid-term and one final. The mid-term exam will be given in class, Monday, October 18, and the final exam will be held in the final exam week.

The course grade will be determined by the assignments (15%), the mid-term exam (35%), and the final (50%).

(Course Outline}

(Introduction to Probability}

Interpretations of probability, experiments and events, sample space, set theory, union, intersection, complements, axioms of probability, counting methods, independence, conditional probability, Bayes Theory.

DeGroot, Chapter 1 and sections 2.1-2.2.
Larson, Chapters 1 and 2.
Larsen and Marx, Chapters 1 and 2.

(Random variables and Distributions}

Random variables, distribution functions, density functions, bivariate distributions, multivariate distributions, marginal distributions, conditional distributions, random variable transformations.

DeGroot, Chapter 3.
Larson, 3.1-3.2, 5.1-5.2.
Larsen and Marx, 3.1--3.7.

(Expectations}

Definition and properties of expectations, variance, moments, moment generating functions, mean, median, covariance, correlation, conditional expectation.

DeGroot, Chapter 4.
Larson, 3.3-3.4.
Larsen and Marx 3.8-3.12.

(Special Distributions}

Bernoulli trials, binomial, negative binomial, Poisson, normal, beta, gamma, multinomial, bivariate normal.

DeGroot, Chapter 5.
Larson, Chapter 4.
Larsen and Marx, Chapter 4.

(Probability Inequalities}

Markov inequality, Chebyshev inequality, Shwarz inequality, Jensen inequality.

DeGroot, 4.8.
Larson, 5.5.
Larsen and Marx, 3.13.

(Law of Large Numbers}

Weak law of large numbers, strong law of large numbers.

DeGroot, 4.8.
Larson, 5.5.
Larsen and Marx 3.13.

(Central Limit Theorem}

DeGroot, 5.7.
Larson, 5.6.
Larsen and Marx, 4.3.

(Estimation}

Statistic(s), estimators, unbiasedness, consistency, likelihood function, maximum likelihood estimation, sufficient statistics, factorization theorem, Fisher information, Cramer-Rao lower bound, efficiency, delta method, method of moments, Bayesian estimation.

DeGroot, Chapter 6, sections 7.7-7.8.
Larson, Chapters 6 and 7 (section 7.1-7.2).

Larsen and Marx, Chapter 5.

(Sampling Distribution of Estimators}

Chi-Square distribution, joint distribution of sample mean and sample variance, t-distribution, F-distribution, confidence intervals.

DeGroot, Chapter 7.
Larsen and Marx Chapter 7.

(Hypothesis testing}

Type I and type II errors, size, power, likelihood ratio test statistics (LRT), generalized LRT, one-sample problem, two-sample problem, t-test, chi-square test, and F-test.

DeGroot, Chapter 8.
Larson, Chapter 8.
Larsen and Marx, Chapters 6 and 8.

(Large Sample Hypothesis Testing}

Wald, Lagrange Multiplier (LM) and Likelihood Ratio (LR) tests.

Lecture notes.