

INTRODUCTION TO PROBABILITY AND STATISTICS

Economics 319

SPRING 2007

Department of Economics, Cornell University

MW 2:55-4:10PM Statler Hall & Auditorium - 196

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Th 12:00-1:00 PM

Course Description

“Probabilities were first considered in games of chance, or gambling. Players of various games of chance observed that there seemed to be ‘rules’ that governed the roll of dice or the results of spinning a roulette wheel. (...) But differences arose among gamblers about probabilities, and they brought their questions to the noted mathematicians of their day.” This was the motivation that fueled the development of the modern theories of probability and statistics, which are now widely applied in diverse fields of study, including economics, engineering, science, management, etc.

This course presents mathematical tools of probability and statistics that constitute the necessary foundations for the successful study of Econ 320, Introduction to Econometrics. These two courses, Econ 319 and Econ 320, constitute the advanced sequence designed for students who plan

to go to graduate school and/or like to have a solid econometrics background. Beginning with the academic year 2004/2005, Econ 320 will be offered both in the Fall and Spring semesters. I suggest you take Econ 320 in the Fall, so that not much time has passed since you studied probability and statistics.

The first part of this course will cover the structure of probability theory, which is the foundation of statistics, and provide many examples of the use of probabilistic reasoning. It will then move to a discussion of the most commonly encountered probability distributions, both discrete and continuous. We will then consider random sampling from a population, and the distributions of some sample statistics. From there we will move to the problem of estimation –the process of using data (in the best possible way) to learn about the value of the unknown parameters of a model. Finally, we will discuss hypothesis testing –the use of data to confirm or reject hypotheses that we have formed about the relationship among (economic) variables.

Prerequisites

Math 111-112 or equivalent. It is assumed that students have a good command of algebra, especially differentiation and integration; both these tools will be extensively used during the course.

Exams and Grade Policy

Grades in this course will be based on the following:

1. **9 problem sets** counting towards **25%** of the final grade. Problem sets will be due in class and the due dates will be firm. Late problem sets will not be accepted. The only exception is if you obtain my prior consent (not the TA's), or in unusual circumstances.
2. **3 tests** counting towards **75%** of the final grade (25% each). **Two of these tests will be given in class, during the 2:55-4:10 class time:**

Test 1: Monday, March 5

Test 2: Wednesday, April 4

The final test will be given during finals period and is scheduled for

Thursday, May 17 2:00 - 4:30 PM

Note: The third test will not be cumulative.

The official policy of this course is that no makeup exams will be offered, because the first two exams are in class and the third exam is during finals.

Textbook

There is one required textbook for the course: *Probability and Statistics*, 3rd Edition, by Morris H. DeGroot and Mark J. Schervish. The textbook is readable and full of examples. My lectures will be based on this book, aiming at making technical material accessible. Therefore, it is very important to attend all lectures. The textbook, on the other hand, will provide extra intuition and many examples.

Handouts

Problem sets and solutions, and occasionally other handouts will be available in lecture. Problem set questions and some handouts will be made available on the course web page. Solutions will not be posted on the web page. Extra copies of problem sets, solutions and handouts will be placed in a box outside Uris 412. If these boxes are ever missing something you need, see the TA, me or my secretary, Johanna Schroeder, who is in Uris 412.

Course Outline

1. Probability

- Sample Spaces
- Events and Probabilities

- Combinatorial Methods and Binomial Coefficients
- Conditional Probabilities and Independent Events
- Bayes' Theorem

2. Random Variables and Probability Distributions

- Random Variables
- Probability Distributions
- Continuous Random Variables
- Discrete Random Variables
- Joint Distributions
- Marginal and Conditional Distributions

3. Mathematical Expectation

- Expected Value of a Random Variable
- Variance
- Covariance
- Linear Combinations of Random Variables
- Chebyshev's Inequality

4. Special Probability Distributions

- Discrete Uniform Distribution
- Bernoulli Distribution
- Binomial Distribution
- Poisson Distribution
- Multinomial Distribution

5. Special Probability Densities

- Uniform Distribution
- Gamma, Exponential, and Chi-Square Distributions
- Normal Distribution
- Bivariate Normal Distribution

6. Functions of Random Variables

- Distribution Function Technique
- Transformation Technique for Functions of One Variable
- Transformation Technique for Functions of Several Variables

7. Sampling Distributions

- Distribution of the Mean and Central Limit Theorem
- Chi-Square Distribution
- t Distribution
- F Distribution

8. Point Estimation

- Estimators
- Bias
- Efficiency
- Consistency

9. Confidence Intervals

- Estimation of Means
- Estimation of Proportions
- Estimation of Variances

10. Hypothesis Testing

- General Concepts
- Null and Alternatives
- Testing a Statistical Hypothesis
- Rejection Rules
- The Power Function of a Test