

## Probability and Statistics

### Winter School @ Fudan SOE 2022

<b>Course Code</b>	ECON2130001		
<b>Course Title</b>	Probability and Statistics		
<b>Credit</b>	3	<b>Credit Hours</b>	48 credit hours
<b>Course Objectives</b>	<p>After you finish the course, you are supposed to</p> <ul style="list-style-type: none"> <li>• Develop a deep understanding of probability and statistics and a solid intuition for statistical concepts.</li> <li>• Learn how the mathematical ideas of statistics carry over into the world of applications in economics and finance.</li> </ul>		
<b>Course Description</b>	<p>This course provides necessary probability and statistics background for undergraduate for their courses in econometrics, microeconomics, and macroeconomics. Statistics and mathematics are two basic analytic tools in economics. Statistics is an essential tool to study situations involving uncertainties, in the same way as calculus is essential to characterize optimizing behaviors in economics. For example, probability theory is needed in study of game theory. In macroeconomics, as Robert Lucas points out, the introduction of stochastic factors can provide much new insights into dynamic economic systems. Indeed, probability and statistics are necessary analytic tools in every field of economics. Of course, the demand for probability and statistics varies from field to field in economics, with econometrics most heavily using it.</p> <p>The analysis will be conducted in a relatively rigorous manner. Formal proofs will be given for some important theorems, because the proofs themselves can aid understanding and in some cases, the proof techniques or methods have practical value.</p> <p>In addition to developing a fundamental understanding of probability and mathematical statistics that are most relevant to modern econometrics, this course also tries to develop a sound intuition for statistical concepts from economic perspective. For example, why are statistical concepts (e.g., mean and variance) useful in economics? What are economic intuition and interpretation for the probability and statistical relations?</p>		
<b>Course Requirements:</b>			
Prerequisites: Calculus, Linear algebra			

**Teaching Methods:**

homework assignments.

**Course Schedule**

**Chapter 1: Introduction to Econometrics**

**Chapter 2: Foundation of Probability Theory (6 hours)**

- 2.1 Random Experiments
- 2.2 Basic Concepts of Probability
- 2.3 Fundamental Probability Laws
- 2.4 Conditional Probability and Independence
- 2.5 Bayes' Rule

**Chapter 3: Random Variables and Probability Distributions (3 hours)**

- 3.1 Random Variables and Distribution Functions
- 3.2 Discrete Random Variable
- 3.2 Continuous Random Variables
- 3.3 Functions of a Random Variable
- 3.4 Joint Probability Distribution
- 3.5 Conditional Probability Distribution
- 3.6 Independence

**Chapter 4: Mathematical Expectations (3 hours)**

- 4.1 Univariate Mathematical Expectations
- 4.2 Moments and Moment Generating Function
- 4.3 Multivariate Mathematical Expectations
- 4.4 Covariance and Correlation
- 4.5 Conditional Expectations and Conditional Moments

**Chapter 5: Introduction to Sampling Theory and Statistics (3 hours)**

- 5.1 Normal Distribution
- 5.2 Student's t Distribution
- 5.3 Snedecor's F Distribution
- 5.4 Chi-square Distribution
- 5.5 Central Limit Theorem

- 5.6 Population and Random Sample
- 5.7 Sampling Distribution of Sample Mean
- 5.8 Sampling Distribution of Sample Variance

**Chapter 6: Parameter Estimation and Evaluation (6 hours)**

- 6.1 Population and Parameter Estimation
- 6.2 Point Estimators and Mean Squared Error Criterion
- 6.3 Best Unbiased Estimators
- 6.4 Confidence Interval Estimators

**Chapter 7: Hypothesis Testing (6 hours)**

- 7.1 Introduction to Hypothesis Testing
- 7.2 Hypothesis Testing for Population Mean
- 7.3 Hypothesis Testing for Population Variance

**Chapter 8: Conclusion (6 hours)**

**The design of class discussion or exercise, practice, experience and so on:**

Class participation is highly recommended. Students are encouraged to share their thoughts or current works in class.

**Grading & Evaluation (Provide a final grade that reflects the formative evaluation process):**

Student grade in this courses will be based on:

Homework: 40%

Final Exam: 60% , cumulative, open-book

**Teaching Materials & References:**

Walpole, Myers, Myers and Ye., Barry, Probability and Statistics for Engineers and Scientists, Pearson, 2016.