
COURSE SYLLABUS

FOR FULL-TIME UNDERGRADUATE PROGRAMS

(Issued under Decision No.1380/QĐ-ĐHKTQĐ on 15/8/2016 by the University President)

1. COURSE NAME: PROBABILITY THEORY

Code: TOKT1105

Number of Credit: 03

2. DEPARTMENT IN CHARGE OF INSTRUCTION: Mathematical Economics

Office: Level 4, Building 7

Office Hours: *Times & Days

Office Telephone: (084) 04 3628 3007

3. PRE-REQUISITE: Analysis A1, Analysis A2, Algebra.

4. COURSE DESCRIPTION:

This subject provides learners with foundation knowledge of probability theory that is necessary for understanding specialized subjects later. It approaches the probability theory by Kolmogorov's axiomatic system based on measure theory of the Advanced Mathematics (for students majoring in Applied Mathematics in Economics). The concepts and results of the probability theory are built and explained in detail with a wide range of exercises giving students a coherent and logical knowledge system. This subject also introduces some basic concepts of stochastic process that is completed in Foundation of mathematical finance subject.

5. COURSE OBJECTIVES:

This course provides basic knowledge of the probability theory, helping students to gain a necessary tool in processing random phenomena, especially in social economic ones. On the other hand, it helps students to learn relevant subjects such as: Mathematical statistics, Application statistics, Econometrics, and Foundation of mathematical finance.

6. COURSE CONTENTS:

TENTATIVE SCHEDULE

<i>No</i>	<i>Contents</i>	<i>Total hours</i>	<i>In details</i>		<i>Notes</i>
			<i>Theory</i>	<i>Practice, Discussion, Exams</i>	
1	Chapter 1	9	6	3	<i>Practice with computer software and report in group.</i>
2	Chapter 2	9	6	3	
3	Chapter 3	9	6	3	
4	Chapter 4	11	7	4	
5	Chapter 5	4	3	1	
6	Chapter 6	3	2	1	
	Total	45	30	15	

CHAPTER 1 – RANDOM EVENT AND PROBABILITY

This chapter introduces basic concepts of probability theory from the point of measurement. The concept of probability is built on the Kolmogorov's axiomatic system. Properties of probability are proved by the results of the measurement theory. On this basis, this chapter also introduces the concept of conditional probability, independence events, independence experiment, from which basic probability formula are presented in later chapters.

1.1. Probability

1.1.1. Experiment and space of events

1.1.2. Relation of events

1.1.3. Algebra - σ

1.1.4. Axiomatic definition of probability

1.1.5. Some inceptive definition of probability

1.1.6. Large probability principle, small probability principle

1.2. Conditional probability

1.2.1. Concepts of conditional probability

1.2.2. Rule of join

1.2.3. Rule of union

1.2.4. Total probability and Bayes' Theorem

1.3. Independence

1.3.1. Independence of events

1.3.2. Independence of experiments

1.3.3. Bernulli formula

References of the chapter:

- 1 - Nguyen Manh The, Probability Theory lecture notes.
- 2 - Dang Hung Thang, 2002, Probability Exercise, Education Publishing House.
- 3 - A.N. Kolmogorov, A.N. Shirayev, Probability Theory and Mathematical Statistics, Selected Works of A.N. Kolmogorov: vol. 2.

CHAPTER 2 – RANDOM VARIABLE AND PROBABILITY DISTRIBUTION

With the concepts of random event and probability measure being presented in Chapter 1, this chapter presents random variables and their probability distribution. The random variable is introduced from one-dimension to twodimensions and then expanded to multi-dimensions. Concept of function of random variable function and its probability distribution are also introduced. The necessary and sufficient conditions for systems of two or more independent random variables are proved in detail.

2.1. One dimensional random variable

- 2.1.1. Concept
- 2.1.2. Probability distribution function
- 2.1.3. Discrete random variables
- 2.1.4. Continuous random variables

2.2. Two dimensional random variables

- 2.2.1. Concept
- 2.2.2. Probability distribution function
- 2.2.3. Discrete two dimensions random variables
- 2.2.4. Continuous two dimensions random variables
- 2.2.5. Independence of random variables

2.3. Multidimensional random variable

- 2.3.1. Concept
- 2.3.2. Probability distribution function
- 2.3.3. Discrete-multidimensional random variables
- 2.3.4. Continuous-multidimensional random variables
- 2.3.5. Independence of multidimensional random variables
- 2.3.6. Concept of random samples

2.4. Function of random variables

- 2.4.1. Functions of a random variable
- 2.4.2. Functions of various random variables

References of the chapter :

- 1 - Nguyen Manh The, Probability Theory lecture note.

- 2 - Đinh Van Gang, 2003, Probability Theory and Mathematical Statistics, Education Publishing House.
- 3 - Dang Hung Thang, 2002, Probability Exercise, Education Publishing House.
- 4 - A.N. Kolmogorov, A.N. Shirayev, Probability Theory and Mathematical Statistics, Selected Works of A.N. Kolmogorov: vol. 2.

CHAPTER 3 – CHARACTERISTIC PARAMETERS OF RANDOM VARIABLE

This chapter introduces characteristic parameters of random variables: expectation, variance, standard deviation., etc. This characteristic parameters are determined through probability distribution of random variables. This chapter also introduces an approach with random variables by characteristic functions. Properties of characteristic functions and relationships with the moments are introduced.

3.1. Characteristic parameters of one dimension random variable

- 3.1.1. Expectation
- 3.1.2. Moments
- 3.1.3. Variance and standard deviation
- 3.1.4. Other characteristic parameters

3.2. Characteristic parameters of two dimension random variables

- 3.2.1. Expectation of functions of random variable two
- 3.2.2. Moments
- 3.2.3. Correlation moments and linear correlation coefficient

3.3. Characteristic parameters of multidimensional random variables

3.4. Characteristic functions

- 3.4.1. Concept and properties
- 3.4.2. Relationship between the moments and characteristic functions
- 3.4.3. Relationship between the distribution functions and characteristic functions

References of the chapter:

- 1 - Nguyen Manh The, Probability Theory lecture note.
- 2 - Dang Hung Thang , 2002, Probability Exercise, Education Publishing House.
- 3 - A.N. Kolmogorov, A.N. Shirayev, Probability Theory and Mathematical Statistics, Selected Works of A.N. Kolmogorov: vol. 2.

CHAPTER 4 – SOME COMMON PROBABILITY DISTRIBUTION

This chapter introduces some common probability distributions. The probability distributions are introduced from discrete to continuous and demonstrate the link between the rules. With distributions: chi-squared, student, fisher, this

chapter focuses only on constructing laws, the relationship between them and defining characteristic parameters, and critical value excluding application exercises. The application of these laws is will be presented in the mathematical statistics and other subjects. This chapter also introduces two- dimensional standard law for future research. Similarly, multi-dimensional cases can be expanded.

4.1. Discrete distribution

4.1.1. Bernoulli distribution

4.1.2. Binomial distribution

4.1.3. Hypergeometric distribution

4.1.4. Poisson distribution

4.2. Continuous distribution

4.2.1. Special integrals

4.2.2. Uniform distribution

4.2.3. Normal distribution

4.2.4. Chi-Squared distribution

4.2.5. Student distribution

4.2.6. Fisher distribution

4.3. Multi-dimensional Standard Distribution

4.3.1. Concept

4.3.2. Uncorrelation and independence

4.3.3. Regression function

References of the chapter:

1 - Nguyen Manh The, Probability Theory lecture note.

2 - Đặng Hùng Thang, 2002, Probability Exercise, Education Publishing House.

3 - A.N. Kolmogorov, A.N. Shirayev, Probability Theory and Mathematical Statistics, Selected Works of A.N. Kolmogorov: vol. 2.

CHAPTER 5 – SOME THEOREMS ON THE CONVERGENCE

This chapter introduces convergence: convergence in probability, convergence in mean square and convergence in distribution. It also presents Law of large numbers and Limit theorems as a basis theory for the mathematical Statistics statistical and other application subjects.

5.1. Concept of convergence

5.1.1. Convergence in probability

5.1.2. Convergence in mean square

5.1.3. Convergence in distribution

5.2. Law of large numbers

5.2.1. Chebyshev's inequality

5.2.2. Chebyshev's Theorem

- 5.2.3. Bernoulli's Theorem
- 5.3. Limit theorem in probability
 - 5.3.1. Concept of approximately normal
 - 5.3.2. Local limit theorem
 - 5.3.3. Integral limit theorem
 - 5.3.4. Central limit theorem

References of the chapter:

- 1 - Nguyen Manh The, Probability Theory lecture note.
- 2 - Đặng Hùng Thang , 2002, Probability Exercise, Education Publishing House.
- 3 - A.N. Kolmogorov, A.N. Shiryaev, Probability Theory and Mathematical Statistics, Selected Works of A.N. Kolmogorov: vol. 2.

CHAPTER 6 - INTRODUCE ABOUT STOCHASTIC PROCESS

Chapter 6 introduces some basic knowledge about the theory of stochastic process to help the student with the original look of this concept. This theory will continue to be completed in the following subjects.

- 6.1. Stochastic process
 - 6.1.1. Concept of stochastic process
 - 6.1.2. Classification of stochastic process
- 6.2. Markov process
 - 6.2.1. Markov chain
 - 6.2.2. Markov process

References of the chapter:

- 1 - Nguyen Manh The, Probability Theory lecture note.
- 2 - Đặng Hùng Thang , 2002, Probability Exercise, Education Publishing House.
- 3 – Nguyen Duy Tien and Vu Viet Yen, 2001, Probability Theory , Education Publishing House.
- 4 - A.N. Kolmogorov, A.N. Shiryaev, Probability Theory and Mathematical Statistics, Selected Works of A.N. Kolmogorov: vol. 2.

7. REQUIRED TEXTBOOKS & COURSE MATERIALS

Nguyen Manh The, Probability Theory lecture note.

8. RECOMMENDED TEXTS & OTHER READINGS

- 1 - Đinh Van Gang, 2003, Probability Theory and Mathematical Statistics, Education Publishing House.
- 2 - Đặng Hùng Thang, 2002, Probability Exercise, Education Publishing House.
- 3 - Nguyen Duy Tien and Vu Viet Yen, 2001, Probability Theory , Education Publishing House.

4 - A.N. Kolmogorov, A.N. Shirayev, Probability Theory and Mathematical Statistics, Selected Works of A.N. Kolmogorov: vol. 2.

9. ASSESSMENT & GRADING POLICY:

- ✓ Attendance (min 80%): 10%
- ✓ Discussion and homework: Complete all requirement
- ✓ Practice and presentation: 30%
- ✓ Final exam: 60%.

Hanoi, 2016

HEAD OF DEPARTMENT

PRESIDENT

(signed)

(signed)

PhD. Nguyen Manh The

Prof.Dr. Tran Tho Dat