
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 AND MATHEMATICAL STATISTICS 1

Code: TOKT1106

Number of Credit: 3

2. DEPARTMENT IN CHARGE OF INSTRUCTION:

Office: *Location

Office Hours: *Times & Days

Office Telephone: *Phone Number

3. PRE-REQUISITE:

None

4. COURSE DESCRIPTION:

Probability and Mathematical Statistics studies random phenomena and process social-economic data in uncertainty which means in the context of incomplete information.

This subject includes two sections which are structurally independent though tightly connected in term of content.

The first section, Probability, aims to study certain rules of random phenomena. It focuses on direct basis for the analysis and statistical inference in mathematical statistics, and at the same time equips students with knowledge useful for other subjects, namely econometrics, demography, and sociology.

The second section, Mathematical statistics includes: theoretical basis of random samples; the methods of descriptive statistics; and inferential statistics (parameter estimation and statistical hypothesis testing).

5. COURSE OBJECTIVES:

This course provides the basic knowledge of probability theory and mathematical statistics. By the end of the course, students will acquire fundamental knowledge of probability theory and be able to apply this knowledge to solving a real problem in economics and business. Learners are also provided the knowledge of mathematical statistics and the methods to summarize basic characteristics of t

sample data to perform statistical inference for population based on sample data, applying to actual problems in economic and social issues.

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	6	4	2	Projector required
2	Chapter 2	6	4	2	
3	Chapter 3	6	4	2	
4	Chapter 4	4	2	2	
5	Chapter 5	2	1	1	
6	Chapter 6	6	4	2	
7	Chapter 7	6	4	2	
8	Chapter 8	9	6	3	
	Total	45	29	16	

CHAPTER 1– RANDOM EVENT AND PROBABILITY

Chapter 1 introduces the basic concepts of probability theory, including experience, outcome, event, and the concept of probability and probability measure. There are two definitions of probability: classical definition and statistical definition. Chapter 1 introduces the relationship between the events that could be used in analyzing complex events. The probability theorems can be applied to calculate the probability of events easily. The last part of the chapter introduces total probability formula and Bayes theorem.

1.1. Experience and event

1.2. Probability

1.2.1. Classical definition

1.2.2. Statistical definition

1.2.3. Great and small probability principle

1.3. Relationship of events

1.4. Theorem and formula

1.4.1. Union probability theorem

1.4.2. Intersection probability theorem

1.4.3. Bernoulli formula

1.4.4. Total probability and Bayes theorem

Texts and readings:

1 - Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU publisher, Chapter 1.

2 - Paul Newbold, William L. Carlson, Betty Thorne, 2010, *Statistics for Business and Economics*, 7th edition, Pearson. Chapter 3.

CHAPTER 2 – RANDOM VARIABLE AND PROBABILITY DISTRIBUTION

Chapter 2 studies the important and basic concept of the theory of probability and mathematical statistics, random variables, including discrete and continuous variables. The randomness of variables is expressed through probability distribution, including probability distribution table, probability cumulative function, and probability density function. The parameters are summarized information of random variables, measuring central tendency and dispersion, namely expected value, variance, standard deviation, skewness and kurtosis.

2.1. Random variables

2.2. Probability distribution

2.2.1. Probability distribution table

2.2.2. Probability cumulative function

2.2.3. Probability density function

2.3. Parameter

2.3.1. Expected value

2.3.2. Variance and Standard deviation

2.3.3. Median

2.3.4. Mode

2.3.5. Skewness

2.3.6. Kurtosis

Texts and readings:

1 - Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU publisher, Chapter 2, 3.

2 - Paul Newbold, William L. Carlson, Betty Thorne, 2010, *Statistics for Business and Economics*, 7th edition, Pearson. Chapter 4, 5.

CHAPTER 3 – THE COMMON PROBABILITY DISTRIBUTIONS

This chapter studies common probability distribution, applied in many social-economic fields, including two groups of discrete and continuous random variables. For each rule, the probability distribution is presented by probability table, cumulative function and density function, and summarized by parameters of expectation, variance, and standard deviation. Among the distribution, Bernoulli, Binomial and Normal are focused.

- 3.1. Bernoulli distribution - $A(p)$
- 3.2. Binary distribution $B(n,p)$
- 3.3. Poisson distribution $P(\lambda)$
- 3.4. Uniform distribution $U(a,b)$
- 3.5. Normality distribution $N(\mu, \sigma^2)$
 - 3.5.1. Definition
 - 3.5.2. Standardized normality $N(0,1)$
 - 3.5.3. Formula
 - 3.5.4. 3σ rule
 - 3.5.5. Normality approximation
- 3.6. Chi-squared distribution $\chi^2(n)$
- 3.7. Student distribution $T(n)$
- 3.8. Fisher – Snedecor distribution $F(n_1, n_2)$

Texts and readings:

- 1 - Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU publisher, Chapter 3.
- 2 - Paul Newbold, William L. Carlson, Betty Thorne, 2010, *Statistics for Business and Economics*, 7th edition, Pearson. Chapter 4, 5.

CHAPTER 4 – TWO-DIMENSION RANDOM VARIABLE

This chapter studies multivariate random variables, focusing primarily on two-dimensional discrete random variables. The probability distribution of this variable is represented through probability table, marginal and conditional distribution. Besides the basic parameters such as expectations, variance, with two-dimensional random variable with the parameter covariance, coefficient correlation, the basis of econometric courses, is also important for analysis, especially analysis correlation and regression,.

- 4.1. Multi-dimension variable
- 4.2. Probability table for two-dimension discrete variables
 - 4.2.1. Probability table
 - 4.2.2. Marginal probability table
 - 4.2.3. Conditional probability table
- 4.3. Parameters
 - 4.3.1. Expected value and variance
 - 4.3.2. Covariance and correlation coefficient
 - 4.3.3. Conditional expectation and Regression

Texts and readings :

- 1 - Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU Publisher Chapter 4.
- 2 - Tran Trong Nguyen, 2011, Probability Theory , NXB ĐHKQTĐ, Chapter 2, 3.
- 3 - Paul Newbold, William L. Carlson, Betty Thorne, 2010, Statistics for Business and Economics, 7th edition, Pearson. Chapter 4, 5.

CHAPTER 5 – LAW OF LARGE NUMBERS

Chapter 5 introduces some particular theorem in probability and statistics, showing the convergence of probabilities and parameters characteristic of random variables, when they are studied repeatedly and independently. It proves some inequality and meaningful theorem in theoretical analysis which is the basis for the statistics.

- 5.1. Chebysev's inequality
- 5.2. Chebysev's theorem
- 5.3. Bernoulli's theorem
- 5.4. Central limit theorem

Texts and readings:

- 1 - Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU Publisher Chapter 5.
- 2 - Trần Trọng Nguyên, 2011, Lý thuyết xác suất, NXB ĐHKQTĐ, Chapter 5.

CHAPTER 6 – SAMPLE AND SAMPLING

Chapter 6 begins the second part of the chapter, Mathematical statistics. This chapter provides the basic concepts of statistics, population and sample, and the relationship between the two research methods. Population and its parameters are objects of study; samples are taken in order to learn about this information. This chapter analyzes the concept of random samples, observed samples, and statistics. From the study of sampling distribution, the relationship between the statistical characteristics and parameters is specified and applied to inference for sample statistics.

- 6.1. Sampling
- 6.2. Population
 - 6.2.1. Concepts
 - 6.2.2. Population parameters
- 6.3. Random samples
 - 6.3.1. Definition
 - 6.3.2. Sampling method
 - 6.3.3. Sample presentation

6.4. Statistics

6.4.1. Definition

6.4.2. Descriptive statistics

65. Two-dimension sample's statistics

6.6. Sampling distribution

6.6.1. Normality variable

6.6.2. Two normality variable

6.6.3. Distribution of proportion

6.6.4. Distribution of two proportions

6.7. Sampling inference

6.7.1 Acceptance interval for sample mean

6.7.2. Acceptance interval for sample proportion

6.7.3. Acceptance interval for sample variance

Texts and readings:

1 - Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU Publisher, , Chapter 6.

2 - Ngô Văn Thứ, 2010, *Thống kê toán với sự trợ giúp của bảng tính Excel*, NXB ĐHKTQD, Chapter 1.

3 - Paul Newbold, William L. Carlson, Betty Thorne, 2010, *Statistics for Business and Economics*, 7th edition, Pearson. Chapter 6.

CHAPTER 7 – PARAMETER ESTIMATE

Chapter 7 introduces important techniques of statistical inference - parameter estimation. Parameters of random variables in the population are unknown, but could be reflected in the information from the sample. Two types of estimates are point estimates and estimated by confidence intervals, also known as interval estimate. With a point estimate, the unbiased, efficient, consistence property is studied at finding the best estimators. Simultaneously, this chapter also mentions method maximum likelihood estimate, which is widely used in most statistical software. Estimate by confidence interval with given confidence level to the basic parameters of population is studied carefully.

7.1. Point estimate

7.1.1. Concepts

7.1.2. Properties of point estimate

7.1.3. Maximum likelihood estimate

7.2. Confidence interval

7.2.1. Concepts

7.2.2. Confidence interval for mean

7.2.3. Confidence interval for proportion

7.2.4. Confidence interval for variance

Texts and readings:

- 1 - Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU Publisher, , Chapter 7.
- 2 - Ngô Văn Thứ, 2010, *Thống kê toán với sự trợ giúp của bảng tính Excel*, NXB ĐHKQTĐ, Chapter 2.
- 3 - Paul Newbold, William L. Carlson, Betty Thorne, 2010, *Statistics for Business and Economics*, 7th edition, Pearson. Chapter 7, 8.

CHAPTER 8 – HYPOTHESIS TESTING

Chapter 8 introduces the theory of hypothesis testing, an important statistical tool used in the theory verification by empirical. The concept of statistical hypothesis, hypothesis pairs, error type, rejection region, observed value, significance level, power test, probability values are introduced and applied in particular problems. This chapter is divided into parametric testing and non-parametric.

8.1. Basic concepts

- 8.1.1. Statistical hypothesis
- 8.1.2. Hypothesis pair and reject area
- 8.1.3. Types of error
- 8.1.4. Testing rule

8.2. Parametric testing

- 8.2.1. Testing mean
- 8.2.2. Testing two means
- 8.2.3. Testing proportions
- 8.2.4. Testing two proportions
- 8.2.5. Testing r a variance
- 8.2.6. Testing two variances

8.3. Non-parametric testing

- 8.3.1. Chi-squared test
- 8.3.2. Normality test
- 8.3.3. Test the independence of two qualitative signals

Texts and readings:

- 1 - Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU Publisher, , Chapter 8, 9.
- 2 - Ngô Văn Thứ, 2010, *Thống kê toán với sự trợ giúp của bảng tính Excel*, NXB ĐHKQTĐ, Chapter 3, 4.

3 - Paul Newbold, William L. Carlson, Betty Thorne, 2010, *Statistics for Business and Economics*, 7th edition, Pearson. Chapter 9, 10, 14.

7. Textbook

Nguyen Cao Van, Tran Thai Ninh, Ngo Van Thu, 2011, *Probability and Mathematical Statistics*, NEU Publisher .

8. References

1 - Trần Trọng Nguyên, 2011, *Lý thuyết xác suất*, NXB ĐHKQTĐ.

2 - Ngo Van Thu, 2010, *Thống kê toán với sự trợ giúp của bảng tính Excel*, NXB ĐHKQTĐ.

3 - Paul Newbold, William L. Carlson, Betty Thorne, 2010, *Statistics for Business and Economics*, 7th edition, Pearson

9. ASSESSMENT & GRADING POLICY:

- Band score: 10/10 and 4/4

- In which:

+ Class participation: 10%

+ Midterm test: 20%

+ Final Exam: 70%

- Conditions for taking the final test:

+ attend at least 80% of scheduled course hours

+ take the midterm test.

Hanoi, 2016

HEAD OF DEPARTMENT

PRESIDENT

(signed)

(signed)

PhD. Nguyen Manh The

Prof. Dr. Tran Tho Dat