

**MI2020Q****PROBABILITY AND STATISTICS****Version: 2023.1.0****1. GENERAL INFORMATION**

<b>Course ID:</b>	<b>MI2020Q</b>			
<b>Credits:</b>	<b>3</b>			
<b>Workload:</b>	<i>Theory: 30 hrs</i>	<i>Exercise: 30 hrs</i>	<i>Practice: 0 hrs</i>	<i>Self-study: 90 hrs</i>
<b>Prerequisites:</b>	None			
<b>Co-requisites:</b>	None			
<b>Program</b>	Industrial Management			
<b>Level</b>	The second-year student			
<b>Level of using English in teaching</b>	Materials, lecture slides, assignment, in English; Examination in both English and Vietnamese Giving lectures in both English and Vietnamese			

**2. COURSE DESCRIPTION**

The course provides students with the knowledge of probability such as concepts and inference rules for probability as well as random variables and common probability distributions (one-dimensional and two-dimensional); basic concepts of mathematical statistics which help students in dealing with statistical problems in estimation and hypothesis testing. Through the acquired knowledge, students are given a methodology for approaching practical models and finding out an appropriate solution.

**3. COURSE LEARNING OUTCOMES**

<b>Learning Outcomes (LO)</b>	<b>Descriptions</b>	<b>Program Learning Outcomes</b>
<b>M1</b>	<b>Understand and be able to do statistics and probability problems</b>	
M1.1	Capture principal notions and rules of probability, conditional probability, independent events. Apply the total probability formula and Bayes' rule.	[1.1-1.4]
M1.2	Identify discrete and continuous random variables, their probability distribution (mass probability function and density probability function).	[2.1; 2.2]
M1.3	Identify uniform, binomial, Poisson distributions. Determine the critical values for well-known distributions: normal distribution, chi-squared distribution and student t-distribution.	[2.4]
M1.4	Compute the characteristics: mean, variance, covariance, correlation coefficient. Determine marginal distributions. Recognize the independence.	[2.3; 3.1-3.5]
M1.5	Identify the important role of random samples, their characteristics (sample mean, sample variance), particularly of a	[3.6; 4.1; 4.2]

<b>Learning Outcomes (LO)</b>	<b>Descriptions</b>	<b>Program Learning Outcomes</b>
	normal sample. Apply the Central Limit Theorem and Laws of Large Numbers.	
M1.6	Estimate parameters and characteristics using point estimators and confidence intervals.	[4.3; 4.4]
M1.7	Test statistical hypotheses, explain the probability of type I and type II errors.	[5.1-5.3]
<b>M2</b>	<b>Apply statistics and probability knowledge to modeling and analysis</b>	
M2.1	Understand and apply statistics and probability to analysis and create some models in real problems	[1.1-1.4; 2.1-2.4; 3.1-3.5; 4.1-4.4; 5.1-5.3]
M2.2	Recognize simple statistical models and applied them to solve engineering problems	[4.1-4.4; 5.1-5.4]
M2.3	Understand and apply to reading specialized materials	[1.1-1.4; 2.1-2.4; 3.1-3.5; 4.1-4.4; 5.1-5.3]
<b>M3</b>	<b>Capacity to synthesize and present a statistics and probability problem as well as understanding responsibility and professional ethics</b>	
M3.1	Capacity to work in groups, write reports and present presentations on the results of homework	[1.1-1.4; 2.1-2.4; 3.1-3.5; 4.1-4.4; 5.1-5.3]
M3.2	Understanding responsibilities, professional ethics	

#### 4. CONTENTS

Random event and probability calculation, random variables, probability distributions, random vectors, statistical estimation theory, statistical decision theory.

#### 5. TEXTBOOK AND REFERENCES

##### *Textbooks*

- [1] Walpole R.E, Myers R.H, Myers S.L, Ye K. (2011). *Probability & Statistics for Engineers and Scientists*. Prentice-Hall (ninth edition).
- [2] Applied Mathematics Department (2023). *Workbook*. Instituted Materials.

##### *References*

###### Vietnamese References

- [1] Tong Dinh Quy (2009). *Course of Probability and Statistics*. Bach Khoa Publication.

###### English References

- [2] R.A. Johnson (2005). *Probability & Statistics for Engineers*. Person Education, Inc., 2005.
- [3] R.E. Walpole, R.H. Myers, S.L. Myers, K. Ye (2011). *Probability & Statistics for Engineers and Scientists*. Prentice-Hall (ninth edition).
- [4] W. Feller (1971). *An introduction to Probability theory and its applications*. John

Wiley &amp; Sons Publisher.

## 6. EVALUATIONS

The overall grade of the course is evaluated throughout the learning process, including three main points: the attendance score (20%), the midterm test score (30%), and the final exam score (50%).

Assessment Component	Criteria	Assessment Forms	Course Learning Outcomes	Weight
<b>A1. Attendance Score</b>	Student attitude and diligence	Student diligence	<b>M1, M2, M3</b>	<b>20%</b>
<b>A2. Midterm Test Score (*)</b>	<b>A2.1. Midterm Test 1</b> (MTS1, 15 core scale; Content: From week 1 to week 5)	Multiple choice questions	M1.1-M1.2, M2.1	<b>30%</b>
	<b>A2.2. Midterm Test 2</b> (MTS2, 15 core scale; Content: From week 6 to week 10)		M1.2-M1.5, M2.1	
<b>A3. Final Exam Score</b>	Final Exam	Writing	M1, M2.1	<b>50%</b>

(\*) The midterm test score (MTS) is calculated according to the formula  $MTS = 1/3 (MTS1 + MTS2)$  and will be adjusted by adding active learning points. Active learning points are worth from  $-1$  to  $+1$ , according to the Higher Education Regulations of Hanoi University of Science and Technology.

## 7. TEACHING PLAN

Week	Topics	LO	Teaching & Learning Activities	Assessment
[1]	[2]	[3]	[4]	[5]
1	<b>Chapter 1: Random Event and Probability Calculator</b> <b>1.1. Basic Notions</b> 1.1.1. Events and Sample space 1.1.2. Events relation (Union, Intersection, Mutually exclusive events, Complement, Mutually exclusive and exhaustive events) 1.1.3. Methods of Counting (Multiplication Rule, Permutation, Combination, Repeated permutation) <b>Problems - Chapter 1</b>	M1.1 M2.1 M2.3 M3.1 M3.2	<b>Teacher:</b> - Giving lectures - Providing lecture notes, assignments - Leading discussions <b>Student in class:</b> - Participating class activities - Answering questions <b>Student at home:</b> - Reading documents - Do homework	A1 A2.1 A3
2	<b>1.2. Probability of an Event</b> 1.2.1. Theoretical Probability Definition 1.2.2. Geometric Probability 1.2.3. Empirical Probability <b>Problems - Chapter 1</b>	M1.1 M2.1 M2.3 M3.1 M3.2	<b>Teacher:</b> - Giving lectures - Providing lecture notes, assignments - Leading discussions <b>Student in class:</b>	A1 A2.1 A3

Week	Topics	LO	Teaching & Learning Activities	Assessment
[1]	[2]	[3]	[4]	[5]
3	<b>1.3. Additive and the Multiplicative Rules</b> 1.3.1. Conditional Probability 1.3.2. Additive Rules. The Multiplicative Rules 1.3.3. Bernoulli Trial Calculator <b>Problems - Chapter 1</b>	M1.1 M2.1 M2.3 M3.1 M3.2	- Participating class activities - Answering questions <b>Student at home:</b> - Reading documents - Do homework	A1 A2.1 A3
4	<b>1.4. Bayes' Theorem</b> 1.4.1. Total Probability 1.4.2. Bayes' Rule <b>Problems - Chapter 1</b>	M1.1 M2.1 M2.3 M3.1 M3.2		A1 A2.1 A3
5	<b>Chapter 2. Random Variables and Probability Distributions</b> <b>2.1. Random Variables</b> 2.1.1. Concept of a Random Variable 2.1.2. Types (Discrete Random Variables, Continuous Random Variables) <b>2.2. Probability Distributions</b> 2.2.1. Probability Mass Functions. Probability Distribution (The Discrete Case) 2.2.2. Cumulative Distribution Function <b>Problems - Chapter 2</b>	M1.2 M1.4 M2.1 M2.3 M3.1 M3.2	<b>Teacher:</b> - Giving lectures - Providing lecture notes, assignments - Leading discussions <b>Student in class:</b> - Participating class activities - Answering questions <b>Student at home:</b> - Reading documents - Do homework	A1 A2.1 A3
6	2.2.3. Probability Density Function (The Continuous Case) <b>2.3. Mathematical Expectations</b> 2.3.1. Expected of a Random Variable 2.3.2. Variance and Standard Deviation of a Random Variable <b>Problems - Chapter 2</b>	M1.2 M1.4 M2.1 M2.3 M3.1 M3.2		A1 A2.2 A3
7	<b>2.4. Important Probability Distributions</b> 2.4.1. Uniform Distribution 2.4.2. Binomial Distribution 2.4.3. Poisson Distribution <b>Problems - Chapter 2</b>	M1.3 M2.1 M2.3 M3.1 M3.2	<b>Teacher:</b> - Giving lectures - Providing lecture notes, assignments - Leading discussions <b>Student in class:</b>	A1 A2.2 A3

Week	Topics	LO	Teaching & Learning Activities	Assessment
[1]	[2]	[3]	[4]	[5]
8	2.4.4. Exponential Distribution 2.4.5. Normal Distribution 2.4.6. Chi-Square Distribution 2.4.7. Student's t-Distribution <b>Problems - Chapter 2</b>	M1.3 M2.1 M2.3 M3.1 M3.2	- Participating class activities - Answering questions <b>Student at home:</b> - Reading documents - Do homework	A1 A2.2 A3
9	<b>Chapter 3. Pairs of Random Variables</b> <b>3.1. Pairs of Random Variables and Joint Probability Distributions</b> 3.1.1. The Discrete Case 3.1.2. The Continuous Case <b>3.2. Marginal Distributions</b> 3.2.1. The Discrete Case 3.2.2. The Continuous Case <b>3.3. Conditional Distributions</b> 3.3.1. The Discrete Case 3.3.2. The Continuous Case <b>3.4. Independence</b> <b>Problems - Chapter 3</b>	M1.4 M2.1 M2.3 M3.1 M3.2	<b>Teacher:</b> - Giving lectures - Providing lecture notes, assignments - Leading discussions <b>Student in class:</b> - Participating class activities - Answering questions <b>Student at home:</b> - Reading documents - Do homework	A1 A2.2 A3
10	<b>3.4. Functions of Two Random Variables</b> <b>3.5. Covariance and Correlation</b> <b>3.6. Law of Large Numbers and Central Limits Theorem</b> 3.6.1. Chebyshev's Theorem 3.6.2. Law of Large Numbers 3.6.3 Central Limits Theorem <b>Problems - Chapter 3</b>	M1.4 M1.5 M2.1 M2.3 M3.1 M3.2		A1 A2.2 A3

Week	Topics	LO	Teaching & Learning Activities	Assessment
[1]	[2]	[3]	[4]	[5]
11	<p><b>Chapter 4. Sampling Distributions and Estimation of Parameters</b></p> <p><b>4.1. Introduction to Sampling Theory</b></p> <p>4.1.1. Population and Samples</p> <p>4.1.2. Sample Mean</p> <p>4.1.3. Sample Variance and Sample Standard Deviation</p> <p><b>4.2. Random Sampling</b></p> <p>4.2.1. Sampling Distribution of the Sample Mean</p> <p>4.2.2. Sampling Distribution of the Sample Variance</p> <p>4.2.3. Sampling Distribution of Sample Proportions</p> <p><b>4.3. Point Estimate</b></p> <p>4.3.1. Classical Methods of Estimation</p> <p>4.3.2. Properties of Point Estimators</p> <p><b>Problems - Chapter 4</b></p> <hr/> <p><i>An Introduction to Statistical Modelling</i></p>	<p>M1.5</p> <p>M2.1</p> <p>M2.2</p> <p>M2.3</p> <p>M3.1</p> <p>M3.2</p>	<p><b>Teacher:</b></p> <ul style="list-style-type: none"> <li>- Giving lectures</li> <li>- Providing lecture notes, assignments</li> <li>- Leading discussions</li> </ul> <p><b>Student in class:</b></p> <ul style="list-style-type: none"> <li>- Participating class activities</li> <li>- Answering questions</li> </ul> <p><b>Student at home:</b></p> <ul style="list-style-type: none"> <li>- Reading documents</li> <li>- Do homework</li> </ul>	<p>A1</p> <p>A2</p> <p>A3</p>
12	<p><b>4.4. Confidence Interval</b></p> <p>4.4.1. Interval Estimation</p> <p>4.4.2. Confidence Interval for Population Mean</p> <p>4.4.3. Confidence Interval for Population Proportion</p> <p><b>Problems - Chapter 4</b></p>	<p>M1.6</p> <p>M2.1</p> <p>M2.2</p> <p>M3.1</p> <p>M3.2</p>	<p><b>Teacher:</b></p> <ul style="list-style-type: none"> <li>- Giving lectures</li> <li>- Providing lecture notes, assignments</li> <li>- Leading discussions</li> </ul> <p><b>Student in class:</b></p> <ul style="list-style-type: none"> <li>- Participating class activities</li> </ul>	<p>A1</p> <p>A2</p> <p>A3</p>
13	<p><b>Chapter 5. Hypothesis Testing</b></p> <p><b>5.1. Introduction to Hypothesis Testing</b></p> <p>5.1.1. Statistical Hypothesis</p> <p>5.1.2. Testing a Statistical Hypothesis</p> <p><b>5.2. Hypothesis Tests for One-Sample</b></p> <p>5.2.1. Hypothesis Test for one Population Mean (Large-Sample and Small-Sample)</p> <p><b>Problems - Chapter 4</b></p>	<p>M1.7</p> <p>M2.1</p> <p>M2.2</p> <p>M3.1</p> <p>M3.2</p>	<ul style="list-style-type: none"> <li>- Answering questions</li> </ul> <p><b>Student at home:</b></p> <ul style="list-style-type: none"> <li>- Reading documents</li> <li>- Do homework</li> </ul>	<p>A1</p> <p>A2</p> <p>A3</p>

Week	Topics	LO	Teaching & Learning Activities	Assessment
[1]	[2]	[3]	[4]	[5]
14	5.2.2. Hypothesis Test for one Population Proportion (Large-Sample) <b>5.3. Hypothesis Tests for Two-Sample</b> 5.3.1. Hypothesis Test for the Difference of Two Population Proportions (Large-Sample and Small-Sample) 5.3.2. Hypothesis Test for the Difference of Two Population Proportions (Large-Sample) <b>Problems - Chapter 5</b>	M1.7 M2.1 M2.2 M3.1 M3.2	<b>Teacher:</b> - Giving lectures - Providing lecture notes, assignments - Leading discussions <b>Student in class:</b> - Participating class activities - Answering questions <b>Student at home:</b> - Reading documents - Do homework	A1 A2 A3
15	<b>Revision</b> <b>Problems - Chapter 5</b>	M1.7 M2.1 M2.2 M2.3 M3.1 M3.2		A1 A2 A3
	<i>An Introduction to Statistical Modelling</i>			

## 8. COURSE POLICIES

- Students are expected to follow the regulations of Hanoi University of Technology and School of Economics and Management
- For any cheating during the exam or exercise, students must be disciplined by the school and get 0 points for the course.

## 9. APPROVAL DATE:

**Chairman**

**Instructor**

## 10. UPDATES

No.	Adjustments	Approval Date	Time application	Note
1				
2				