MI2020Q **PROBABILITY AND STATISTICS**

Version: 2024.1.0

1. GENERAL INFORMATION

Course ID:	**MI2020Q**			
Credits:	**3**			
Workload:	*Theory:* 30 hrs	*Exercise*: 30 hrs	*Practice:* 0 hrs	*Self-study:* 90 hrs
Prerequisites:	None			
Co-requisites:	None			
Program	Industrial Management			
Level	The second-year student			
Level of using English in teaching	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 an appropriate solution.

3. COURSE LEARNING OUTCOMES

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

Learning Outcomes (LO)	Descriptions	Program Learning Outcomes
	Large Numbers.	
M1.6	Estimate parameters and characteristics using point estimators and confidence intervals.	[4.3; 4.4]
M1.7	Test statistical hypotheses, and explain the probability of type I and type II errors.	[5.1-5.3]
M2	**Apply statistics and probability knowledge to modeling and analysis**	
M2.1	Understand and apply statistics and probability to analyze and create some models for 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 apply 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]
M3	**Capacity to synthesize and present a statistics and probability problem as well as understanding responsibility and professional ethics**	
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, and 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).

References

Vietnamese References

[1] Faculty of Mathematics and Informatics (2024). *Workbook*. Instituted Materials.

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

English References

[3] R.A. Johnson (2005). *Probability & Statistics for Engineers*. Person Education, Inc., 2005.

[4] R.E. Walpole, R.H. Myers, S.L. Myers, K. Ye (2011). *Probability & Statistics for Engineers and Scientists.* Prentice-Hall (ninth edition).

[5] W. Feller (1971). *An introduction to Probability theory and its applications*. John Wiley & 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
A1. Process Score				**50%**
A1.1. Attendance Score	Student attitude and diligence	Student diligence	**M1, M2, M3**	20%
A1.2. Midterm Test Score (*)	**A1.2.1. Midterm Test 1** (MTS1, 15 core scale; Content: From week 1 to week 5)	Multiple choice questions; Fill in the blanks with correct answers	M1.1-M1.2, M2.1	30%
	A1.2.2. Midterm Test 2 (MTS2, 15 core scale; Content: From week 6 to week 10)		M1.2-M1.5, M2.1	
A2. Final Exam Score	Final Exam	Writing	M1, M2.1	**50%**

(*) *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	**Chapter 1: Random Event and Probability Calculator** **1.1. Basic Notions** 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) **Problems - Chapter 1**	M1.1 M2.1 M2.3 M3.1 M3.2	**Teacher:** - Giving lectures - Providing lecture notes, assignments - Leading discussions **Student in class**: - Participating in class activities - Answering questions **Student at home**: - Reading documents - Do homework	A1.1 A1.2.1 A2
2	**1.2. Probability of an Event** 1.2.1. Theoretical Probability Definition 1.2.2. Geometric Probability 1.2.3. Empirical Probability **Problems - Chapter 1**	M1.1 M2.1 M2.3 M3.1 M3.2	**Teacher:** - Giving lectures - Providing lecture notes, assignments - Leading discussions **Student in class**:	A1.1 A1.2.1 A2

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

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 **Problems - Chapter 2**	M1.3 M2.1 M2.3 M3.1 M3.2	- Participating in class activities - Answering questions **Student at home**: - Reading documents - Do homework	A1.1 A1.2.2 A2
9	**Chapter 3. Pairs of Random Variables** **3.1. Pairs of Random Variables and Joint Probability Distributions** 3.1.1. The Discrete Case 3.1.2. The Continuous Case **3.2. Marginal Distributions** 3.2.1. The Discrete Case 3.2.2. The Continuous Case **3.3. Conditional Distributions** 3.3.1. The Discrete Case 3.3.2. The Continuous Case **3.4. Independence** **Problems - Chapter 3**	M1.4 M2.1 M2.3 M3.1 M3.2	**Teacher:** - Giving lectures - Providing lecture notes, assignments - Leading discussions **Student in class**: - Participating in class activities - Answering questions **Student at home**: - Reading documents - Do homework	A1.1 A1.2.2 A2
10	**3.4. Functions of Two Random Variables** **3.5. Covariance and Correlation** **3.6. Law of Large Numbers and Central Limits Theorem** 3.6.1. Chebyshev’s Theorem 3.6.2. Law of Large Numbers 3.6.3 Central Limits Theorem **Problems - Chapter 3**	M1.4 M1.5 M2.1 M2.3 M3.1 M3.2		A1.1 A1.2.2 A2

Week	Topics	LO	Teaching & Learning Activities	Assessment
[1]	[2]	[3]	[4]	[5]
11	**Chapter 4. Sampling Distributions and Estimation of Parameters** **4.1. Introduction to Sampling Theory** 4.1.1. Population and Samples 4.1.2. Sample Mean 4.1.3. Sample Variance and Sample Standard Deviation **4.2. Random Sampling** 4.2.1. Sampling Distribution of the Sample Mean 4.2.2. Sampling Distribution of the Sample Variance 4.2.3. Sampling Distribution of Sample Proportions **4.3. Point Estimate** 4.3.1. Classical Methods of Estimation 4.3.2. Properties of Point Estimators **Problems - Chapter 4** *An Introduction to Statistical Modelling*	M1.5 M2.1 M2.2 M2.3 M3.1 M3.2	**Teacher:** - Giving lectures - Providing lecture notes, assignments - Leading discussions **Student in class**: - Participating in class activities - Answering questions **Student at home**: - Reading documents - Do homework	A1 A2
12	**4.4. Confidence Interval** 4.4.1. Interval Estimation 4.4.2. Confidence Interval for Population Mean **Problems - Chapter 4**	M1.6 M2.1 M2.2 M3.1 M3.2	**Teacher:** - Giving lectures - Providing lecture notes, assignments - Leading discussions **Student in class**: - Participating in class activities - Answering questions **Student at home**: - Reading documents - Do homework	A1 A2
13	4.4.3. Confidence Interval for Population Proportion **Problems - Chapter 4** **Chapter 5.** Hypothesis Testing **5.1.** Introduction to Hypothesis Testing 5.1.1. Statistical Hypothesis 5.1.2. Testing a Statistical Hypothesis	M1.6 M2.1 M2.2 M3.1 M3.2		A1 A2
13	**5.2.** Hypothesis Tests for One-Sample 5.2.1. Hypothesis Test for one Population Mean (Large-Sample and Small-Sample) 5.2.2. Hypothesis Test for one Population Proportion (Large-Sample) **Problems - Chapter 5**	M1.7 M2.1 M2.2 M3.1 M3.2		A1 A2 A3

Week	Topics	LO	Teaching & Learning Activities	Assessment
[1]	[2]	[3]	[4]	[5]
15	**5.3. Hypothesis Tests for Two-Sample** 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) **Problems - Chapter 5**	M1.7 M2.1 M2.2 M3.1 M3.2	**Teacher:** - Giving lectures - Providing lecture notes, assignments - Leading discussions **Student in class**: - Participating in class activities - Answering questions **Student at home**: - Reading documents - Do homework	A1 A2
16	**Revision**			A1 A2

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. DATE OF APPROVAL:

Faculty of Mathematics and Informatics