"APPROVED"

Vice-Rector for Educational and Methodical Work

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Karina NEMASHKALO

PROBABILITY THEORY AND MATHEMATICAL STATISTICS

syllabus of the academic discipline

Training direction	**07 Management and administration**
Speciality	**073 Management**
Academic degree	**first (bachelor)**
Academic program	**Management of innovative activity**

Status of the academic discipline	**Compulsory**
Language of teaching, training and assessment	**English**

Chief of the department of
Higher mathematics and
economic mathematical methods   **Lyudmyla MALYARETS**

Kharkiv
2022

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ ЕКОНОМІЧНИЙ УНІВЕРСИТЕТ
ІМЕНІ СЕМЕНА КУЗНЕЦЯ

"ЗАТВЕРДЖУЮ"
Проректор з навчально-методичної роботи

_____

Каріна НЕМАШКАЛО

___ ТЕОРІЯ ЙМОВІРНОСТЕЙ ТА МАТЕМАТИЧНА СТАТИСТИКА ___
робоча програма навчальної дисципліни

Галузь знань   **07 Управління та адміністрування**
Спеціальність   **073 Менеджмент**
Освітній рівень   **перший (бакалаврський)**
Освітня програма   **Менеджмент інноваційної діяльності**

Статус дисципліни   *обов'язкова*
Мова викладання, навчання та оцінювання   *англійська*

Завідувач кафедри
вищої математики та
економіко-математичних методів   _____   Людмила МАЛЯРЕЦЬ

Харків
2022

APPROVED
at the meeting of the department of Higher mathematics and
economic mathematical methods
Protocol № 1 dated 31.08.2022

Compiled by:
Ie. Misiura, PhD, Associate professor of the department of
Higher mathematics and economic mathematical methods;

Sheet of renewal and re-approval of the academic discipline syllabus

Academic year	Date of the department meeting – the developer of syllabus of the academic discipline	Protocol number	Signature of chief of the department

The annotation of the academic discipline

The fundamental base in the mathematical preparation of economists and managers is the academic discipline "Probability theory and mathematical statistics" which is a compulsory discipline of the natural scientific series and the component of the structural logical scheme which is provided for the educational professional program of bachelors of speciality 073 "Management".

The basic problems of teaching the academic discipline is giving students knowledge of the basic parts of probability theory and mathematical statistics; a rising of the level of the fundamental mathematical training of students with intensification of its applied direction, mastering the fundamentals of probability theory and mathematical statistics and application of this knowledge to the economic investigations for solving economic problems, forming skills in application of probability theory and mathematical statistics in investigations where probability theory and mathematical statistics is applied as instrument of investigation and solving optimization economic problems for forming models of economic processes and developments, acquiring the necessary theoretical and practical knowledge for solving specific problems, which are set in the process of forming economic and mathematical models, and the obtaining the required mathematical knowledge for the study of other disciplines. A modern tendency in higher education is a reorientation of students of higher educational institutions from a process of education to a result, from knowledge to skills, forming definite competences.

The main purpose of teaching is to form a holistic system of theoretical knowledge of the mathematical apparatus of probability theory and mathematical statistics, which helps to model, analyze and solve economic problems, master mathematical methods that allow to study and predict processes and phenomena in the future professional activity of students. and algorithmic thinking, the formation of skills and abilities of independent research of economic problems, the development of the desire for scientific search for ways to improve their work.

The characteristics of the academic discipline:

Academic year	**1st**
Term	**2nd**
Number of credits	**5**
Form of the final control	**exam**

Structural and logical scheme of studying the academic discipline:

Prerequisites	Post-requisites
Higher mathematics	Course work: Planning and organization of an enterprise activity

Competences and the results of mastering the academic discipline:

General competences (GC) / Professional competences (PC)	Learning outcomes (LO)
PC7 (CK7). An ability to choose and use modern management tools.	LO3 (PH3). Demonstrate knowledge of theories, methods and functions of management, modern concepts of leadership.
GC4 (3K4). An ability to apply knowledge in practical situations.	LO4 (PH4). Demonstrate skills in defining problems and a justification of management decisions.
GC8 (3K8). Skills in the use of information and communication technologies.	LO6 (PH6). Demonstrate skills of a search, a collection and an analysis of information, a calculation of indicators to justify management decisions
PC2 (CK2) Ability to analyze the results of an activity of the organization, compare them with the factors of external and internal influences	LO7 (PH7). Demonstrate skills of an organizational design

environment	
PC18 (CK18). An ability to identify types of scientific and technical programs in the field of an innovation.	LO8 (PH8). Apply management methods to ensure the effectiveness of the organization.
GC3 (ЗК3). An ability to an abstract thinking, an analysis, a synthesis. GC4 (ЗК4). An ability to apply knowledge in practical situations. GC8 (ЗК8). Skills in the use of information and communication technologies.	LO11 (PH11). Demonstrate skills of a situation analysis and a communication in various areas of the organization
GC3 (ЗК3). An ability to an abstract thinking, an analysis, a synthesis.	LO16 (PH16). Demonstrate skills of an independent work, a flexible thinking, an openness to new knowledge, be critical and self-critical
GC10 (ЗК10). An ability to conduct research at the appropriate level	LO17 (PH17). Carry out research individually and / or in a group under the guidance of a leader

*СК – спеціальні (фахові) компетентності, ЗК – загальні компетентності, РН – результати навчання

The syllabus of the academic discipline
The themes of lectures

Content module 1. Probability Theory
Theme 1. Empirical and logical foundations of probability theory. Basic theorems of probability theory, their economic interpretation.
Theme 2. Scheme of independent trails.
Theme 3. Distribution laws and numerical characteristics of a discrete random variable.
Theme 4. Distribution laws and numerical characteristics of a continuous random variable.

Content module 2. Mathematical Statistics
Theme 5. Primary processing of statistical data. Statistical estimations of parameters of a distribution.
Theme 6. Testing statistical hypotheses
Theme 7. Elements of variance analysis
Theme 8. Elements of correlation theory. Elements of regression theory

The list of practical and laboratory studies, as well as questions and tasks for an independent work is given in the table "Rating-plan of the discipline".

Methods of study and teaching

To intensify the process of teaching the academic discipline "Probability theory and mathematical statistics" the following educational technologies are applied mini-lectures, work in small groups, brainstorms, computer simulation (games), presentations and problem lectures.

A computer simulation (game) is an education method, which is based on the use of a spesific computer program in order to get visual modelling of a process. Students can change the parameters and data, decisions and analyze the results of such decisions. The purpose of using this method is the development of systematic thinking of students, their ability to plan, form skills to identify and analyze problems, compare and estimate alternatives, make optimal decisions and work under the condition of a limited time (*themes:* 1 – 8).

Mini-lectures provide for the delivery the educational material during a short-length segment of time and they are characterized by a significant content, complexity of logical constructions, forms, proofs and generalizations. They are conducted, as a rule, as a part of a study-investigation. Mini-lectures differ from full-size lectures by a shorter duration. Usually, they last no more than 10 – 15

minutes and they are used in order to give briefly new information for all students. Mini lectures are often used as parts of a whole theme, which it is desirable to teach as a full-size lecture in order to avoid the audience's getting tired. Then the information is given by turn as several particular fragments, between them other forms and methods of study are used (*themes:* 1, 5, 8).

Work in small groups gives an opportunity to structure practical studies in the form and content, gives a possibility for each student's partaking in the work on the theme under study, stimulates forming personal qualities and experience of social communication (*themes:* 2 – 7).

Brainstorming is a method of solving urgent tasks, its core lies in expressing as many ideas as possible in a short period of time, discussing and selecting them (*themes:* 1, 5, 8).

Presentations are speeches to students which are used for presenting certain achievements, group work results, reports of individual task fulfillment, instruction, demonstration of new goods and services (*themes:* 1 – 8).

Problem lectures are directed at the development of students' logical thinking. The theme is confined to two or three key issues, students' attention is concentrated on the material which has not been represented in textbooks, the experience of foreign educational universities is used with handing out printed materials to students during the lecture and drawing basic conclusions as to the issues considered. In the course of lectures students are asked questions for independent reflection which a lecturer answers himself, without waiting for students' answers. This kind of system makes students concentrate and begin to actively think in search of a correct answer (*themes:* 1 – 8).

The order of assessment of studying results

The system of assessment of competences which were formulated for a student during the learning of the academic discipline, takes into consideration the forms of studies which according to the syllabus of the academic discipline provide lectures, practical studies, laboratory works, fulfillment of students' independent work. The assessment of the formed competences of students is carried out on the accumulative 100-point system. Control ways include:

current control which is carried out within a term during lectures, practical studies and laboratory works and it is assessed as a sum of accumulative points (the maximum equals 60 points; the minimum which makes it possible for a student to pass an exam, equals 35 points);

module control which is carried out in the form of a colloquium with taking into account the current control according to a corresponding thematic module, provides an integral assessment of student's results after learning the material of a logically completed part of the discipline (or a thematic module);

final/term control, which is carried out as a terminal exam, according to the schedule of the educational process.

Current control on the given academic discipline is carried out in the following forms: homework; defence of laboratory works; a written test; an independent creative work, a colloquium.

The total number of points is 60, which are distributed as lectures (including 2 colloquiums (12 points) and one independent creative task (6 points), practical studies (including 2 written tests (12 points) and homework (14 points)) and laboratory studies (including 8 laboratory works (16 points)).

Final/term control is conducted in the form of a term exam. **Term exams** are a form of assessment of students' final mastery of the theoretical and practical material of a particular module of the academic discipline or the academic discipline on the whole, which is conducted as a test.

Assessment of student's knowledge during practical studies and carrying out laboratory works is conducted on the accumulative system according to the following criteria: understanding, the degree of the mastery of the theory and methodology of problems which are considered; the degree of the mastery of the factual material of the academic discipline; familiarizing with the recommended literary sources and modern literature on the questions which are considered; the ability to connect theory and practice in the consideration of particular examples, solving problems, carrying out laboratory works, carrying out calculations in the process of doing homework and tasks which are considered in class; the logic, structure, style of presenting the material in written works and in oral answers in class, the

ability to ground one's position, carry out generalization of the information and draw conclusions.

The general criteria for the assessment of **independent work** of students are profound and deep of knowledge, the level of thinking, skills in systematization knowledge on particular themes, skills in drawing conclusions, attainments and techniques of carrying out practical tasks, the ability to find necessary information, carry out its classification and processing, self-realization in practical and laboratory studies.

The criteria for assessment of independent creative work and independent tests are: the ability to carry out a critical and an independent estimation of the defined problem questions; skills in the explanation of alternative views and availability of a students' own point of view, position on the defined problem question; using the analytical approach; the quality and accuracy of expressing the thought; the logic, structure and explanation of conclusions about a particular problem; independence of carrying out of the work; grammatical correctness of the presentation of the material; using the methods of comparison, generalization of the concepts and facts; the design of the work; the quality of presentation.

Independent work is a scheduled educational and scientific work which is carried out on a lecture task under the methodical and scientific guidance of a lecturer, it is a specific form of the educational activity, its main objective is forming independence of a person.

The educational time, which is intended for students' independent work of the day-time form of education, is defined according to the educational plan and makes 68 % (102 hours) out of the total educational time for learning the discipline.

During independent work a student becomes an active participant in the educational process, learns to master consciously theoretical and practical knowledge, orientates easily in the information space, has to take responsibility for the quality of his own professional training.

The necessary element of successful mastery of the material of the academic discipline is the students' independent work with specifical literature of the mathematical and economic direction.

The final control (the exam) of knowledge and competences of students on the academic discipline is carried out on the base of the term exam. The examination paper includes the syllabus of the discipline and provides for assessment of the knowledge level and a degree of the mastery of corresponding competences of students.

The purpose of the exam is to test student's understanding of the syllabus material on the whole, the logic and relations between its particular parts, the skills in the creative use of the stored knowledge, the ability to formulate one's attitude to a particular problem of the academic discipline and so on. The competent approach to the assessment of the exam implies measuring the level of the student's mastery of the competences provided by the qualifying requirements.

Each examination paper contains 5 practical tasks, including two first-level (diagnostic) tasks, two second level (situational) tasks and one third level (heuristic) task.

The assessment of the exam is carried out according to the temporary provision "About the Order of Assessment of Students' Academic Performance on the Accumulative Point Rating System" of Simon Kuznets Kharkiv National University of Economics.

A student can't be allowed to take the exam, if the number of points, obtained during the current and module control according to the thematic module during the term, does not make 35 points. After the examination period the dean of the department gives a notice about sitting the failed exams. In a given period the student adds the required points.

In the case of irreproachable fulfillment of all the examination tasks with the demonstration of deep knowledge of the academic discipline, skills in the practical use of the formed competences which are based on the ability to analyze and solve a wide range of tasks, a high level of completing the written work the student obtains 40 points.

It should be assessed student's progress, if a sum of points, obtained as the total result of an assessment by all forms of a control, equals or exceeds 60. Accordingly the minimal possible quantity of points by a current and a module control during a term equals 35 and the minimal possible quantity of points, obtained on an exam, equals 25.

The result of a terminal exam is assessed in points (the maximum is 40 points, the minimum of a quantity, which is passed, equals 25 points) and it is entered into the corresponding column of an

examination «Mark sheet».

The final mark of the academic discipline is calculated according to the points obtained during the exam and points obtained during the current control on the accumulative system.

The total result in points during the term is "*60 and more points mean passed*", "*59 and less points mean failed*" and it is entered into the "*Mark sheet*" on the academic discipline.

Rating-plan of the academic discipline

Theme	Forms and types of study		Forms of assessment	Maxi-mal point
1	**2**		**3**	**4**
Theme 1	*Class work*			
	Lecture	**Lecture 1.** Empirical and logical foundations of probability theory. Basic theorems of probability theory, their economic interpretation.		
	Practical study	**Practical study 1.** Empirical and logical foundations of probability theory. Basic theorems of probability theory, their economic interpretation.		
	Laboratory study	**Laboratory work 1.** Empirical and logical foundations of probability theory. Basic theorems of probability theory, their economic interpretation.	laboratory work	2
	Independent work			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 2	*Class work*			
	Lecture	**Lecture 2.** Scheme of independent tests.		
	Practical study	**Practical study 2.** Scheme of independent trails.		
	Laboratory study	**Laboratory work 2.** Scheme of independent trails.	laboratory work	2
	Independent work			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 3	*Class work*			
	Lecture	**Lecture 3.** Distribution laws and numerical characteristics of a discrete random variable		
	Practical study	**Practical study 3.** Distribution laws and numerical characteristics of a discrete random variable		
	Laboratory study	**Laboratory work 3.** Distribution laws and numerical characteristics of a discrete random variable	laboratory work	2
	Independent work			
	Questions and	Search, choice and looking through literary	homework	2

	tasks to self-study	sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work. Preparation for a written test		
Theme 4	*Class work*			
	Lecture	**Lecture 4.** Distribution laws and numerical characteristics of a continuous random variable.	colloquium	6
	Practical study	**Practical study 4.** Distribution laws and numerical characteristics of a continuous random variable.	written test	6
	Laboratory study	**Laboratory work 4.** Distribution laws and numerical characteristics of a continuous random variable.	laboratory work	2
	Independent work			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 5	*Class work*			
	Lecture	**Lecture 5.** Primary processing of statistical data. Statistical estimations of parameters of a distribution.		
	Practical study	**Practical study 5.** Primary processing of statistical data. Statistical estimations of parameters of a distribution.		
	Laboratory study	**Laboratory work 5.** Primary processing of statistical data. Statistical estimations of parameters of a distribution.	laboratory work	2
	Independent work			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 6	*Class work*			
	Lecture	**Lecture 6.** Testing statistical hypotheses		
	Practical study	**Practical study 6.** Testing statistical hypotheses		
	Laboratory study	**Laboratory work 6.** Testing statistical hypotheses	laboratory work	2
	Independent work			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 7	*Class work*			
	Lecture	**Lecture 7.** Elements of variance analysis	independent creative task	6
	Practical study	**Practical study 7.** Elements of variance analysis		
	Laboratory	**Laboratory work 7.** Elements of variance	laboratory	2

		study	analysis	work	
	Independent work				
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 8	*Class work*				
	Lecture	**Lecture 8.** Elements of correlation theory. Elements of regression theory	colloquium	6
	Practical study	**Practical study 8.** Elements of correlation theory. Elements of regression theory	written test	6
	Laboratory study	**Laboratory work 8.** Elements of correlation theory. Elements of regression theory	laboratory work	2
	Independent work				
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.		
	Exam			40

Recommended reading

Main

1. Теорія ймовірностей та математична статистика : практикум [Електронний ресурс] / Е. Ю. Железнякова, Л. О. Норік ; Харківський національний економічний університет ім. С. Кузнеця. – Електрон. текстові дані. (9,34 МБ). - Харків : ХНЕУ ім. С. Кузнеця, 2019. – 320 с.

2. Лабораторний практикум із навчальної дисципліни «Теорія ймовірностей та математична статистика» : навч. посіб. / Е. Ю. Железнякова, І. Л. Лебедєва, Л. О. Норік, К. В. Стєпанова – Харків : ХНЕУ ім. С. Кузнеця, 2016. – 184 с.

3. Теорія ймовірностей та математична статистика : мультимедійні методичні рекомендації до самостійної роботи з теми «Схема незалежних випробувань. Закони розподілу та числові характеристики дискретної випадкової величини» / Уклад. Е. Ю. Железнякова, І. Л. Лебедєва, С. С. Лебедєв – Мультимедійне інтерактивне електрон. вид. комбінованого використ. (62 Мб). – Харків: ХНЕУ ім. С. Кузнеця, 2020. - https://pns.hneu.edu.ua/course/view.php?id=5289

4. Теорія ймовірностей та математична статистика : методичні рекомендації до самостійної роботи з теми «Емпіричні та логічні основи теорії ймовірностей. Основні теореми теорії ймовірностей» для студентів усіх спеціальностей /Уклад. Железнякова Е.Ю., Лебедєва І.Л., Лебедєв С.С. [Мультимедійний ресурс] – Харків : Вид. ХНЕУ ім. С. Кузнеця, 2018. - http://ebooks.git-elt.hneu.edu.ua/tvms

5. Probability Theory and Mathematical Statistics : Multimedia guidelines to independent work for Bachelor's (first) degree students for all specialties / Misiura Ie., Lebediev S. – Харків: ХНЕУ ім. С. Кузнеця, 2021. - https://pns.hneu.edu.ua/course/view.php?id=7356

6. Introduction to probability and mathematical statistics (6th edition) / Sheldon Ross. – San Diego, United States : Elsevier Science Publishing Co Inc, 2021. – 740 p.

7. Introduction to probability and mathematical statistics (2nd edition) / Lee Bain, Max Engelhardt. – Kentucky, United States : Cengage Learning, Inc, 2020. – 656 p.

Additional

8. Основи теорії ймовірностей і математичної статистики : навч. посібник. – Львів : ЛНУ імені Івана Франка, 2020. – 184 с.

9. Практикум з теорії ймовірностей та математичної статистики. Навчальний посібник для студентів економічних спеціальностей / Алілуйко А. М., Дзюбановська Н. В., Єрьоменко В. О. та ін. — Тернопіль : Підручники і посібники, 2018. – 352 с.

10. Теорія ймовірностей та математична статистика: навч. посіб. / Д. А. Найко, О. Ф. Шевчук – Вінниця: ВНАУ, 2020. – 382 с.

Internet Information Resources:

11. Освітньо-професійна програма "Менеджмент інноваційної діяльності" https://www.hneu.edu.ua/wp-content/uploads/1/Menedzhment-innovatsijnoyi-diyalnosti-OPP-2021-bakalavr.pdf

Methodical support

12. Сайт персональних навчальних систем: Probability theory & mathematical statistics / доц. Місюра Є. Ю. https://pns.hneu.edu.ua/course/view.php?id=3742