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

"ЗАТВЕРДЖУЮ"

Проректор з навчально-методичної роботи

Каріна НЕМАШКАЛО

№02071211

ТЕОРІЯ ЙМОВІРНОСТЕЙ ТА МАТЕМАТИЧНА СТАТИСТИКА

робоча програма навчальної дисципліни

Галузь знань	*05 Соціальні та поведінкові науки*
Спеціальність	*051 Економіка*
Освітній рівень	*перший (бакалаврський)*
Освітня програма	*Міжнародна економіка*

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

Завідувач кафедри
*вищої математики та
економіко-математичних методів*

Людмила МАЛЯРЕЦЬ

Харків
2021

THE MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY
OF ECONOMICS

"APPROVED"

Vice-Rector responsible for educational and methodical work

Karina NEMASHKALO

PROBABILITY THEORY AND MATHEMATICAL STATISTICS

syllabus of the academic discipline

Branch of knowledge   **05 Social and Behavioral Sciences**

Specialty   **051 Economics**
Level of education   **first (bachelor)**
Academic program   **International Economics**

Discipline status   **Compulsory**
Language of teaching, training and assessment   **English**

Head of the Department of
Higher Mathematics,
Economic and Mathematical Methods   Lyudmyla MALYRETS

Kharkiv
2021

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Kharkiv
2021

APPROVED
At the meeting of the Department *of   Higher Mathematics*
Economic and Mathematical Methods
Protocol № 1 dated 27.08.2021

Completed by:
S. Lebedev, senior teacher *of the Department of Higher Mathematics,*
Economic and Mathematical Methods

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

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

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Каріна НЕМАШКАЛО

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Харків
2021

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Abstract of the Discipline

The current stage of globalization of the world economy and the formation of the information society determine the active use of the mathematical apparatus in all spheres of practical activity in general and in international business in particular. The application of mathematical methods and models in solving practical problems of economics and management allows: to improve economic information systems by organizing them, identifying shortcomings in existing information and developing requirements for the preparation of new information or its adjustment; increase the accuracy of economic calculations; conduct research that suggests the existence of several alternatives; identify and justify optimal solutions; deepen the quantitative analysis of economic problems; to solve fundamentally new economic problems. The fundamental base in the mathematical preparation of economists and managers is the discipline "Probability theory and mathematical statistics"

Today it is noticeable the transition to new areas of application of mathematical methods in the development of socio-economic solutions that will determine the future of our country, namely: investment policy planning, modernization of enterprises, forecasting environmental processes, determining both state and private interests in development international projects and so on. In solving these management problems, the leading place is occupied by the methods and means of computational mathematics. Therefore, every future economist, business leader, business owner needs a thorough mathematical training that forms analytical and research competencies, as well as the ability to apply mathematical tools to solve a wide range of problems in their professional activities.

The main purpose of this discipline is: The main purpose of this discipline is: the formation of a holistic system of theoretical knowledge of the mathematical apparatus, which helps to model, giving students knowledge of the basic parts of probability theory and mathematical statistics; rise of the le

vel of the fundamental mathematical preparation of students with intensification of its applied direction, mastering the fundamentals of probability theory and mathematical statistics and application of this knowledge in the economic investigations for solving economic problems, , the obtainment of necessary totality of theoretical and practical knowledge for solving specific problems, which are set in a process of forming economic and mathematical models, the development of the desire for scientific search for ways to improve their work.

Characteristics of the academic discipline

Academic year	**2**
Term	**3**
Number of credits ECTS	**5**
Form of final control	**Exam**

Structural and logical scheme of studying the academic discipline

Previous academic disciplines	Next academic disciplines
Higher mathematics	Statistics
Informatics	Operations Research and Optimization Techniques
	Econometrics

Competences and result of mastering the academic discipline

Competences	Learning outcomes
3K7. Skills in the use of information and communication technologies	PH19. Use information and communication technologies to solve socio-economic problems, prepare and present analytical reports
3K8. Ability to search, process and analyze information from various sources	PH13. Identify sources and understand the methodology for determining and methods of obtaining socio-economic data, collect and analyze the necessary information, calculate economic and social indicators
CK4. Ability to explain economic and social processes and phenomena on the basis of theoretical models, analyze and interpret the results	PH3. Know and use economic terminology, explain the basic concepts of micro- and macroeconomics
CK6. Ability to apply economic and mathematical methods and models to solve economic problems	PH4. Understand the principles of economics, features of economic systems
CK7. Ability to use computer technology and data processing software to solve economic problems, analyze information and prepare analytical reports	PH8. Apply appropriate economic and mathematical methods and models to solve economic problems
CK9. Ability to predict on the basis of standard theoretical and econometric models of socio-economic processes	PH8. Apply appropriate economic and mathematical methods and models to solve economic problems
CK11. Ability to substantiate economic decisions on the basis of understanding the laws of economic systems and processes and with the use of modern methodological tools	PH2. To reproduce moral, cultural, scientific values, to increase the achievements of society in the socio-economic sphere, to promote a healthy lifestyle
CK14. Ability to analyze in depth the problems and phenomena in one or more professional areas, taking into account economic risks and possible socio-economic consequences	PH1. Associate yourself as a member of civil society, the scientific community, recognize the rule of law, in particular in professional activities, understand and be able to exercise their rights and freedoms, show respect for the rights and freedoms of others, including team members. PH4. Understand the principles of economics, features of economic systems

The syllabus of the academic discipline

Thematic module 1. Probability theory

Theme 1. Empirical and logical bases of probability theory
Theme 2. Basic theorems of probability theory, their economic meaning
Theme 3. Scheme of independent trials
Theme 4. Random variables and their economic meaning
Theme 5. Distribution laws and numerical characteristics of random variables
Theme 6. Multidimensional random variables

Thematic module 2. Mathematical statistics

Theme 7. Limit theorems of probability theory. Preprocessing of statistical data
Theme 8. Statistical estimates of the basic numerical characteristics of the general population and
       their properties. Point and interval estimates
Theme 9. Checking of statistical hypothesis
Theme 10. Elements of correlation theory
Theme 11. Elements of variance analysis
Theme 12. Elements of regression theory

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

Teaching and learning methods

During the teaching of the discipline "Probability theory and mathematical statistics" in order to enhance the educational and cognitive activities of students such interactive forms of teaching provides for the use. There are presentations, computer simulations, visual support banks, "inverted classroom", interactive distance learning, and creative independent work. The application of these technologies is aimed at the formation of competencies that are defined for each topic of the discipline.

Presentations are speeches to the audience, used to present the results of individual tasks (for each theme of the discipline), a report on the implementation of creative independent work. Presentations can be individual or collective (a group of two to five students).

Computer simulation (*game*) is a method of learning based on the use of special computer programs that can be used to virtually simulate the process. It is used in teaching themes 8 and 12. The purpose of using this method is to develop students' systematic thinking, the formation of skills to recognize and analyze problems, evaluate alternatives, make optimal decisions.

Visual support banks help to intensify the learning process on the discipline with the help of clarity (for each theme of the discipline).

"*Flipped classroom*" is a principle of learning, according to which the main assimilation of new material by students takes place at home, and classroom time is allocated for tasks, exercises, laboratory and practical research, individual teacher consultations and more.

Interactive distance learning is a set of pedagogical technologies based on the principles of communication in the information educational space, serving to organize the education of users, distributed in space and time (for each theme of the discipline, if classes on this theme are on-line).

Creative independent work involves writing a scientific article or thesis report, which highlights the economic problem and demonstrates the possibilities of using mathematical tools to solve it (the topic is chosen by the student himself from the list of themes which are teaching during a semester).

The order of assessment of studying results

The system of assessment of formed competencies of students during the study of this discipline takes into account the types of classes that, according to the curriculum of the discipline, include lectures, practical classes, laboratory work, as well as students' independent work. Assessment of competencies formed in students is carried out on a cumulative 100-point system.

Control measures include:

current control, carried out during the semester during lectures, practical classes and laboratory works and evaluated by the amount of points scored. In the first semester, the maximum amount is 100 points; the minimum amount that allows a student to get a credit of 60 points. In the second semester, the maximum amount is 60 points; the minimum amount that allows a student to take the exam is 35 points;

final / semester control, carried out in the form of a semester exam, according to the schedule of the educational process.

Current control is carried out within a term during:

lectures – in the form of colloquia (during the semester students write two colloquia; the maximum number of points for both colloquia is 16 points);

practical classes – in the form of tasks of written tests in practical classes (during the semester students perform two written tests; the maximum number of points for two tests is 14 points);

laboratory classes – in the form of defense of the report on laboratory work (during the semester students perform 6 laboratory works; the maximum number of points for the performance of six laboratory works is 12 points);

independent work:

in the form of homework (during the semester, students complete six homework assignments – the maximum number of points for completing six homework assignments is 12 points);

in the form of creative work (during the semester students perform one creative work – the maximum number of points is 6).

Final control of knowledge and competencies of students in the discipline is carried out on the basis of a semester exam, the task of which is to test students' understanding of the program material in general, logic and relationships between individual sections, ability to creatively use accumulated knowledge, ability to formulate their attitude to a particular problems of academic discipline, etc.

The examination ticket covers the program of the discipline and provides for the determination of the level of knowledge and the degree of mastery of competencies by students.

Each exam ticket consists of 5 practical situations (two stereotypical, two diagnostic and one heuristic task), which provide for the solution of typical and professional tasks and allow to diagnose the level of theoretical training of the student and his level of competence in the discipline.

The result of the semester exam is evaluated in points (maximum number – 40 points, minimum number of credits – 25 points) and is affixed in the appropriate column of the examination "Information of success".

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 final grade in the discipline is calculated taking into account the points obtained during the exam and the points obtained during the current control of the accumulative system. The total result in points for the semester is: "60 or more points – credited", "59 or less points – not credited" and is entered in the "Statement of performance" of the discipline.

The final grade is set according to the scale given in the table "Grade scale: national and ECTS". Forms of assessment and distribution of points are given in the table "Rating-plan of the discipline".

The scales of assessment: national and ECTS

Sum of points including all forms of study	Mark on the ECTS scale	Mark on the national scale	
		for an exam, a term paper, practice	for a test
90 – 100	A	excellent	passed
82 – 89	B	good	
74 – 81	C		
64 – 73	D	satisfactory	
60 – 63	E		
35 – 59	FX	unsatisfactory	failed
1 – 34	F		

Rating-plan of the discipline

Theme	Forms and types of teaching		Forms of evaluation	Max points
Theme 1	*Classroom work*			
	Lecture	*Lecture №1.* Empirical and logical bases of probability theory	–	–
	Practical lesson	*Practical task №1.* Empirical and logical foundations of probability theory	Homemade work	2
	Individual work			
	Questions and tasks for self-study	Search, selection and review of literary sources on the subject of the discipline. Doing homework	–	–
Theme 2	*Classroom work*			
	Lecture	*Lecture №2.* Basic theorems of probability theory and their economic interpretation	–	–
	Laboratory lesson	*Laboratory task №1.* Empirical and logical foundations of probability theory. Basic theorems of probability theory, their economic interpretation	LW №1	2
	Individual work			
	Questions and tasks for self-study	Study of lecture material, calculations in MS Excel	–	–

		Classroom work		
Theme 3	Lecture	*Lecture №3*. Scheme of independent trials	–	–
	Practical lesson	*Practical task №2*. Basic theorems of probability theory, their economic interpretation. Scheme of independent tests	Homemade work	2
		Individual work		
	Questions and tasks for self-study	Search, selection and review of literary sources on a given topic. Doing homework	–	–
Theme 4		Classroom work		
	Lecture	*Lecture №4.* Random variables and their economic meaning	–	–
	Laboratory lesson	*Laboratory task №2*. Random variables and their economic interpretation, investigation of their properties in MS Excel	LW №2	2
		Individual work		
	Questions and tasks for self-study	Study of lecture material, preparation for practical classes, solving problems using MS Excel	–	–
Theme 5		Classroom work		
	Lecture	*Lecture №5*. Distribution laws and numerical characteristics of random variables		
	Practical lesson	*Practical task №3*. Distribution laws and numerical characteristics of DRV. Basic laws of distribution of CRV	Homemade work	2
		Individual work		
	Questions and tasks for self-study	Study of lecture material, preparation for practical classes. Doing homework	–	–
Theme 6		Classroom work		
	Lecture	*Lecture №6*. Multidimensional random variables	Colloquium №1	8
	Laboratory lesson	*Laboratory task №3*. Scheme of independent tests. Distribution laws and numerical characteristics of a discrete random variable	LW №3	2
		Individual work		
	Questions and tasks for self-study	Search, selection and review of literary sources on a given topic. Execution of practical tasks. Preparation for the colloquium	–	–
Theme 7		Classroom work		
	Lecture	*Lecture №7*. Limit theorems of probability theory. Preprocessing of statistical data	–	–

	Practical lesson	***Practical task №4***. Boundary theorems of probability theory. Pre-processing of statistical data	Homemade work	2
			RT №1	7
		Individual work		
	Questions and tasks for self-study	Study of lecture material. Doing homework. Preparation for control work	–	–
Theme 8		*Classroom work*		
	Lecture	*Lecture №8*. Statistical estimates of the basic numerical characteristics of the general population and their properties. Point and interval estimates	–	–
	Laboratory lesson	*Laboratory task №4*. Primary processing of statistical data. Statistical evaluation of distribution parameters in MS Excel	LW №4	2
		Individual work		
	Questions and tasks for self-study	Study of lecture material. Preparation for laboratory work. Execution of practical tasks	–	–
Theme 9		*Classroom work*		
	Lecture	*Lecture №9*. Checking of statistical hypothesis	–	–
	Practical lesson	*Practical task №5*. Statistical evaluation of distribution parameters. Test of the statistical hypothesis about the distribution law	Homemade work	2
		Individual work		
	Questions and tasks for self-study	Review of literature on the subject; doing homework using MS Excel	–	–
Theme 10		*Classroom work*		
	Lecture	*Lecture №8*. Elements of correlation theory	–	–
	Laboratory lesson	*Laboratory task №5*. Test of the statistical hypothesis about the distribution law	LW №5	2
		Individual work		
	Questions and tasks for self-study	Study of lecture material; performance of practical tasks. Preparation for the presentation of an independent creative task	Creative work	6
Theme 11		*Classroom work*		
	Lecture	*Lecture №9*. Elements of variance analysis	–	–
	Practical lesson	*Practical task №6.* Elements of the theory of correlation and regression analyzes	Homemade work.	2
			RT №2	7
		Individual work		
	Questions and tasks for self-study	Study of lecture material. Do your homework. Preparation for writing test	–	–

		Classroom work		
Theme 12	Lecture	***Lecture №10***. Elements of regression theory	Colloquium №2	8
	Laboratory lesson	***Laboratory task №6***. Elements of correlation theory and regression theory	LW №6	2
		Individual work		
	Questions and tasks for self-study	Study of lecture material. Execution of practical tasks. Preparation for the colloquium	–	–
			Exam	40

Recommended reading

Main

1. Лабораторний практикум із розділу "Теорія ймовірностей та математична статистика" навчальної дисципліни "Математика для економістів" : навч.-практ. посіб. / І. Л. Лебедєва, О. О. Єгоршин, Е. Ю. Железнякова та ін. – Харків : Вид. ХНЕУ, 2009. – 116 с.

2. Малярець Л. М. Математика для економістів. Теорія ймовірностей та математична статистика: навч. посіб. У 3-х ч., ч.3 / Л. М. Малярець, І. Л. Лебедєва, Л. Д. Широкорад – Харків : Вид. ХНЕУ, 2011. – 568 с.

3. Малярець Л. М. Практикум з теорії ймовірностей та математичної статистики в Excel : навч.-практ. посіб. / Л. М. Малярець, І. Л. Лебедєва, Е. Ю Железнякова. – Харків : Вид. ХНЕУ, 2007. – 160 с.

4. Місюра Є. Ю. Теорія ймовірностей. Конспект лекцій / Є. Ю. Місюра. – Харків : Вид. ХНЕУ, 2013. – 95 с. (Англ. мов.)

Additional

5. Малярець Л. М. Теорія ймовірностей та математична статистика: навч. посіб. / Л. М. Малярець, І. Л. Лебедєва, Е. Ю. Железнякова та ін. – Х. : Вид. ХНЕУ, 2010. – 404 с.

6. Збірник вправ з розділу "Теорія ймовірностей та математична статистика" навчальної дисципліни "Математика для економістів" для студентів галузі знань "Економіка і підприємництво" усіх форм навчання / укл. Е. Ю. Железнякова, А. В. Ігначкова, З. Г. Попова та ін. – Харків : Вид. ХНЕУ, 2009. – 116 с.

7. Ross S. Introduction to probability and mathematical statistics / Sheldon Ross. – San Diego : Elsevier Academic Press, 2004. – 641 p.

Methodical support

8. Железнякова Е.Ю. 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 / Е.Ю. Железнякова, І.Л. Лебедєва, С.С. Лебедєв // Мультимедійне видання. – Харків, ХНЕУ ім. С. Кузнеця, 2018. [Електронний ресурс] – Режим доступу : http://ebooks.git-elt.hneu.edu.ua/tvms

9. Железнякова Е.Ю. Теорія ймовірностей та математична статистика : методичні рекомендації до самостійної роботи з теми "Схема незалежних випробувань. Закони розподілу та числові характеристики дискретної випадкової величини" для студентів усіх спеціальностей / Е.Ю. Железнякова, І.Л. Лебедєва, С.С. Лебедєв // Мультимедійне видання. – Харків, ХНЕУ ім. С. Кузнеця, 2020. [Електронний ресурс] – Режим доступу : https://pns.hneu.edu.ua/mod/url/view.php?id=274068

10. Сайт персональних навчальних систем ХНЕУ ім. С. Кузнеця: Theory of Probability and Mathematical Statistics [Electronic resource] – Access mode: https://pns.hneu.edu.ua/course/view.php?id=4886