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

"ЗАТВЕРДЖУЮ"
Заступник керівника
(проректор з науково-педагогічної роботи)

_____ Микола АФАНАСЬЄВ

ТЕОРІЯ ЙМОВІРНОСТЕЙ ТА МАТЕМАТИЧНА СТАТИСТИКА
робоча програма навчальної дисципліни

Галузь знань	*Усі галузі знань*
Спеціальність	*Усі спеціальності*
Освітній рівень	**перший (бакалаврський)**
Освітня програма	*Усі освітні програми*

Статус дисципліни	*базова*
Мова викладання, навчання та оцінювання	*іноземна (англійська)*

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

Харків
2020

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

<u>PROBABILITY THEORY AND MATHEMATICAL STATISTICS</u>
syllabus of the academic discipline

Training direction   ***All training directions***

Specialty   ***All specialties***

Academic degree   ***first (bachelor)***
Academic program   ***All academic programs***

Type of the academic discipline   *basic*
Language of teaching, training and assessment   *foreign (English)*

Chief of the department of higher mathematics,
economical and mathematical methods   Ludmila MALYRETS

Kharkiv
2020

APPROVED
at the meeting of the department of higher mathematics and economic mathematical methods
Protocol № 1 dated 20.08.2020

Compiled by:
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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 current stage of globalization of the world economy and the formation of the information society determines the active use of the mathematical apparatus. In practice, we often have to deal with random events, i.e. events that are either realized or not realized for reasons that can not be predicted in advance in these test conditions. The study of quantitative regularities to which mass random events are subject is the subject of probability theory. Probability theory studies the mathematical laws of distribution of random events, and is in fact a theoretical basis for mathematical statistics. In turn, mathematical statistics is a branch of mathematics devoted to mathematical methods of systematization, processing and use of statistical data for scientific and practical conclusions.

Probability theory and mathematical statistics are used in various fields of science and technology, but one of the most important areas of their use is economics. Without the help of probability theory, the issues of organization and planning, which are related to the need to take into account random events, cannot be solved, and the study of certain phenomena by mathematical statistics makes it possible to solve many questions posed by science and practice (correct organization of the technological process, the most appropriate planning and others).

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 purpose of the discipline 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 purpose of the academic discipline:

Academic year	1st / 2nd
Term	2nd / 3rd
Number of credits	5
Form of final control	exam

Structural and logical scheme of studying the discipline:

Previous academic disciplines	Next academic disciplines
Higher mathematics	Operations research and optimization methods
	Econometrics
	Statistics
	Finances

Competences and result of mastering the academic discipline:

Competences	Results of mastering the academic discipline
Using methods of probability theory for a prognosis of a probabilistic random events and making of a graphic interpretation of solutions of economic problems with the help of instruments of probability theory	Use basic definitions and theorems to a calculation of a probability of a random event. Define laws of a distribution of a discrete and a continuous (one-dimensional) random variables, calculate their basic numerical characteristics, plot distribution functions.

Competences	Results of mastering the academic discipline
	Find numerical characteristics of a function of a discrete and a continuous random argument. Use a concept of theory of random processes and theory of queuing theory for a modeling of economic processes
An identification of quantitative characteristics of economic processes with the help of a sampling method	Understand a relationship between instruments of probability theory and mathematical. Form a representative sampling totality. Plot a variational series and estimate basic numerical characteristics of a random variable using results of an investigation of a sample. Check statistical hypothesis of a correspondence of properties of numerical characteristics and a distribution law of a random variable in a population and their estimations using results of an investigation of a sample. Understand possibilities and a restriction of using instruments of mathematical statistics during solving of real economic problems. Be able to use the capabilities of MS Excel in conducting research to determine the quantitative and qualitative characteristics of economic factors
Using of variance analysis for an investigation of economic processes, using correlation and regression analysis during learning different economic phenomenon, understanding a meaning of economic values, which form a model of a pair regression	Understand possibilities to use single-factor analysis of variance at checking of an existence a difference between investigated samples. Distinguish types of dependences between economic factors. Investigate a form of a correlation and construct a model of a pair regression using the least-squares method (LSM). Know methods of a checking of parameters significance of a model of a pair regression and an estimation of an adequacy of a model in whole. Be able to use the capabilities of MS Excel in solving real economic problems to determine the statistical relationship between factors

The syllabus of the academic discipline
The themes of lectures

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 / Laboratory studies, as well as questions and tasks for an independent work is given in the table "Rating-plan of the discipline".

Teaching and learning methods

The methods used in teaching the discipline "Probability Theory and Mathematical Statistics" are aimed at the formation of competencies that are defined for each topic of the discipline. During lectures, practical and laboratory classes the use of explanatory-illustrative, reproductive methods with the use of elements of problem statement, as well as research and heuristic methods are envisaged. In order to activate and stimulate the educational and cognitive activities of students, presentations (during lectures) are used, as well as individual research work, the result of which is the writing of a scientific article.

The order of assessment of studying results

Simon Kuznets KhNUE uses a cumulative (100-point) evaluation system. The system of assessment of the formed competencies of students during the study of the 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. In accordance with the Provisional Regulation "On the procedure for assessing the learning outcomes of students on the cumulative scoring system" Simon Kuznets KhNUE, control measures 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 modular control work, which includes theoretical and practical tasks and with taking into account the current control according to a 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.

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.

General criteria for evaluating extracurricular independent work of students are: depth and strength of knowledge, level of thinking, ability to systematize knowledge on individual topics, ability to draw sound conclusions, mastery of categorical apparatus, skills and techniques of practical tasks, ability to find necessary information, to carry out its systematization and processing, self-realization in practical and laboratory classes.

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.

The total number of points is 60, which are distributed as lectures (including 2 colloquiums (14 points) and one independent creative work (7 points), practical studies (including 3 written tests (18 points) and homework (9 points)) and laboratory studies (including 2 competence-oriented tasks (12 points)).

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 all themes of 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 (diagnostic and heuristic) task.

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. The minimum possible number of points that you need to get on the exam is 25.

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 modules 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.

The final mark on the academic discipline is calculated as a summa of points, obtained during an exam, and points, obtained during a current control by an accumulative system.

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 "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 student should be considered certified, if a sum of points, obtained as the total result of an assessment by all forms of a control, equals or exceeds 60, taking into account that 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 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.

The final grade is set according to the scale given in the table "The scales of assessment: 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	for a test
90 – 100	A	excellent	
82 – 89	B	very good	
74 – 81	C	good	passed
64 – 73	D	satisfactory	
60 – 63	E		
35 – 59	FX	satisfactory	failed
1 – 34	F		

Rating plan of the discipline

Theme	Forms and types of education		Forms of evaluation	Max score
Theme 1.	*Classroom work*			
	Lecture	Lecture 1. Empirical and logical bases of probability theory	-	-
	Practice	Practical study 1. Empirical and logical bases of probability theory	-	-
	Independent work			
	Questions and tasks for self-study	Selection and review of literature on the subject. Study of theoretical material on the topic	-	-
Theme 2.	*Classroom work*			
	Lecture	Lecture 2. Basic theorems of probability theory, their economic meaning	-	-
	Laboratory study	Laboratory study №1. Empirical and logical bases of probability theory. Basic theorems of probability theory, their economic meaning	Competence-oriented task №1 (part 1)	2
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic	-	-
		Solving the task for independent performance on the basis of laboratory work №1		
Theme 3.	*Classroom work*			
	Lecture	Lecture 3. Scheme of independent trials	-	-
	Practice	Practical study 2. Scheme of independent trials	Written test №1	6
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic	Homework	1
		Doing homework		
m e	*Classroom work*			

Theme	Forms and types of education		Forms of evaluation	Max score
	Lecture	Lecture 4. Random variables and their economic meaning	-	-
	Laboratory study	Laboratory study № 2. Random variables and their economic meaning	Competence-oriented task №1 (part 2)	2
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic		
		Solving the task for independent performance on the basis of laboratory work №2	-	-
Theme 5.	*Classroom work*			
	Lecture	Lecture 5. Distribution laws and numerical characteristics of random variables	-	-
	Practice	Practical study 3. Distribution laws and numerical characteristics of a random variable	-	-
	Laboratory study	Laboratory study № 3. Distribution laws and numerical characteristics of a discrete random variable	Competence-oriented task №1 (part 3)	2
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic	Homework	2
		Doing homework		
Theme 6.	*Classroom work*			
	Lecture	Lecture 6. Multidimensional random variables	Colloquium №1	7
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic		
		Solving the task for independent performance on the basis of laboratory work №3	-	-
Theme 7.	*Classroom work*			
	Lecture	Lecture 7. Limit theorems of probability theory. Preprocessing of statistical data	-	-
	Practice	Practical study 4. Primary processing of statistical data	Written test №2	6
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic. Doing homework	Homework	2
m e	*Classroom work*			

	Lecture	Lecture 8. Statistical estimates of the basic numerical characteristics of the general population and their properties. Point and interval estimates	-	-
	Laboratory study	Laboratory study № 4. Primary processing of statistical data. Statistical evaluation of distribution parameters	Competence-oriented task №2 (part 1)	2
	Practice	Practical study 5. Statistical evaluation of distribution parameters	-	-
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic	-	-
		Solving the task for independent performance on the basis of laboratory work №4		
Theme 9.	*Classroom work*			
	Lecture	Lecture 9. Checking of statistical hypothesis	-	-
	Laboratory study	Laboratory study № 5. Testing of the statistical hypothesis regarding the distribution law	Competence-oriented task №2 (part 2)	2
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic	Homework	2
		Doing homework		
Theme 10.	*Classroom work*			
	Lecture	Lecture 10. Elements of correlation theory	-	-
	Practice	Practical study 6. Elements of correlation theory	Written test №3	6
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic.	Independent creative work	7
		Solving the task for independent performance on the basis of laboratory work №5		
Theme 11.	*Classroom work*			
	Lecture	Lecture 11. Elements of variance analysis	-	-
	Independent work			
	Questions and tasks for self-study	Study of theoretical material on the topic.	Homework	2
		Doing homework		
Theme 12.	*Classroom work*			
	Lecture	Lecture 12. Elements of regression theory	Colloquium №2	7
	Laboratory study	Laboratory study № 6. Elements of	Competence-	2

		regression theory and variance analysis	oriented task №2 (part 3)*	
Independent work				
Questions and tasks for self-study		Study of theoretical material on the topic.	-	-
		Solving the task for independent performance on the basis of laboratory work №6		
			Exam	40
			Total	100

* Students accumulate points for competence-oriented tasks №1 and №2 in the process of a fulfillment of laboratory works

Recommended reading

Main

1. 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 – Х. : Вид. ХНЕУ, 2011. – 568 с.

2. 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.

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

4. Теория вероятностей и математическая статистика в примерах и задачах. Учебное пособие для студентов-иностранцев отрасли знаний 0305 «Экономика и предпринимательство» / Малярец Л.М., Железнякова Є.Ю., Игначкова А.В.- Х.: ХНЕУ. - 2012. - 124 с.

5. Ross S. (2014) Introduction to probability and mathematical statistics / Sheldon Ross. – 5th Edition, San Diego : Elsevier Academic Press. – 686 p.

Additional

6. Барковський В. В. Теорія ймовірностей та математична статистика / В. В. Барковський, Н. В. Барковська, О.К. Лопатін. – 5-е вид. – К. : Центр учбової літератури, 2010. – 424 с.

7. Валєєв К. Г. Збірник задач з теорії ймовірностей та математичної статистики / К. Г. Валєєв, І. А. Джалладова. – К. : КНЕУ, 2005. – 340 с.

8. Гмурман В. Е. Руководство по решению задач по теории вероятностей и математической статистике / В. Е. Гурман. – М. : Высшая школа, 2001. – 576 с.

9. Гмурман В. Е. Теория вероятностей и математическая статистика : учеб. пособ. для вузов / В. Е. Гурман. – 6-е изд. – М. : Высшая школа, 1998. – 480 с.

10. Дороговцев А. Я. Теорія ймовірностей : збірник задач / під ред. А. В. Скорохода. – К. : Вища школа, 1976. – 384 с.

11. Елисеева И. И. Теория статистики с основами теории вероятностей : учеб. пособ. / И. И. Елисеева, В. С. Князевский. – М. : ЮНИТИ-ДАНА, 2001. – 446 с.

12. Жлуктенко В. І. Теорія ймовірностей і математична статистика : навч.-метод. посіб. у 2 ч. – Ч. I. Теорія ймовірностей / В. І. Жлуктенко, С. І. Наконечний. – К. : КНЕУ, 2000. – 304 с.

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14. 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. – Х. : Вид. ХНЕУ, 2009. – 116 с.

15. Кремер Н. Ш. Теория вероятностей и математическая статистика / Н. Ш. Кремер. – М.: ЮНИТИ-ДАНА, 2000. – 544 с. Теория вероятностей и математическая статистика. Базовый курс с примерами и задачами : учеб. пособ. / под ред. А. И. Кибзуна. – М. : Физматлит, 2002. – 224 с.

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

Methodical support

18. Доклад ЮНЕСКО по науке: на пути к 2030 году [Электронный ресурс] . – режим доступа : http://unesdoc.unesco.org/images/0023/002354/235407r.pdf

19. Железнякова Е.Ю Теорія ймовірностей та математична статистика. мультимедійні методичні рекомендації з теми: "Емпіричні та логічні основи теорії ймовірностей. Основні теореми теорії ймовірностей" / Е.Ю. Железнякова, І.Л. Лебедєва, С.С. Лебедєв // Мультимедійне видання. – Харків, ХНЕУ ім. С. Кузнеця, 2018.. [Електронний ресурс] . – режим доступу : https://pns.hneu.edu.ua/course/view.php?id=4821

20. Железнякова Е.Ю Теорія ймовірностей та математична статистика: мультимедійні методичні рекомендації з теми "Емпіричні та логічні основи теорії ймовірностей. Схема незалежних випробувань. Закони розподілу та числові характеристики дискретної випадкової величини" / 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/course/view.php?id=5289

21. Сайт персональних навчальних систем ХНЕУ ім. С. Кузнеця: Theory of Probability and Mathematical Statistics [Електронний ресурс] . – режим доступу :
https://pns.hneu.edu.ua/course/view.php?id=3742 (Misiura Ie.Iu.)
https://pns.hneu.edu.ua/enrol/index.php?id=4886 (Lebedev S.S.)