

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



"ЗАТВЕРДЖУЮ"

Заступник керівника
(проректор з науково-педагогічної роботи)

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ТЕОРІЯ ЙМОВІРНОСТЕЙ ТА МАТЕМАТИЧНА СТАТИСТИКА

робоча програма навчальної дисципліни

Галузь знань	05 Соціальні та поведінкові науки
Спеціальність	07 Управління та адміністрування
Освітній рівень	051 Економіка
Освітня програма	073 Менеджмент
	перший (бакалаврський)
	Міжнародна економіка
	Бізнес-адміністрування
	Логістика
	Менеджмент інноваційної діяльності
	Менеджмент організацій і адміністрування

Вид дисципліни	базова
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Завідувач кафедри вищої математики та
економіко-математичних методів

Л.М. Малярець Л.М.

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ЗАТВЕРДЖЕНО

на засіданні кафедри вищої математики та економіко-математичних методів
Протокол № 1 від 27.08.2018 р.

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**Лист оновлення та перезатвердження
робочої програми навчальної дисципліни**

Навчальний рік	Дата засідання кафедри – розробника РПНД	Номер протоколу	Підпис завідувача кафедри

1. Introduction

The fundamental base in the mathematical preparation of economists and managers is the discipline "Probability theory and mathematical statistics" which is the basic discipline of the natural scientific series and the component of the structurally logical scheme which is provided for educationally professional program of the preparation of bachelors of specialties 051 "Economics" and 073 "Management".

The basic problems of teaching the discipline is giving students knowledge of the basic parts of probability theory and mathematical statistics; rise of the level 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, forming skills of application of elements of probability theory and mathematical statistics in investigations which are applied as instrument of investigation and solving optimization economic problems for forming models of economic processes and developments, 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, and the obtainment of required mathematical preparation for study of other disciplines.

The annotation of the academic discipline:

The main purpose of teaching is forming future specialists' basic mathematical knowledge for solving theoretical and practical problems in professional activity of competent specialist in a service sphere, skills of analytical thinking and skills of using mathematical knowledge for formation of real processes and developments, and for solving economic problems.

The main tasks that should be solved in the process of teaching the discipline are: giving students knowledge of the basic parts of probability theory and mathematical statistics; definitions, theorems, rules; proving of the main theorems; mastering the fundamentals of a methodology of a mathematical investigation of the applied economic problems; independent broadening of knowledge, development of logical and algorithmical thinking; the obtainment of primary skills for independent-learning of mathematical and applied Bibliography by students.

The subject of the discipline "Probability theory and mathematical statistics" is the fundamentals of probability theory and mathematical statistics.

In the process of learning the discipline "Probability theory and mathematical statistics" a student receives analytic and investigatory competences which are necessary for a modern economist in any sphere of his activity.

The syllabus of the educational discipline "Probability theory and mathematical statistics" is compiled according to statements of field standard of the higher education of Ministry of Education and Science of Ukraine based on the educational professional program of bachelor training, which is made by Scientific methodical committee of economics and enterprise of Ministry of Education and Science of Ukraine.

A student starts studying educational discipline "Probability theory and mathematical statistics" in the first term of the first year of studies.

In the process of learning the students obtain the required theoretical knowledge during lectures and acquire practical skills at the practical and laboratory studies and during independent work and fulfillment of individual tasks. Independent and individual work of students have a great value in the process of mastering material and fixing of knowledge. All of these types of studies were devised according to the statements of Bolognese declaration. As the result of the educational discipline study a student **must know**: general notions of probability theory; random, persistent and impossible events; a notion of a probability and methods of its calculation; compatible and incompatible events; dependent and independent

events; conditional and unconditional probabilities; theorems of an addition; theorems of an multiplication; total probability formula and Bayes' formula; a trial by Bernoulli's scheme; discrete and continuous random variables; basic laws of a distribution of discrete random variables and their basic numerical characteristics; basic laws of a distribution of continuous random variables and their basic numerical characteristics; theoretical initial and central moments; conditional laws of a distribution of probabilities of components of discrete two-dimensional random variable; a calculation of basic numerical characteristics of two-dimensional random variable; characteristics of a function of one random argument; a random process; a simplest flow of events; Markov chains; limiting theorems of probability theory; general notions of mathematical statistics; a sampling method; a statistical distribution and its basic numerical characteristics; statistical estimations of parameters of a population; requirements for statistical estimations; notions of point and interval estimations and a calculation of their accuracy; methods of parametric and nonparametric estimations of parameters; types of statistical hypotheses; statistical hypotheses and statistical criteria for their checking;

be able to: calculate a probability of an elementary random event using a classical and geometrical definitions of probability; use Venn-Euler diagram for a representation of random events on a sample space; compute a probability of a complete random event with the help of addition and multiplication theorems; calculate a total probability and a posteriori probability of a definite hypothesis using Bayes' formula; compute a probability that a random event will occur a definite number times in series of repeated trials (using Bernoulli's scheme); calculate basic characteristics of a discrete random variable which is distributed by a binomial law and use built-in function of MS Excel for their calculations; use local and integral theorems of Moivre – Laplace for a approximate calculation of probabilities of random events if a random event is distributed by a binomial law and a number of independent trials increases unboundedly; use Poisson formula for a approximate calculation of probabilities of random events if a random event is distributed by a binomial law, a number of independent trials increases unboundedly and an occurrence of an event in one trial is low-probable; define a distribution function of a discrete random variable and plot its graph; define a distribution function and a density function of a continuous random variable and plot these graphs; calculate basic numerical characteristics of a distribution of a continuous random variable: a mathematical expectation; a variance; a root-mean-square deviation; calculate additional numerical characteristics of a distribution of random variables: a mode, a median, theoretical initial and central moments, an asymmetry, an excess, also use built-in functions of MS Excel for their calculations; construct conditional laws of a distribution of probabilities of a composite discrete two-dimensional random variable; compute basic numerical characteristics of a discrete two-dimensional random variable and use built-in functions of MS Excel for their calculations; construct laws of a distribution of a random variable which is a function of one random argument; compute a matrix of transition probabilities and a presentation of Markov chain as a graph; plot a histogram and a polygon of frequencies and relative frequencies at an investigation of a sample; plot graphs of functions with the help of built-in functions of MS Excel; define a statistical distribution function and plot its graph; calculate basic numerical characteristics of a statistical distribution: a sample mean; a sample variance; a corrected variance; a root-mean-square deviation; compute additional numerical characteristics of a statistical distribution: a mode, a median, theoretical initial and central moments, an variation coefficient; define point statistical estimations of numerical characteristics of a population and confidence intervals for statistical estimations of a mathematical expectation, a variance and a root-mean-square deviation using built-in functions of MS Excel; calculate a sample size which is necessary for defining basic numerical characteristics of a distribution of a population with a definite reliability; compute estimations of parameters of a distribution of a random variable supposing a normal, random and exponential laws in a population using data of a sample; use statistical criteria for a checking of a statistical hypothesis that a significance of a difference between values of

means of two samples; use statistical criteria for a checking of a statistical hypothesis that a significance of a difference between values of variances of two samples; use statistical criteria for a checking of a statistical hypothesis that a significance of a difference between empirical frequencies and frequencies which are calculated supposing a normal distribution of a random variable in a population; classify empirical data and construct empirical regression lines in a pair correlation; conduct an estimation of equation parameters supposing a correlation dependence between two random variables and use built-in functions of MS Excel for this; check a statistical hypothesis about a significance of a correlation using Fisher fitting test; construct a confidence of a regression line; learn mathematical literature by oneself; form and use economic mathematical models for an estimation of a state and a forecast of a development of economic processes; use skills of using built-in functions of MS Excel for statistical investigations; broaden of knowledge, develop of logical and algorithmic thinking by oneself.

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 academic discipline:

Academic year	1 st	
Term	1 st	
Number of credits	5	
The form of studies	lectures	32
	practical studies	16
	laboratory studies	16
Independent work		86
Form of final control	exam	

Structural and logical scheme of studying the academic discipline:

Previous academic disciplines	Next academic disciplines
Algebra, Geometry (Mathematics)	Econometrics

2. 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. 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

Competences	Results of mastering the academic discipline
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 prerepresentative 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
Using of variance analysis for an investigation of economic processes, using correlation and regression analysis during learning different economic phenomena, 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 and define a essence of a correlation. 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

3. The syllabus of the academic discipline

Thematic module 1. Probability theory

Theme 1. Empirical and logical bases of probability theory

1.1. The subject and problems of this course.

The role of this course as a theoretical base of a mathematical modelling of economic processes and phenomena, which take into consideration of possible risks.

1.2. Basic definitions, rules and types of events

A probabilistic model of an experiment. Sure (certain), random and impossible events. Rules of operations with random events. A space of elementary events.

1.3. Basic concepts and formulas

A classical definition of a probability and its calculation. Basic formulas of combinatorics. A statistical definition of a probability. Axiomatics of Kolmogorov.

A geometrical definition of a probability. Venn-Euler diagram.

Theme 2. Basic theorems of probability theory, their economic meaning

2.1. Basic definitions and multiplication theorems of probabilities

Probabilistic space. Dependent and independent events. A conditional probability. Multiplication theorems of probabilities.

2.2. Basic concepts and addition theorems of probabilities

A complete group of events. Complementary events.

Joint (compatible) and disjoint (incompatible) events. Addition theorems of probabilities.

2.3. The probability of at least one event

The probability of at least one event. The probability that an event will occur at least once. Calculation of a necessary number of trials, which occur with a definite reliability in order to guarantee an occurrence of a random event at least once.

2.4. Formula of a total probability and Bayes formula

Formula of a total probability. Bayes formula (the theorem of hypothesis).

Theme 3. Scheme of independent trials

3.1. Repeated independent trials and Bernoulli's scheme

A scheme of repeated independent trials. Bernoulli's formulas.

3.2. Local theorem of Moivre – Laplace

Local theorem of Moivre – Laplace. Gauss's function, its properties, an application to approximate calculations of a probability of an occurrence of a random event of a definite number times in series of independent trials.

3.3. Integral theorem of Moivre – Laplace

Integral theorem of Moivre – Laplace. Laplace's function, its properties and an application to approximate calculations of a probability that values of a random variable lies in a definite interval.

A relationship between Gauss and Laplace functions.

3.4. Poisson's theorem

Low-probability events. Poisson's theorem.

Theme 4. Random variables and their economic meaning

4.1. Definitions and types of random variables

A definition of a random variable. Discrete and continuous random variables.

4.2. Distribution laws and distribution function of probabilities

Distribution laws of probabilities for a random variable and ways of finding (tabular, graphic and analytical).

A distribution function of probabilities, its properties.

4.3. Basic numerical characteristics

Basic numerical characteristics of a random variable: a mathematical expectation, a variance and a root-mean-square deviation. Properties of basic numerical characteristics.

4.4. Additional numerical characteristics

Additional numerical characteristics of a distribution: a mode, a median, an excess.

Initial and central theoretical moments, their application to a calculation of numerical characteristics of a distribution of a random variable.

Theme 5. Distribution laws and numerical characteristics of a discrete random variables

5.1. Basic types and properties of distribution laws of a discrete random variable

Distribution laws of a discrete random variable, which are often used in social and economic investigations: a binomial distribution, a geometrical distribution, a hypergeometrical distribution. Specificities and properties of these distributions, their basic numerical characteristics and the economic meaning.

5.2. A flow of events

A flow of events. The simplest flow of events and its properties.

Theme 6. Basic distribution laws of a continuous random variable

6.1. A density distribution function and its properties

A density of a distribution and its probable meaning. A density distribution function of a random variable and its properties.

6.2. Basic types and properties of distribution laws of a continuous random variable

Distribution laws of a continuous random variable, which are often used in social and economic investigations: a uniform distribution, a normal distribution and an exponential distribution. Properties of these distributions and their basic numerical characteristics.

An influence of parameters of a distribution on a density function of probabilities at a normal distribution law.

6.3. Student's, Pearson's and Fisher's distributions

Student's distribution, Pearson's distribution and **Fisher's** distribution. Specificities and properties of these distributions. A relationship of these distributions and a normal distribution law of a continuous random variable.

Theme 7. Multidimensional of random variables

7.1. A system of random variables

A concept of a system of random variables. A distribution function and a density of a distribution of a system of two random variables.

7.2. Conditional distribution laws of a system of random variables

Conditional distribution laws of components of a system of discrete random variables, their basic numerical characteristics.

7.3. Basic numerical characteristics of a system of two random variables

Basic numerical characteristics of a system of two random variables.

A correlation moment, its properties.

A coefficient of a correlation, its properties.

Theme 8. Functions of random argument

8.1. Basic definitions and a distribution law of a function of a random argument

General concepts of a function of a random argument.

A construction of a distribution law of a function of a discrete random argument using a distribution law of its argument.

8.2. Basic numerical characteristics of a function of a random argument Basic numerical characteristics of a function of a random argument.

A function of a continuous random argument and its basic numerical characteristics. A function of two random variables.

Theme 9. Elements of theory of random processes and theory of queuing problems

9.1. Basic definitions queuing theory

The subject of queuing theory. Random functions. Random processes with a finite set of states.

9.2. Numerical characteristics and a correlation function

Numerical characteristics and a correlation function of a random process. Properties of a correlation function of a random process. A correlation function of a dependence between two random processes.

9.3. A flow of events and elements of queuing theory

A flow of events. The simplest flow of events and its properties.

Markov random process and Markov chains.

Elements of queuing theory.

Thematic module 2. Mathematical statistics

Theme 10. Limits theorems of probability theory

10.1. A statistical definition of a probability and a statistical stability

Bernoulli's theorem. A statistical definition of a probability. A statistical stability of sampling characteristics.

10.2. Basic theorems and their consequences

Laws of large numbers. A convergence by a probability and a convergence by a distribution. An inequality of Chebyshev. The theorem of Chebyshev and its consequences. The theorem of Lyapunov (the central limiting theorem) and its consequences. The theorem of Glivenko.

Theme 11. Preprocessing of statistical data

11.1. Basic definitions and problems of mathematical statistics

Basic problems of mathematical statistics. A sampling method. Definitions of a population and its sample.

11.2. Discrete and interval variational series

An empirical distribution law. Ways of a presentation of sampling totalities and a representation of results of observations. Discrete and interval variational series, rules of its construction. A defining limits of an interval by Sturges's formula.

11.3. A graphical presentation of a statistical distribution

A graphical presentation of a statistical distribution. A polygon and a histogram.

11.4. Basic numerical characteristics

Basic sampling numerical characteristics and their asymptotic behavior.

Theme 12. Statistical estimation of parameters of a distribution

12.1. Basic statistical estimations and their properties

Statistical estimations of parameters of a distribution of a population and their properties: an unbiasedness, possibility and an efficiency.

An asymptotic efficiency of maximally plausible estimations.

12.2. Types of estimations

The method of moments. Point and interval estimations. An confidence interval for a mathematical expectation of a normal population.

Theme 13. Checking of statistical hypothesis

13.1. Types of statistical hypothesis and kinds of errors

Main and alternative statistical hypothesis. A statistical test. A construction of critical domains for a statistical test. Errors of the first and the second kinds. A concept of power of a test.

13.2. Different types of tests for checking of a statistical hypothesis

A checking of a statistical hypothesis about a defining of a distribution law for a population using results of an investigation of a sample. Pearson and Kolmogorov fitting tests. The fitting test relative to a frequency.

A checking of a statistical hypothesis about an equality of two population means at an assumption of a normal distribution law. Student's fitting test.

A comparison of variances. **Fisher-Snedeker** fitting test.

A checking of a hypothesis about an equality of a sampling mean and a mathematical expectation.

Theme 14. Elements of correlation theory

14.1. Basic definitions and problems of correlation analysis

Problems of correlation analysis.

14.2. Basic coefficients and their properties

A sampling coefficient of a correlation, its properties and a confidence interval. A coefficient of determination. A correlation ratio, its properties.

Theme 15. Elements of variance analysis

15.1. Basic definitions and problems of variance analysis

Problems of variance analysis. The role of variance analysis in economic investigations.

15.2. Single-factor variance analysis

Single-factor analysis as a procedure of a checking of hypotheses about a lack of a factor influence on a feature, which is investigated.

A general, an external and intrinsically group variances.

15.3. Multidimensional variance analysis

A concept of multidimensional variance analysis.

Theme 16. Elements of regression theory

16.1. Basic concepts of regression analysis and LSM

Problems of regression analysis. A correlation dependence. A correlation table. Empirical lines of a regression. An estimation of parameters of a pair regression equation using the least-squares method (LSM). Point estimations.

16.2. A significance and a confidence interval of a pair regression line

A checking of a significance of parameters of a pair regression equation. A confidence interval for a line of a pair regression.

4. 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. 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 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: active in-class work (lecture); active in-class work (practical study); active in-class work (laboratory study); homework; competence oriented tasks (defence of laboratory works); an independent test; a written test; independent creative work.

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.

The final control 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 (diagnostic and 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.

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.

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.

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

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.

The distribution of points by weeks

Themes of the thematic module			Lectures	Practical study	Laboratory study	Homework	Competence-oriented task	Independent test	Written test	Independent creative work	Colloquium	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
Thematic module 1. Probability theory	Theme 1	week 1	0.3	0.3	–	–						0.6
	Theme 2	week 2	0.3	–	0.3	–						0.6
	Theme 3	week 3	0.3	0.3	–	0.4						1.0
	Theme 4	week 4	0.3	–	0.3	–						0.6
	Theme 5	week 5	0.3	0.3	–	0.5		4				5.1
	Theme 6	week 6	0.3	–	0.3	–	5					5.6
	Theme 7	week 7	0.3	0.3	–	0.5			6			7.1
Thematic module 2 Mathematical statistics	Theme 8	week 8	0.3	–	0.3	–					5	5.6
	Theme 9	week 9	0.3	0.3	–	0.5						1.1
	Theme 10	week 10	0.3	–	0.3	–						0.6
	Theme 11	week 11	0.3	0.3	–	0.5		4				5.1
	Theme 12	week 12	0.3	–	0.3	–						0.6
	Theme 13	week 13	0.3	0.3	–	0.5			6			7.1
	Theme 14	week 14	0.3	–	0.3	–	5					5.6
	Theme 15	week 15	0.3	0.3	–	0.5					5	6.1
	Theme 16	week 16	0.3	–	0.3	–				7		7.6
	Exam											40
Total			4.8	2.4	2.4	3.4	10	8	12	7	10	100

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	very good	
74 – 81	C	good	
64 – 73	D	satisfactory	
60 – 63	E		
35 – 59	FX	unsatisfactory	failed
1 – 34	F		

5. Recommended reading

5.1. Main

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