MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
Lesya Ukrainka Volyn National University
Faculty of Information Technologies and Mathematics

Department of General Mathematics and Methods of Teaching Informatics

SYLLABUS

of normative educational component

MATHEMATICS AND STATISTICS FOR ECONOMISTS

training of applicants of the first (bachelor) level of higher education
Field of knowledge: 29 «International Relations»
Specialty: 292 «International Economic Relations»
Educational program: «International Business»

Lutsk – 2022

Syllabus of normative educational component «Mathematics and Statistics for Economists» training of a bachelor of Field of knowledge: 29 «International Relations», Specialty: 292 «International Economic Relations» Educational program: «International Business».

Developer: Khomyak Maria Yaroslavivna, PhD on Mathematics, Associate Professor, Associate Professor of the Department of General Mathematics and Informatics Teaching Methods,

Agreed

Guarantor of the educational program:  Andriy Boyar

Approved at the meeting of the Department of General Mathematics and Methods of Teaching Informatics

Protocol No.2 dated September, 2, 2022.

Head of the Department:  Maria Khomyak

I. Description of the educational component

Table 1

<table>
<tr><th>Name</th><th>Field of knowledge, specialty, educational and professional program, educational level</th><th>Characteristic of EC</th></tr>
<tr><td rowspan="2">Full-time education</td><td rowspan="9">29 «International Relations»

292 «International Economic Relations»

«International Business»

Bachelor</td><td>Educational component of the professional training cycle</td></tr>
<tr><td>year of study: I</td></tr>
<tr><td rowspan="7">Number of hours / credits:
240 / 8</td><td>Semester: 1-, 2-th</td></tr>
<tr><td>Lectures: 52 hours</td></tr>
<tr><td>Practical classes: 36 hours</td></tr>
<tr><td>Laboratory lessons: 26 hours</td></tr>
<tr><td>Self study: 110 hours</td></tr>
<tr><td>Consultations: 16 hours</td></tr>
<tr><td>Form of control: exam, exam</td></tr>
<tr><td colspan="2">Language of study</td><td>English</td></tr>
</table>

II. Information about the professor

Khomyak Maria Yaroslavivna,
Academic degree: PhD in Mathematics;
Academic title: Associate professor;
Position: Associate Professor of the Department of General Mathematics and Informatics Teaching Methods
Phone:0502546025
E-mail: khomyak.maria@vnu.edu.ua

III. Description of the educational component

1. Abstract

The educational component "Mathematics and Statistics for Economists" belongs to the cycle of professional training, which provides the study of the following:

- basic principles and tools of the mathematical apparatus used to solve theoretical and applied problems of business processes and international activities;
- mathematical methods of systematization, processing and application of statistical data to develop analytical models related to their further practical activities as specialists in the field of international business.

The subject of the educational component "Mathematics and Statistics for Economists" is elements of linear and vector algebra; elements of analytical geometry; introduction to mathematical analysis, elements of differential calculus; elements of integral calculus; numerical and functional series; differential equations; basic concepts, formulas, statements of statistics.

2. Prerequisites

Knowledge of the basic concepts of school courses in algebra and the beginnings of analysis, geometry in the scope of the secondary school program.

Post requisites

Direct application of learning outcomes in the study of disciplines «Information Technology in International Relations», «Theory of International Economic Relations», «World Economy and World Markets», «International Monetary and Financial Relations», «Firm Economics», «Business analytics», «Management and marketing in international business».

3. Purpose and tasks of the educational component

Providing students with basic knowledge of higher mathematics and statistics, which allow them to further master special disciplines based on mathematical concepts. Much attention is paid to the development of practical skills in solving professional problems, the ability to apply mathematical methods and statistical apparatus to study real processes and make optimal decisions..

4. Learning outcomes (competencies)

In the process of studying the educational component, students must develop the following competencies:

Table 2

Integral competence (IC)	The ability to solve complex specialized tasks and practical problems in the field of international economic relations in general and international business in particular, as well as in the learning process, which involves the application of the latest theories and methods in the implementation of complex studies of global economic relations, is characterized by the complexity and uncertainty of conditions.
General competences (GC)	GC 1. The ability to exercise their rights and responsibilities as a member of society, to realize the values of civil (free democratic). GC 3. Ability to learn and be modernly trained. GC 6. Ability to communicate in foreign languages. GC 7. Skills in the use of information and communication technologies. GC 8. Ability to abstract thinking, analysis and synthesis. GC 10. Ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge / types of economic activity). GC 12. Knowledge and understanding of the subject area and understanding of professional activity.
Professional competences (PC)	PC 2. Ability to use basic categories and the latest theories, concepts, technologies and methods in the field of international economic relations, taking into account their basic forms, to apply theoretical knowledge about the functioning and development of international economic relations. PC 3. Ability to identify features of the functioning of the environment of international economic relations and models of economic development. PC 11. Ability to conduct research on economic phenomena and processes in the international sphere, taking into account causal and spatio-temporal relationships. PC 16. The ability to constantly improve the theoretical level of knowledge, generate and effectively use them in practice. PC 20. Ability to search, critically evaluate and process information from various sources in the field of international business; generate conclusions, recommendations and proposals, new original ideas for (re) organization of business, planning and modeling of business processes and strategic (including anti-crisis) management.
Learning outcomes	Mastering the content of the discipline allows to get the following results: PR 1. Treat professional self-improvement responsibly, aware of the need

	for lifelong learning, show tolerance and readiness for innovative change. PR 3. Use modern information and communication technologies, general and special purpose software packages. PR 10. Identify and identify the features of the functioning of the subjects of international relations and models of their economic development. PR 13. Select and skillfully apply analytical tools to study the state and prospects of development of individual segments of international markets for goods and services using modern knowledge of methods, forms and tools of international trade regulationi. PR 14. Understand and apply theories, principles, tools and instruments for the implementation of international monetary, financial and credit relations. PR 23. Recognize the need for lifelong learning in order to maintain a high level of professional competence. PR 28. Use the acquired knowledge in the field of international management and marketing for independent analysis of world economic processes and making informed management decisions on this basis; analyze the specifics of the culture of international business in different countries; choose ways to enter international markets; analyze international markets and the international economic environment; develop measures to increase the competitiveness of the enterprise in foreign markets. PR 29. Carry out analysis and synthesis of international information; determine the information value of international databases; understand and use information that reflects the activities of international companies; to carry out competitive intelligence and other information and analytical research on a wide range of problems of international business, to communicate their results in the international business environment.

5. The structure of the educational component

Table 3

Name of content modules and themes	**Total (hours)**	**Lectures (hours)**	**Practical classes (hours)**	**Laboratory lessons (hours)**	**Self study (hours)**	**Consultations (hours)**	*** Form of control / Points**
SEMESTER I							
Content module 1 Elements of Linear and Vector Algebra and Analytic Geometry							
Theme 1. Matrices and operations on them. Determinants and their properties. Inverse matrix	4	2		2			*OS, ST*
Theme 2. Main methods of solving systems of linear (simultaneous) equations	12	2		4	5	1	*OS, ST /* **4 points**
Theme 3. Vectors and operations on them. Scalar, vector and mixed products of vectors and their applications. Goods space, price vector.	9	2	2	2	3		*OS, ST /* **2 points**
Theme 4. Straight line on plane and its equations. The angle between the straight lines	12	4		4	3	1	*OS, ST /* **4 points**
Theme 5. Application of methods of analytical geometry for solving economic problems: market equilibrium model; the balance of income and loss of companies; budget sets and budget constraint lines. Second-order curves	12	2		4	5	1	*OS, ST /* **4 points**
Total for module 1	**49 hrs**	**12 hrs**	**2 hrs**	**16 hrs**	**16 hrs**	**3 hrs**	**14 points**
Module test 1							*Presentation /* **5 points** + MT/ **15 points** **Total: 20 б points**
Content module 2. Introduction to mathematical analysis. The elements of Calculus							
Theme 1. Limit of a numerical sequence. Limit of a function.	4	2	2				*OS, ST/* **2 points**
Theme 2. Derivative of the first and higher orders. Differential. Application of the derivative to	9	2		2	5		*OS, ST /* **4 points**

the study of functions.							
Theme 3. Elements of differential calculus of a function of two variables. Application of functions and derivative in economic theory.	12	2		4	5	1	*OS, ST /* **2 points**
Theme 4. Antiderrivative and indefinite integral. Basic methods of integrating indefinite integrals	8	2	2		3	1	*OS, ST /* **4 points**
Theme 5. Definite integral, its application. Improper integrals. Application of integration methods in economic theory.	12	2	2	2	5	1	*OS, ST/* **2 points**
Total for module 2	**45 hrs**	**10 hrs**	**6 hrs**	**8 hrs**	**18 hrs**	**3 hrs**	**14 points**
Module test 2							*Presentation /* **5 points** + MT/ **15 points** **Total: 20 points**
Content module 3. Differential Equations. Numerical and Functional Series							
Theme 1. Basic concepts of the theory of differential equations. First-order differential equations: with separable variables; homogeneous; linear.	15	4	2	2	6	1	*OS, ST/* **4 points**
Them 2. Differential equations in economic processes.	9	2	2		5		*ST/* **4 points**
Theme 3. Series.	12	4	2		5	1	*O , ST/* **4 points**
Total for module 3	**36 hrs**	**10 hrs**	**6 hrs**	**2 hrs**	**16 hrs**	**2 hrs**	**12 points**
Module test 3							*Presentation /* **5 points** + MT/ **15 points** **Total: 20 points**
Total for semester: hours / points		**32 hrs**	**14 hrs**	**26 hrs**	**50 hrs**	**8 hrs**	**100 points**
Form of control	**exam**						

SEMESTER II							
Content module 1. Organizing, grouping and representation of data							
Theme 1. Methodological principles of statistics and presentation of statistical data	15	2	2		10	1	*OS, Presentation/* **5 points**
Theme 2. Statistical methods of analysis of socio-economic phenomena and processes.	11	2	2		6	1	*O , ST /* **5 points**
Theme 3. Statistical summary and grouping	11	2	2		6	1	*OS, ST /* **5 points**
Theme 4. Graphical Representation of Data. Statistical functions in Microsoft Excel.	15	4	4		6	1	*OS , ST /* **5 points**
Total for module 1	**52hrs**	**10hrs**	**10 hrs**		**28 hrs**	**4 hrs**	**20 points**
Module test 1							*Presentation /* **5 points** + MT/ **25 points** **Total: 30 points**
Змістовий модуль ІІ. Методи обчислення, аналізу та інтерпретації узагальнювальних статистичних показників							
Theme 1. Central Tendencies and Measure of Dispersion in mass socio-economic phenomena	13	2	2		8	1	*OS , ST /* **5 points**
Theme 2. Sampling and estimation	13	2	2		8	1	*OS , ST /* **5 points**
Theme 3. Significance Tests of Hypothesis	15	2	4		8	1	*OS , ST /* **5 points**
Theme 4. Correlation analysis and its application in economic analysis.	17	4	4		8	1	*OS , ST /* **5 points**
Total for module 2	**58 hrs**	**10 hrs**	**12 hrs**		**32 hrs**	**4 hrs**	**20 points**
Module test 2							*Presentation /* **5 points** + MT/ **25 points** **Total: 30 points**
Total for semester: hours / points	**110 hrs**	**20 hrs**	**22 hrs**		**60 hrs**	**8 hrs**	**100 hrs**
Form of control	**exam**						
Total:	**240hrs**	**52 hrs**	**36 hrs**	**26 hrs**	**110 hrs**	**16 hrs**	

***** *Form of control: OS - oral survey, SS - self study, ST - solving tasks, MT - modular Test.*

6. Tasks for an individual work

Table 4

#	Topics	Time (hrs)
	SEMESTER I	
1.	Application of linear algebra methods for solving economic problems: linear exchange model (international trade model); linear balance model (Leontiev model); model of equilibrium prices.	5
2.	Scalar and vector quantities. Concept of vector. Scalar product of vectors.	3
3.	The angle between two straight lines on a plane and in space. The angle between a straight line and a plane.	3
4.	Curves of the second order: circle, parabola. Application of analytical geometry methods for solving economic problems: market equilibrium model; the model of balance of income and losses of companies; budget sets and budget constraint lines.	5
5.	The application of the derivative for the studing of functions (monotonicity, extremum, the largest and smallest value of a function on an interval).	5
6.	Application of functions and derivatives in economic theory.	5
7.	The concept of the original. Table of integrals.	3
8.	Application of the definite integral.	5
9.	Application of integration methods in economic theory.	6
10.	Homogeneous, linear differential equations	5
11.	Application of the theory of differential equations in economic research.	5
Total for the 1st semester:		**50**
	SEMESTER II	
1.	Normative and legal provision of statistics. International statistical organizations.	10
2.	Concept of statistical information. Types and methods of observation.	6
3.	Methodology of statistical grouping. Scheme of typological and structural grouping. Scheme of analytical and combinational grouping. Methods of secondary grouping.	6
4.	Classification of statistical tables. Transfer of statistical tables. Statistical graph. Classification of statistical graphs.	6
5.	Averages and their essence and significance in the study of mass socio-economic phenomena.	8
6.	Simple random sampling. Systematic (mechanical) sampling. Serial sampling. Size of a sample.	8
7.	Statistical hypotheses and their varieties. General procedure for testing statistical hypothesis.	8
8.	Economic interpretation of the correlation relation and the coefficient of determination. Economic characteristics of regression equation parameters.	8
Total for 2-nd semester:		**60**
Total		**110**

IV. COURSE POLICY

Evaluation policy

The educational component is mandatory for students studying specialty 292 "International Economic Relations". A student has to fully master the knowledge, skills, practical skills and competences of this educational component.

The form of control is a semester's exam. Evaluation is carried out on a 100-point scale. The assessment includes current control (accrued for the quality performance of laboratory works) and final modular control (accrued for the performance of modular control works and modular test works).

The maximum number of points that a student can receive during the current assessment for the semester is 40 points. The final module control for the semester includes grades for all module control works, test tasks and is 60 points.

If at least 75 points are accumulated according to the results of the semester and the student agrees with this result, then the grade for the semester can be issued without taking the exam. Otherwise, the student takes the exam; the maximum number of points that can be obtained on the exam is 60 points, while the points for the final module control are canceled. The exam is held in written form. The grade for the semester in the case of passing the exam is the sum of the points of the current control and the points obtained during the exam.

Grading scale (national and ECTS)

A scale for evaluating the knowledge of education seekers on educational components, where the form of control is an exam

Scores	Linguistic score	ECTS score	
		grade	Explanation
90–100	Excellent	A	Outstanding performance without errors
82–89	Very good	B	Above the average standard but with minor errors
75–81	Fine	C	Generally sound work with some errors
67–74	Satisfactorily	D	Fair but with significant shortcomings
60–66	Enough	E	Performance meets the minimum criteria
1–59	Unsatisfactorily	Fx	Fail. Re-examenation is required

EXAM QUESTIONS

SEMESTER I

1. Definition of matrix. Types of matrices. Operations on matrices and their properties.
2. Determinant of the matrix. Basic methods of calculating determinants. Properties of determinants.
3. Basic methods of solving systems of linear equations (matrix, Kramer's and Gaussian's methods).
4. Rank of matrix. Methods of evaluating the rank of a matrix.
5. Application of linear algebra methods for solving economic problems: linear exchange model (international trade model); linear balance model (Leontiev model); model of equilibrium prices.
6. Scalar and vector quantities. Definition of a vector. Linear operations on vectors and their properties. Space of goods, vector of prices.
7. Scalar, vector and mixed products of vectors, their properties and applications.
8. A straight line on a plane is different equations of a straight line. Angle between two straight lines. The distance from a point to a straight line.
9. A plane in space. Different equations of the plane.
10. Angle between planes. The distance from the point to the plane.
11. Straight line in a space. Different equations of a straight line.
12. Mutual location of straight lines in space. Conditions of parallelism and perpendicularity of lines.
13. Mutual placement of a straight line and a plane.
14. Curves of the second order (definition, canonical equation, basic concepts and properties).
15. Application of analytical geometry methods to solving economic problems: market equilibrium model; the model of balance of income and losses of companies; budget sets and budget constraint lines.
16. The limit of a function at a point. Geometric interpretation.
17. Continuity of a function at a point and on an interval.
18. Application of functions in economic theory: cost function, income function, profit function, cost function, function of dependence of demand for various goods on population income. Their analysis.
19. Problems that lead to the concept of a derivative. The economic content of the derivative.
20. The application of the derivative for studing of functions: monotonicity, extremum, the largest and smallest value on the interval.
21. Study of the functions of two variables at the extremum.
22. The application of the derivative in economic theory: the derivative of the production function as: marginal costs, marginal revenue, marginal revenue, marginal profit of production, elasticity of the function of one variable and partial elasticity of the function of many variables of production functions, functions of demand and supply, maximization of income and profit and minimization costs in the case of production functions of one and many variables, minimization of transport costs, optimization of enterprise taxation, supply and demand functions, equilibrium price and web-like model.
23. Basic properties of the primitive and indefinite integral.
24. Basic methods of calculating the indefinite integral.
25. The definite integral, its properties and applications.
26. Application of integration methods in economic theory: calculation of total costs, income, profit based on known relevant marginal costs, income, profit; calculation of the volume of manufactured products based on known labor productivity; calculation of additional expenses, income and profit, calculation of profit from deposit interest with continuous accrual.

27. Series and their convergence.
28.A differential equation and its solution.
29. Differential equations with separated and separable variables.
30. Application of the theory of differential equations in economic research: the Evans model (setting the equilibrium price), the growth model (growth for a constant growth rate), the growth model under competitive conditions, the dynamic Keynes model, the neoclassical growth model, the market model with predicted prices.

SEMESTER II

1. Statistics as a science and a field of practical activity.
2. Subject, basic concepts and methods of statistics.
3. Normative and legal provision of statistics.
4. Organization of statistics in Ukraine and other countries. International statistical organizations.
5. The essence and organizational forms of statistical observation.
6. Types and methods of survey.
7. Grouping Data and Frequency Tables
8. Mean, Median, and Mode
9. Measures of Dispersion
10. Basic issues of statistical grouping methodology.
11. Probability Distributions and their application in grouping data and statistical study.
12. Graphical Representation of Data.
13. Data Shapes. Using Graphs to Compare Distributions
14. Sampling Terminology and Sampling Methods.
15. Representative sample and Sampling errors
16. Confidence Interval for the Mean.
17. Confidence Intervals for Proportions.
18. Confidence Interval for the Variance
19. Significance Tests of Hypothesis.
20.Type I and Type II Errors
21. Chi-Square Tests.
22. Goodness-of-Fit Test
23. Test of Independence
24. Bivariate Statistics
25. Statistical methods of correlation analysis and their application in economic analysis.

Resolution of conflict situations

Any conflict situation that arises among the participants of the educational process is resolved in accordance with the "REGULATION on the procedure and procedures for resolving conflict situations at Lesya Ukrainka Volyn National University".

The teacher's policy regarding the student

All participants in the educational process must comply with the requirements of the current legislation of Ukraine, the Statute and Rules of Internal Procedure of Lesya Ukrainka Volyn National University, generally accepted moral principles, rules of conduct and corporate culture; maintain an atmosphere of benevolence, responsibility, decency and tolerance. The atmosphere in classes should be creative, open to constructive criticism. Lateness to classes is unacceptable; using a mobile phone, tablet or other mobile devices during class; writing off Attending lectures, practical classes, consultations are mandatory.

Academic Integrity Policy

The policy, standards and procedures for compliance with academic integrity at Lesya

Ukrainka Volyn National University are reflected in the Code of Academic Integrity of Lesya Ukrainka Volyn National University. The requirements for academic integrity are determined by the "Regulations on the system of prevention and detection of academic plagiarism in research activities of higher education applicants and scientific and pedagogical workers of Lesya Ukrainka Volyn National University".

Every student of education must familiarize himself with and follow the Code of Academic Integrity of Lesya Ukrainka Volyn National University, adhere to ethical principles and rules defined by law, which should be guided by participants in the educational process during training, teaching and conducting scientific activities.

Observance of academic integrity by applicants involves: independent performance of educational tasks, tasks of current and final control (for persons with special educational needs, this requirement is applied taking into account their individual needs and capabilities); references to sources of information in the case of using ideas, statements, information; compliance with copyright legislation; providing reliable information about the results of one's own educational (scientific, creative) activities.

During the evaluation of learning results, students do not use prohibited means (mobile phone, tablet, notes, educational literature, other sources of information, including Internet resources), independently perform the proposed tasks.

Deadlines and Rescheduling Policy

If the student of higher education was absent from classes for any reason, he/she has to study the theoretical material by himself using textbooks, lecture notes, performs all tasks for classroom classes, all homework.

There is a possibility to report on the completion of tasks within the deadlines set by the teacher during consultations, at the same time clarify unclear points, ask questions to the teacher. The debt from the module must be liquidated by the student before the final control from the next module begins. The deadline for liquidation of arrears from modular control is limited to the beginning of the credit and examination session.

Passing over the modular control is not allowed. Tasks that are submitted late without any reason will be assigned a lower grade.

V. Recommended literature and Internet resources

Methodical support

1. Maria Khomyak Mathematics and statistics for economists: some guidelines on Statistics. Lutsk : Lesia Ukrainka VNU, 2022. 22 p.
2. Maria Khomyak Statistics: Course Description. Lutsk : Lesia Ukrainka VNU, 2022. 26 p.
3. Khomyak M. Analysis of data on the organization of distance learning. M*iddle east international conference on contemporary scientific studies-V*, March 27-28, 2021, Ankara, Turkey. Vol.II, P. 384-386.
4. Khomyak M. A polinomial errors-in-variables model in forecasting of economic processes. *Information society: technological, economic and technical aspects of development: coll. theses add. International of science Internet Conf.* Vol. 52. Ternopil, 2020. P. 17-19. (in Ukr.)
5. Maria Khomyak A goodness-of-fit test of a difussion model Hagia Sophia. *5th International conference on multidisciplinary scientific studies*. 2022. Istanbul, Turkey, 2022. P.85-86.

Recommended Books

1. Aliluyko A.M. Higher mathematics in examples and problems for economists: teaching. manual / edited by: Aliluyko A.M., Dzyubanovska N.V., Lesyk O.F., Nemish V.M., Novosad I.Ya., Shinkaryk M.I. Ternopil: TNEU, 2017. 148 p. (in Ukr.)
2. Beskrovnyi O.I. Mathematics for economists: Higher mathematics [Text]: synopsis of lectures for students of economic specialties. Kyiv: UU, 2019. 192 p. (in Ukr.)
3. Horkavy V. K. Statistics: Textbook. Kind. 3rd, perovl. and added Textbook. Kyiv: Alerta, 2020. 644 p. (in Ukr.)

4. Gorodyanska L. V., Syzov A. I. Statistics for economists: Education. manual. Kyiv: Kyiv. national T. Shevchenko University, 2019. 350 p. (in Ukr.)
5. Kraevsky V. M. Statistics: Education. manual Irpin, 2019. 218 p. (in Ukr.).
6. Motoryn R.M., Chekotovskyi E.V. Statistics for economists: a study guide. Kyiv: Znannia, 2021. 381p. (in Ukr.)
7. Neter, Wasserman, and Whitmore. Applied Statistics, 4th Edition, Allyn and Bacon, Boston, MA.
8. Ryan, T. A. Significance Tests for Multiple Comparisons of Proportions, Variances, and Other Statistics, Psychological Bulletin, 57, 2018. P. 318-328.

Internet resources

1. State Statistics Service of Ukraine. [Electronic resource]. URL: www.ukrstat.gov.ua
2. UN Statistical Committee. [Electronic resource]. URL: http://unstats.un.org/
3. International Institute of Statistics. [Electronic resource]. URL: http://isi.cbs.nl/
4. UN Statistical Committee. [Electronic resource]. Access mode: http://unstats.un.org/ 2.
5. International Institute of Statistics. [Electronic resource]. Access mode: http://isi.cbs.nl/.
6. Trevor Hastie, Robert Tibshirani, and Jerome Friedman.The Elements of Statistical Learning. https://hastie.su.domains/ElemStatLearn/
7. Data Science Full Course - Learn Data Science in 10 Hours | Data Science For Beginners | Edureka https://www.youtube.com/watch?v=-ETQ97mXXF0
8. Statistics - A Full University Course on Data Science Basics https://www.youtube.com/watch?v=xxpc-HPKN28