KSPEU

MINISTRY OF SCIENCE AND HIGHER EDUCATION OF THE RUSSIAN FEDERATION
Federal State Budgetary Educational Institution of Higher Education
«KAZAN STATE POWER ENGINEERING UNIVERSITY»
(FSBEI HE «KSPEU»)

APPROVED
Director of the Institute of Digital Technologies and Economics
_____Zainullin R.R.
«24»_____February_____2026

WORK PROGRAM FOR THE DISCIPLINE

B1.M.24 Economic and mathematical modeling

Field of training — 38.03.02 Management

Qualification — Bachelor's Degree

Kazan, 2026

The program was developed by:

Department Name	Position, Academic Degree, Academic Rank	Full Name of the Developer
HistoryandPedagogy	Associate Professor, Candidate of Technical Sciences	_____ S.A. Livshits

Approval	Department Name	Date	No.	Signature
Approved	By the EOP	05.03.26	11	_____ Associate Professor, Candidate of Economics, Associate Professor Livshits S.A.
Agreed upon	Management	10.02.2026	Protocol №5	_____ Head of the Department, Doctor of social sciences, prof. Makhiyanova A.V.
Agreed upon	Educational and Methodological Board of the Institute of Digital Technologies and Economics	24.02.2026	Protocol №6	_____ Director, PhD in Technical Sciences, Assoc. Prof. R.R. Zainullin
Approved	Academic Board of the Institute of Digital Technologies and Economics	24.02.2026	Protocol №6	_____ Director, PhD in Technical Sciences, Assoc. Prof. R.R. Zainullin

1. Purpose, objectives and planned learning outcomes for the discipline

The aim of the discipline "Economic and Mathematical Modelling" is to acquire knowledge, skills and practical abilities for the application of statistical methods in professional activities.

The objectives of the discipline are:

- to acquire knowledge of methods for collecting, processing and analysing statistical data;
- to acquire skills in summarising and grouping statistical data;
- to acquire skills in analysing the interrelationships and dynamics of socio-economic phenomena and processes;
- mastering modern methods of modelling and forecasting.

Competencies and indicators developed in students:

Competency code and name	Code and name of indicator
GPC-2 Is able to collect, process, and analyze data necessary for solving management tasks using modern tools and intelligent information and analytical systems	GPC-2.5 Able to apply methods of analysis, modeling, theoretical and experimental research in solving professional tasks
GPC-3 Able to develop sound organizational and management decisions, taking into account their social significance, promote their implementation in a complex and dynamic environment, and evaluate their consequences	GPC-3.2 Applies basic methods for assessing the needs and effectiveness of an organization's resource use to identify key organizational and management decisions, taking into account their social significance

2. Place of the discipline in the structure of the educational programme

The discipline "Economic and Mathematical Modelling" belongs to the main part of the curriculum for the training programme 38.03.01 "Economics".

Prerequisite disciplines (modules), practical training, research work, etc.:

- Mathematics.
- Fundamentals of Statistics.
- Business planning.

Subsequent disciplines (modules), practical training, research work, etc.:

Analysis of financial and economic activities.

- Methods of optimal decision-making.
- Final Qualification Work.

3. Structure and content of the discipline
3.1. Structure of the discipline

For full-time study

Type of academic work	Total ZE	Total hours	Semester(s)
			4
TOTAL WORKLOAD OF THE DISCIPLINE	5	180	180
CONTACT WORK*	-	85	85
AUDIT WORK	1.9	68	68
Lectures	0.94	34	34
Practical (seminar) classes	0.94	34	34
INDEPENDENT STUDY BY THE STUDENT	3.1	112	112
Study of educational material	2.1	76	76
Preparation for interim assessment	1	36	36
Interim assessment:			E

For full-time and part-time study

Type of academic work	Total ZE	Total hours	Semester(s)
			5
TOTAL WORKLOAD OF THE DISCIPLINE	5	180	180
CONTACT WORK*	-	55	55
AUDIT WORK	0.9	32	32
Lectures	0.45	16	16
Practical (seminar) classes	0.45	16	16
INDEPENDENT STUDY BY THE STUDENT	4.1	148	148
Study of educational material	3.85	139	139
Preparation for interim assessment	0.25	9	9
Interim assessment:			E

3.2. Course content, structured by sections and types of classes

Sections of the discipline	Total hours	Distribution of workload by type of academic work			Forms and types of of control	Indices of indicators of competencies being formed
		lectures	practical classes	independent work		
Section 1	45	10	10	25	TK1	OPK-2.5-Z, OPK-2.5-U, OPK-2.5-V
Section 2	54	14	14	26	TK2	OPK-2.5-Z, OPK-2.5-U, OPK-2.5-V OPK-3.2-Z, OPK-3.2-U, OPK-3.2-V
Section 3	45	10	10	25	TK3	OPK-2.5-Z, OPK-2.5-U, OPK-2.5-V

						OPK-3.2-Z, OPK-3.2-U, OPK-3.2-V
Exam	36			36	**OM**	OPK-2.5-Z, OPK-2.5-U, OPK-2.5-V OPK-3.2-Z, OPK-3.2-U, OPK-3.2-V
TOTAL	**180**	**34**	**34**	**112**		

3.3. Course content

Section 1. Statistical observation. Statistical methods of classification and grouping

Topic 1. Introduction to game theory. Classification of games. Antagonistic games with a saddle point. Simplification of games. Duplicate and majoritarian strategies. Nash equilibrium. Selection of the optimal strategy.

Topic 2. Games with nature. Criteria-based approach. Choosing criteria for determining the optimal strategy. The concept of information cost. Coalition games and approaches to solving them

Section 2. Statistical methods for analysing the interrelationships between socio-economic phenomena and sociological information

Topic 3. Introduction to LP. Graphical and simplex methods for solving LP problems. Sensitivity analysis of LP solutions.

Section 3. Dynamics of socio-economic phenomena. Indices

Topic 4. Distribution problems and their areas of application. Models used in solving transport problems. Prohibitive tariffs and model balancing. Stages of constructing models for solving transport problems. Construction of a reference plan. The potential method for solving transport problems. Other approaches to solving distribution problems

Topic 5. Stages of constructing models for solving transport problems. Construction of a reference plan. The potential method for solving transport problems. Other approaches to solving distribution problems

3.4. Thematic plan for practical classes

1. Introduction to game theory. The concept of a saddle point. Antagonistic games. Simplification of games. Nash equilibrium.

2. Games with nature. Choosing criteria for determining the optimal strategy. The concept of information price. Coalition games. Approaches to solving coalition games.

3. Introduction to LP. Graphical method for solving LP problems. Simplex method for solving LP problems. Sensitivity analysis of LP solutions.

4. Distribution problems. Areas of application of distribution problems. Methods and models in linear programming. Formulation of a transport problem. Models used in solving transport problems. Prohibitive tariffs and model balancing.

5. Stages of constructing models for solving transportation problems.

Construction of a basic plan. The potential method for solving transportation problems. Other approaches to solving distribution problems.

3.5. Thematic plan for laboratory work

This type of work is not included in the curriculum.

3.6. Course project/coursework

This type of work is not included in the curriculum.

4. Assessment of learning outcomes

Assessment of learning outcomes for the discipline is carried out as part of ongoing monitoring and interim assessment, conducted using a point-based rating system (PBS).

The scale for assessing learning outcomes for the discipline is as follows:

Code Competence	Competence Competence indicator code	Planned results learning in the subject	Level of development of the indicator of competence			
			High	Average	Below than average	Low
			from 85 to 100	70 to 84	from 55 to 69	from 0 to 54
			Grading scale			
			excellent	good	satisfactory	unsatisfactory
			pass			not counted
GPC-2 Is able to collect, process, and analyze data necessary for solving management tasks using modern tools and intelligent information and	GPC-2.5 Able to apply methods of analysis, modeling, theoretical and experimental research in solving professional tasks	Know:				
		methods of collecting, processing and statistically analysing data necessary for solving economic problems	Has a high level of knowledge of methods for collecting, processing and statistically analysing data necessary for solving economic problems	Good knowledge of methods for collecting, processing and statistically analysing data necessary for solving economic problems	Does not have sufficient knowledge of methods for collecting, processing and statistically analysing data necessary for solving economic problems	Does not know the methods of collecting, processing and statistically analysing data necessary for solving economic tasks
		methods of modelling and forecasting the development of economic phenomena and processes	Has a high level of knowledge of methods for modelling and forecasting economic phenomena and processes	Has a good knowledge of methods for modelling and forecasting the development of economic phenomena and processes	Does not sufficiently know methods of modelling and forecasting the development of economic	Does not know methods of modelling and forecasting the development of economic phenomena

analytical systems						
					phenomena and processes	and processes
		Be able to:				
		collect, process and statistically analyse data, conduct statistical research	High level of ability to collect, process and statistically analyse data, conduct statistical research	Good at collecting, processing and statistically analysing data, conducting statistical research	Not sufficiently proficient in collecting, processing and statistically analysing data, conducting statistical research	Unable to collect, process and statistically analyse data, conduct statistical research
		apply the mathematical apparatus of probability theory and mathematical statistics to model and forecast the development of economic phenomena and processes	High level of proficiency in applying mathematical tools of probability theory and mathematical statistics for modelling and forecasting the development of economic phenomena and processes	Is able to apply the mathematical apparatus of probability theory and mathematical statistics to model and forecast the development of economic phenomena and processes at a good level	Insufficiently proficient in applying mathematical tools of probability theory and mathematical statistics for modelling and forecasting the development of economic phenomena and processes	Unable to apply the mathematical apparatus of probability theory and mathematical statistics for modelling and forecasting the development of economic phenomena and processes
		Possess:				
		skills in applying the mathematical apparatus of probability theory and mathematical statistics, performing modelling and forecasting of the development of socio-economic	High level of proficiency in applying the mathematical apparatus of probability theory and mathematical statistics, performing modelling and forecasting	Good command of the mathematical apparatus of probability theory and mathematical statistics, performing modelling and forecasting of socio-economic	Does not have sufficient skills in applying the mathematical apparatus of probability theory and mathematical statistics, performing modelling and forecasting of the	Does not possess the skills to apply the mathematical apparatus of probability theory and mathematical statistics when modelling and forecasting the

		phenomena and processes	of socio-economic phenomena	phenomena and processes	development of socio-economic	development of socio-economic
			and processes		phenomena and processes	phenomena and processes
GPC-3 Able to develop sound organizational and management decisions, taking into account their social significance, promote their implementation in a complex and dynamic environment, and evaluate their consequences	GPC-3.2 Applies basic methods for assessing the needs and effectiveness of an organization's resource use to identify key organizational and management decisions, taking into account their social significance	Know:				
		the methodological foundations of the functioning of the economic nature at the micro and macro levels	Has a high level of knowledge of the methodological foundations of the functioning of the economic nature at the micro and macro levels	Has a good understanding of the methodological foundations of the functioning of the economic nature at the micro and macro levels	Does not have a sufficiently good knowledge of the methodological foundations of the functioning of the economic nature at the micro and macro levels	Does not know the methodological foundations of the functioning of the economic nature at the micro and macro levels
		Be able to:				
		analyse and interpret the nature of economic processes at the micro and macro levels	High level of ability to analyse and interpret the nature of economic processes at the micro and macro levels	Able to analyse and interpret the nature of economic processes at the micro and macro levels at a good level	Not sufficiently skilled at analysing and interpreting the nature of economic processes at the micro and macro levels	Unable to analyse and interpret the nature of economic processes at the micro and macro levels
		Possess:				
		skills in applying economic knowledge to assess the nature of economic processes at the micro and macro levels	High level of proficiency in applying economic knowledge to assess the nature of economic processes at the micro and macro levels	Good level of proficiency in applying economic knowledge to assess the nature of economic processes at the micro and macro levels	Does not have sufficient skills in applying economic knowledge to assess the nature of economic processes at the micro and macro levels	Does not possess the skills to apply economic knowledge to assess the nature of economic processes at the micro and macro levels

Assessment materials for ongoing monitoring and interim assessment are provided in the Appendix to the course syllabus.

A complete set of assignments and materials necessary for assessing learning outcomes in the discipline is stored at the developer's department.

5. Teaching, methodological and information support for the discipline

5.1. Teaching and methodological support

1. Katargin, N. V. Economic and mathematical modelling: a textbook for universities / N. V. Katargin. — 2nd ed., revised. — Saint Petersburg: Lan, 2022. — 256 p. — ISBN 978-5-507-44332-1. — Text: electronic // Lan: electronic library system. — URL: https://e.lanbook.com/book/223430.

2. Kiselev, V. V., Mathematical Modelling of Socio-Economic Processes (Methods of Optim al Solutions): Textbook / V. V. Kiselev, V. M. Goncharenko. — Moscow: KnoRus, 2023. — 179 p. — ISBN 978-5-406-11419-3. — URL: https://book.ru/book/949200. — Text: electronic.

5.1.2. Additional literature

1. Methods of optimal solutions (Economic and mathematical methods and modelling): textbook / S. I. Makarov, M. V. Kurghanova, E. Yu. Nuikina [et al.]; edited by S. I. Makarov. — Moscow: KnoRus, 2022. — 298 p. — ISBN 978-5-406-09775-5. — URL: https://book.ru/book/944117. — Text: electronic.

2. Pirogova, I. N. Theory of Queues: Teaching Manual / I. N. Pirogova, P. P. Skachkov, E. G. Filippova. — Yekaterinburg: , 2017. — 84 p. — Text: electronic // Lan: electronic library system. — URL: https://e.lanbook.com/book/121340. — Access mode: for authorised users.

3. Soroka, M. S. Differential Equations in Natural Science and Technical Problems: Textbook / M. S. Soroka, I. Yu. Pokornaya, A. N. Ovsyannikova; edited by V. V. Obukhovsky. — Voronezh: VSPU, 2022. — 84 p. — ISBN 978-5-00044-889-2. — Text: electronic // Lan: electronic library system. — URL: https://e.lanbook.com/book/266963. — Access mode: for authorised users.

5.2. Information support

5.2.1. Electronic and Internet resources

1. Open Education Portal. http://npoed.ru
2. Single window for access to educational resources. http://window.edu.ru

5.2.2. Professional databases / Information and reference systems

1. Scientific electronic library http://elibrary.ru/
2. Federal educational portal "Economics, Sociology, Management". http://ecsocman.hse.ru/
3. Reference system "Consultant Plus" http://consultant.ru/
4. Reference and legal system on Russian legislation http://garant.ru/
5. Portal of Federal State Educational Standards of Higher Education. http://fgosvo.ru
7. Electronic library of dissertations (RGB). https://diss.rsl.ru/
8. Official website of the State Duma of the Federal Assembly of the Russian Federation. http://duma.gov.ru/

5.2.3. Licensed and freely distributed software for the discipline

No	Name of software	Description	Requisites
No	Description		supporting documents
1	Windows 7 Professional (Pro)	User operating system	SoftLineTrade CJSC No. 2011.25486 dated 28 November 2011. Non-exclusive right. Perpetual
2	Office Professional Plus 2007 Windows32 Russian DiskKit MVL CD	A package of software products containing the necessary office programmes	SoftLineTrade CJSC No. 225/10 dated 28 January 2010. Non-exclusive right. Indefinite term
3	Chrome browser	Internet search engine	Free licence. Non-exclusive right. Perpetual
4	Firefox browser	Internet search engine	Free licence. Non-exclusive right. Perpetual
5	OpenOffice	Office application suite	Free licence. Non-exclusive right. Perpetual
	1C: Enterprise 8	Software designed to automate accounting and management accounting, economic and organisational activities of an enterprise	IE Valishina No. VZS0000641-L dated 22 May 2013 Non-exclusive right. Perpetual
	1C: Enterprise 8 Training kit for higher and secondary educational institutions	"Software for automating accounting and management accounting, economic and organisational activities of the enterprise"	BIT Business Solution LLC No. 21/000608 dated 05.2010 Non-exclusive right. Indefinite
6	LMS Moodle	Software for effective online interaction between teachers and students	Free licence. Non-exclusive right. Perpetual

6. Material and technical support for the discipline

Name of type of educational work	Name of classroom, specialised laboratory	List of necessary equipment and technical teaching aids
Lectures	Classroom for lecture-type classes	Specialised educational furniture, technical teaching aids used to present educational information to a large audience (multimedia projector, computer (laptop), screen), demonstration equipment, visual teaching aids
Practical classes	Classroom for seminars, group and individual consultations, ongoing assessment and interim certification	Specialised educational furniture, technical teaching aids (multimedia projector, computer (laptop), screen), etc.
Independent work	Computer classroom with Internet access B-600a	Specialised educational furniture for 30 seats, 30 computers, technical teaching aids (multimedia projector, computer (laptop), screen), video cameras, software
	Reading room Library	Specialised furniture, computer equipment with Internet access and access to the Electronic Information and Educational System, screen,

		multimedia projector, software

7. Features of the organisation of educational activities for persons with limited health capabilities and disabilities

Persons with disabilities and special health needs have the opportunity to move freely from one teaching and laboratory building to another, to go up to all floors of the teaching and laboratory buildings, and to study in classrooms and other premises, taking into account the characteristics of their psychophysical development and state of health.

For the education of persons with disabilities and persons with disabilities who have musculoskeletal disorders, conditions for unimpeded access to all educational premises are provided. Information about the special conditions created for students with disabilities and special educational needs is available on the university website www// kgeu. ru . Technical assistance from an assistant is available, as well as sign language interpreters and deaf-blind interpreters.

The following conditions are provided to adapt reference and educational materials for persons with disabilities and hearing impairments:

- for better orientation in the classroom, signals are used to indicate the beginning and end of the lesson (the word "bell" is written on the board);
- the teacher attracts the attention of a hearing-impaired student with a gesture (a hand is placed on the shoulder, a gentle pat is given);
- When talking to a student, the teacher looks at them, speaks clearly, in short sentences, allowing them to read lips.

Compensation for speech and intellectual development difficulties in hearing-impaired students is achieved by:

- using diagrams, charts, drawings, computer presentations with hyperlinks commenting on individual components of the image;
- regularly using exercises to graphically highlight the essential features of objects and phenomena;
- providing students with the opportunity to receive targeted advice by email as needed.

In order to adapt the reference, educational and informational materials provided by the educational programme in the chosen field of study to the perception of persons with disabilities and visually impaired persons, the following conditions are provided:

- adaptation of the official website on the Internet, taking into account the special needs of visually impaired persons, provision of large-print reference information on the schedule of training sessions;
- the teacher and his or her interlocutor (if necessary) present at the class are introduced to the students, and each time the name of the person to whom the teacher is addressing is mentioned;
- The actions, gestures and movements of the teaching staff are commented on briefly and clearly.
- Printed information is provided in large print (18 point font) and is read aloud in its entirety.
- The necessary level of lighting in the premises is ensured.

- Students are given the opportunity to use computers during classes and the right to record explanations on a dictaphone (at the students' request).

The form of ongoing and interim assessment for students with SEN and disabilities is determined by the teaching staff in accordance with the curriculum. If necessary, students with special educational needs and disabilities, taking into account their individual psychophysical characteristics, are given the opportunity to take interim assessments orally, in writing on paper, in writing on a computer, in the form of tests, etc., or are given additional time to prepare their answers.

8. Methodological recommendations for teachers on organising educational work with students.

Methodological support for the educational process is one of the determining factors of high-quality education. University teachers, demonstrating high professionalism, erudition, a clear civic position, self-discipline, and a creative approach to solving professional tasks, contribute to the formation of a harmonious personality during the educational process.

When teaching the subject, the teacher may use the following educational methods:

- methods of shaping personal awareness (conversation, debate, suggestion, instruction, control, explanation, example, self-control, storytelling, advice, persuasion, etc.);
- methods of organising activities and shaping behavioural experience (assignments, public opinion, pedagogical requirements, instructions, training, creating educational situations, training, exercises, etc.);
- methods of motivating activities and behaviour (approval, encouragement of social activity, reprimands, creating situations for success, creating situations for emotional and moral experiences, competition, etc.)

When teaching the subject, the teacher should take into account the following areas of educational activity:

Civic and patriotic education:

- forming in students a holistic worldview, Russian identity, respect for their family, society, state, spiritual, moral and socio-cultural values accepted in the family and society, national, cultural and historical heritage, forming a desire to preserve and develop it;
- to develop an active civic position in students based on the traditional cultural, spiritual and moral values of Russian society in order to increase their ability to responsibly exercise their constitutional rights and obligations;
- developing students' legal and political culture, expanding their constructive participation in decision-making that affects their rights and interests, including in various forms of self-organisation, self-government and socially significant activities;
- the formation of motives, moral and meaningful attitudes of the individual that enable them to resist extremism, xenophobia, discrimination on social, religious, racial or national grounds, inter-ethnic and inter-confessional intolerance, and other negative social phenomena.

Spiritual and moral education:

- cultivating a sense of dignity, honour and honesty, conscientiousness, respect for parents, teachers and older people;
- the formation of principles of collectivism and solidarity, a spirit of , mercy and compassion, and the habit of caring for people in difficult life situations;
- the formation of solidarity and a sense of social responsibility towards people with disabilities, overcoming psychological barriers towards people with disabilities;
- the formation of an emotionally rich and spiritually elevated attitude towards the world, the ability and skill to convey one's aesthetic experience to others.

Cultural and educational upbringing:

- forming an aesthetic picture of the world;
- developing respect for the cultural values of one's hometown, region, and country;
- increasing the cognitive activity of students.

Scientific and educational upbringing:

- developing a scientific worldview in students;
- developing the ability to acquire knowledge;
- developing skills for analysing and synthesising information, including in the professional field.

Changes and approvals for the new academic year

No No.	No. of section of changes	Date of changes of changes	Content of changes	"Approved" Head of the department teaching the discipline	"Approved" Chair of the Academic Council of the institute (faculty) to which the implementing department belongs)
1	2	3	4	5	6
1					
2					
3					

Appendix to the course syllabus

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ASSESSMENT MATERIALS
for the discipline

B1.M.24 Economic and mathematical modeling

(Name of the discipline in accordance with the curriculum)

Kazan, 2026

Assessment materials for the discipline "Economic and Mathematical Modelling" are intended to evaluate learning outcomes for compliance with competency achievement indicators.

Assessment of learning outcomes for the discipline is carried out as part of ongoing assessment (OA) and interim assessment, conducted using a point-based rating system (PBS).

1. Technological map

Semester 4

Section name	Forms and types of assessment	Rating indicators							
		I ongoing assessment	Additional points to TC1	II ongoing assessment	Additional points to TC2	III ongoing assessment	Additional points to TC3	Total	Interim assessment
Section 1. "Statistical observation. Statistical methods of classification and grouping"	**TC1**	**15**	**0**					**15**	**15**
Interview (Sbs)		5	5					10	10
Practical assignment (PA)		7	7					14	14
Report (Rep), presentation (Pres)		3	3					6	6
Section 2. "Statistical methods for analysing the interrelationships between socio-economic phenomena and sociological information"	**TC2**			**20**	**0-15**			**20**	**20**
Interview (Sbs)				4	3			7	7
Practical assignment (PA)				13	9			22	22
Report (R), presentation (P)				3	3			6	6
Section 3. "Dynamics of socio-economic phenomena. Indices"	**TC3**					**20**	**0-15**	**20**	**20**
Interview (Sbs)						5	3	8	8
Practical assignment (PA)						11	9	20	20
Report (R), presentation (P)						4	3	7	7
									55-100
Interim assessment (exam)	**OM**								**0-45**
In written form based on tickets									0-45

2. Assessment materials for ongoing assessment and interim assessment

Scale for assessing learning outcomes in the discipline:

Code compete	Code indicator code	Planned results results of training in discipline	Level of development of the indicator of competence			
			High	Average	Below than average	Low
			from 85 to 100	70 to 84	from 55 to 69	from 0 to 54

			Grading scale			
			excellent	good	satisfactory	unsatisfactory
			pass			not counted
GPC-2 Is able to collect, process, and analyze data necessary for solving management tasks using modern tools and intelligent information and analytical systems	GPC-2.5 Able to apply methods of analysis, modeling, theoretical and experimental research in solving professional tasks	Know:				
		methods of collecting, processing and statistically analysing data necessary for solving economic problems	Has a high level of knowledge of methods for collecting, processing and statistically analysing data necessary for solving economic problems	Good knowledge of methods for collecting, processing and statistically analysing data necessary for solving economic problems	Does not have sufficient knowledge of methods for collecting, processing and statistically analysing data necessary for solving economic problems	Does not know the methods of collecting, processing and statistically analysing data necessary for solving economic problems
		methods of modelling and forecasting the development of economic phenomena and processes	Has a high level of knowledge of methods for modelling and forecasting the development of economic phenomena and processes	Has a good knowledge of methods for modelling and forecasting the development of economic phenomena and processes	Does not have a sufficiently good knowledge of methods for modelling and forecasting the development of economic phenomena and processes	Does not know methods for modelling and forecasting the development of economic phenomena and processes
		Be able to:				
		Collect, process and statistically analyse data, conduct statistical research	High level of proficiency in collecting, processing and statistically analysing data, conducting statistical research	Good at collecting, processing and statistically analysing data, conducting statistical research	Not sufficiently proficient in collecting, processing and statistically analysing data, conducting statistical research	Unable to collect, process and statistically analyse data, conduct statistical research
		apply the mathematical apparatus of probability theory and mathematical statistics to model and forecast the development of economic	Highly proficient in applying mathematical apparatus of probability theory and mathematica	Good ability to apply the mathematical apparatus of probability theory and mathematical statistics for modelling	Not sufficiently skilled in applying the mathematical apparatus of probability theory and mathematical	Unable to apply the mathematical apparatus of probability theory and mathematical statistics for modelling

		phenomena and processes	l statistics for modelling and forecasting the development of economic phenomena and processes	and forecasting the development of economic phenomena and processes	statistics for modelling and forecasting the development of economic phenomena and processes.	and forecasting the development of economic phenomena and processes
		Possess:				
		skills in applying the mathematical apparatus of probability theory and mathematical statistics, performing modelling and forecasting of the development of socio-economic phenomena and processes	High level of proficiency in applying the mathematical apparatus of probability theory and mathematical statistics to model and forecast the development of socio-economic phenomena and processes	Good command of the mathematical apparatus of probability theory and mathematical statistics, performing modelling and forecasting of the development of socio-economic phenomena and processes	Does not have sufficient skills in applying the mathematical apparatus of probability theory and mathematical statistics to model and forecast the development of socio-economic phenomena and processes	Does not possess the skills to apply the mathematical apparatus of probability theory and mathematical statistics in modelling and forecasting the development of socio-economic phenomena and processes
GPC-3 Able to develop sound organizational and management decisions, taking	GPC-3.2 Applies basic methods for assessing the needs and effectiveness of an organizatio	Know:				
		the methodological foundations of the functioning of the economic nature at the micro and macro levels	Has a high level of knowledge of the methodological foundations of the functioning of the economic	Has a good understanding of the methodological foundations of the functioning of the economic nature at the	Insufficient knowledge of the methodological foundations of the functioning of the economic nature at the	Does not know the methodological foundations of the functioning of the economic nature at the micro- and

into account their social significance, promote their implementation in a complex and dynamic environment, and evaluate their consequences	n's resource use to identify key organizational and management decisions, taking into account their social significance		nature at the micro- and macro-levels	micro- and macro-levels	micro- and macro-levels	macro-level
		Be able to:				
		analyse and interpret the nature of economic processes at the	Highly skilled at analysing and interpreting the nature of	Able to analyse and interpret the nature of economic	Not sufficiently able to analyse and interpret the	Unable to analyse and interpret the nature of economic

		micro and macro levels	economic processes at the micro and macro levels	processes at the micro and macro levels at a good level	nature of economic processes at the micro and macro levels	processes at the micro and macro levels
		Possess:				
		skills in applying economic knowledge to assess the nature of economic processes at the micro and macro levels	High level of proficiency in applying economic knowledge to assess the nature of economic processes at the micro and macro levels	Good level of skills in applying economic knowledge to assess the nature of economic processes at the micro and macro levels	Insufficient skills in applying economic knowledge to assess the nature of economic processes at the micro and macro levels	Does not possess the skills to apply economic knowledge to assess the nature of economic processes at the micro and macro levels

An **"excellent"** grade is given if the student fully presents the material (answers questions) and correctly defines the basic concepts; for demonstrating the student's knowledge of the material on the topic of the practical work, identifying the relationship between the indicators of the task, and correctly solving more than 85% of the tasks; for the relevance of the report's content to the topic covered, the completeness of the topic disclosed in the report, the presentation of information in the presentation, correct and reasoned answers to questions about the report; answers to exam questions on the ticket.

A **"good"** grade is given if the student presents the material well (answers questions), gives correct definitions of concepts, but there are inaccuracies in the answers; for demonstrating the student's knowledge of the subject matter of the practical work, allowing minor inaccuracies in solving problems with 70-85% of the problems solved correctly; for the relevance of the content of the report to the topic covered, the completeness of the topic disclosed in the report, the presentation of information in the presentation, with minor inaccuracies in answering questions about the report; there were also inaccuracies in the answers to the exam questions on the ticket.

A **"satisfactory"** grade is given if the student presents the material (answers questions) incompletely and makes inaccuracies in defining concepts; if the student has difficulty correctly assessing the proposed task, gives an incomplete answer that requires leading questions from the teacher, the choice of the algorithm for solving the task is possible with leading questions from the teacher (50-70% of tasks solved); for the content of the report to correspond to the topic covered, but there are logical inconsistencies in the presentation of the material and inaccuracies in answering questions about the report; when answering exam questions, the wording is not sufficiently correct, and the sequence and presentation of the programme material is disrupted.

A student is given an **"unsatisfactory"** grade if they have significant problems with their knowledge of the basic theoretical and practical material, the content of the questions is not fully disclosed, the solution algorithm is incorrectly chosen (less than 50% of the problems are solved); the content of the report does not

reveal the stated topic, there are logical inconsistencies in the presentation of the material, significant inaccuracies in answering questions about the report; when answering the exam questions, the student demonstrates a lack of knowledge of the programme material, and there are errors in the answers.

3. List of assessment tools

Brief description of the assessment tools used for ongoing monitoring of student progress and interim assessment in the discipline:

Name assessment tool	Brief description of the assessment tool	Description of the assessment tool
Interview (Sbs)	A means of assessment organised as a special conversation between a teacher and a student on topics related to the subject being studied, designed to ascertain the extent of the student's knowledge of a particular section, topic, problem, etc.	Questions on sections of the discipline
Practical assignment (PA)	A means of assessing the ability to apply theoretical knowledge in a practical situation. The assignment is aimed at assessing competencies in the discipline and contains clear instructions for completion or an algorithm of actions.	Set of tasks and assignments
Report (Dkl), presentation (Sbsch)	The product of a student's independent work, consisting of a public presentation of the results obtained in solving a specific educational-practical, educational-research or scientific topic.	Topics for reports and presentations

4. List of test assignments or other materials necessary for assessing the knowledge, abilities and skills that characterise the stages of competence formation in the process of mastering the discipline

Examples of assignments

For ongoing assessment TK1:

Questions for comprehensive assignment TK1.

Questions for the interview

1. What types of games are there depending on the interests of the participants?
2. How is the winning function represented in a matrix game?
3. What is a zero-sum game?
4. What is the process of "playing a matrix game"?
5. What determines the positive value of a payment matrix element?
6. What determines the negative value of a payment matrix element?
7. What is an n*m game?
8. What player strategy is called optimal?
9. What values are called the lower and upper prices of the game?
10. What inequality between the lower and upper prices of the game is always

true?

Practical tasks:

Task 1. A small construction company specialises in building and selling single-family homes. The company offers two main types of homes: model A and model B. Model A homes require 4,000 hours of labour, 2 tonnes of stone and 2,000 square feet of lumber. Model B houses require 10,000 hours of labour, 3 tonnes of stone and 2,000 square feet of lumber. Due to long delivery times for materials and a shortage of skilled and semi-skilled labour in the area, the company will have to make do with the resources it already has for the coming construction season: approximately 400,000 hours of labour, 150 tonnes of stone and 200,000 square feet of lumber.

How many models A and B should the company produce if the profit from model A is $1,000 per unit and from model B is $2,000 per unit? It is assumed that the company can sell all the houses it builds.

1. Prepare answers to the following questions: a) What is the criterion for optimality in the problem b) What constraints should be taken into account when constructing the model c) Develop a tabular and mathematical model of the problem.

2. Enter the problem data into an Excel spreadsheet and solve the problem in SOLVER mode. Save the solution found and print the contents of the spreadsheet.

3. Based on the printout, answer the following questions: a) What is the structure of the plan found? b) What are the estimated production volumes for each model? c) What is the optimality criterion value? d) Are all resources used fully? e) Calculate the utilisation coefficient for each resource.

Task 2. A manufacturer of household electrical appliances produces two models of microwave ovens: model H and model W. The production of each model involves the manufacturing and assembly of parts; each unit of model H requires four hours of manufacturing and assembly of parts, while model W requires two and six hours, respectively. The company has 600 hours of working time per week for manufacturing and 480 hours for assembly. Each model H product generates a profit of $40, while model W generates a profit of $30.

In what proportion will the production of models H and W provide maximum profit?

Problem 3. A company produces cast iron blanks. Manufacturing requires three main operations: casting, grinding, and drilling. The available time per week for casting is 36,000 minutes; for grinding, 2,250 minutes; and for drilling, 3,600 minutes. Billet X requires 80 minutes for casting, 2.5 minutes for grinding, and 9 minutes for drilling per product. Billet Y requires 60 minutes for casting, 4.5 minutes for grinding, and 4 minutes for drilling per product. Each blank X yields a profit of $4, while blank Y yields a profit of $2.

What combination of X and Y products will maximise weekly profit?

Problem 4. A married couple supplements their income by making fruit pies, which they sell through a small grocery store. In September, they bake grape and

apple pies. Apple pies are sold to the grocer for $1.50, and grape pies for $1.20. All the pies they bake sell out because of their high quality. Let's consider only two main ingredients for making them: flour and sugar, which are purchased once a month. For September, 120 kg of sugar and 210 kg of flour have already been purchased. Each apple pie requires 150 g of sugar and 300 g of flour, and each grape pie requires 200 g of sugar and 300 g of flour. Determine the number of grape and apple pies that will maximise profit if this couple can make an apple pie in six minutes and a grape pie in three minutes. They plan to work no more than 60 hours in September.

Determine the amount of sugar, flour, and time that will remain unused.

Topics for reports (presentations):

1. Economic and mathematical modelling: scope of application.
2. The limits of the cognitive capabilities of economic and mathematical modelling.
3. The significance of economic and mathematical modelling for economic science and practice.
4. Definition of economic and mathematical modelling according to V.S. Nemchinov.
5. Stages of economic and mathematical modelling.
6. Classification of economic and mathematical methods.
7. Classification of economic and mathematical models.
8. Concepts of material and value balances in economic and mathematical modelling.
9. Structural diagram of the inter-industry balance.
10. Economic problems solved using the inter-industry balance model.
11. Economic content and methodology for determining direct cost coefficients.

For ongoing assessment TK2:

Questions for the comprehensive task TK2.

Questions for the interview

1. Tell us about mathematical programming tasks. Give examples.
2. Describe the criteria for optimality in mathematical programming problems.
3. List the main forms of linear programming problems. What is the difference between them?
4. List the main stages of the graphical method for solving linear programming problems.
5. Formulate the algorithm for the simplex method with a natural basis.
6. When is it necessary to use the simplex method with an artificial basis (M-method)?
7. What is the essence of this modification of the simplex method?
8. Formulate the algorithm for the simplex method with an artificial basis.
9. Define the dual problem of linear programming.
10. Formulate the complementary slackness theorem.

11. Formulate the theorem on estimates.

Practical tasks:

Problem 1. A company manufactures two brands of televisions, Astro and Cosmo. There are two assembly lines, each producing televisions of one brand, and two workshops engaged in the production of parts for televisions of both brands. The production capacity of the Astro assembly line is 70 televisions per day, and that of the Cosmo assembly line is 50 televisions per day. Workshop A produces television tubes. It takes 1 hour of working time to produce a tube for an Astro television and 2 hours to produce a tube for a Cosmo television. At this stage, workshop A can devote no more than 120 hours of working time per day to the production of tubes for both brands of television. Workshop B manufactures television casings. It takes 1 hour of working time to produce one casing for Astro, as well as for Cosmo. Workshop B can devote no more than 90 hours of working time per day to the manufacture of casings. The specific gross profit from the sale of Astro and Cosmo is $20 and $10, respectively.

Assuming that the company can sell all the televisions it produces, what should the daily production plan be (the goal is to maximise the specific gross profit)?

Task 2. An electronics company manufactures five models of radio receivers, with models 1-3 produced on production line A and models 4-5 on production line B. The daily production volume of line A is 70 units, and line B is 95 units. All radio models use the same type of electronic components in quantities specified in the table:

Количество однотипных элементов в одном радиоприемнике

(по видам моделей)

Модель приёмника	1	2	3	4	5
Кол-во элементов	10	8	6	11	15
Прибыль от реализации, долл.	30	20	10	22	40

The maximum daily stock of components used is 1,800 units. 1. Determine the optimal daily production volumes for different types of radio receivers that will generate maximum profit. 2. In addition to the two existing lines, the company plans to launch a third production line C for the assembly of radio receivers with a capacity of 100 units per day.

Which radio models should be produced on this line, in what volumes, and what is the minimum daily stock of components required to fully utilise all three lines?

Task 3. A factory located in a developing country can produce five different products in any ratio. Three machines are involved in the production of each product, as shown in the table

Нормы времени на изготовление единицы продукта по видам станков

Продукт	Время работы станка, мин./кг		
	I	II	III
A	12	8	5
B	7	9	10
C	8	4	7
D	10	0	3
E	7	11	2

The working time resource of each machine is 128 hours per week. All products are competitive and all quantities produced can be sold at a price of $5, $4, $5, $4 and $4 per kg of products A, B, C, D and E, respectively. Variable labour costs are $4 per hour for machines I and II and $3 per hour for machine III. The cost of materials used to produce each kg of products A and C is $2, and for products B, D and E it is $1.

Management wants to maximise the company's profits.

1. Build an economic-mathematical model of the company.
2. How many hours will each machine work, and in what units are shadow prices measured for constraints that set the working time resource for machines?
3. How much can the selling price of product A increase before the optimal production plan changes?

Task 4. The company specialises in the production of three types of cardboard blanks: P1 – size 20x30, P2 – 30x40 and P3 – 40x40, which are cut from cardboard sheets measuring 60x100. There are four options for cutting the cardboard sheet with the corresponding waste values, and the demand for blanks is also specified. These data are shown in the table

План совместного раскроя листа картона

Заготовка	Вариант раскроя				Потребность в заготов-ках, шт
	1	2	3	4	
П1	3	4	5	10	240
П2	2	0	1	0	100
П3	1	8	1	0	80
Отходы	70	-	120	-	

Determine the number of cardboard sheets that need to be cut using each method to meet the demand for blanks.

Topics for reports (presentations):

1. Economic content and methodology for determining total cost coefficients.
2. The principle of optimality in planning and management.
3. The concepts of acceptable and optimal solutions to linear programming problems.
4. Incompatibility of the system of constraints of a linear programming problem: causes, examples, economic interpretation.
5. Unboundedness of the objective function of a linear programming problem: causes, examples, economic interpretation.
6. Canonical form of linear programming, its economic interpretation.

7. Transition from the standard form of a linear programming problem to the canonical form.

8. Geometric interpretation of linear programming problems.

9. Simplex method for solving linear programming problems.

10. Basic solutions of linear programming problems. Finding the initial basic solution.

11. The main task of production planning.

12. The main task of national economic planning.

13. Recording the dual problem of linear programming.

For ongoing assessment TK3:

Questions for the comprehensive task TK3.

Questions for the interview:

1. Seasonality indices.

2. Types of indices: individual and summary (aggregate and average); indices of quantitative and qualitative indicators.

3. Interrelationship between indices of qualitative indicators: variable, constant composition and structural shifts.

4. General economic equilibrium models. Types and properties of market equilibrium models.

5. Market functioning models. Modelling the process of achieving market equilibrium.

6. Application of equilibrium models of supply and demand.

7. How is equilibrium achieved in an economy with production? What conditions are necessary for this?

8. How is consumer equilibrium achieved in an exchange economy?

9. Explain the economic meaning of the "welfare theorem".

10. What consequences are possible in conditions of disequilibrium in the economies of exchange, production and foreign trade?

11. What role do market prices play in achieving overall equilibrium?

Practical tasks:

Task 1. There are two groups of equipment in the workshop area, on which two types of products are manufactured

Производительность групп оборудования при производстве изделий А и Б

Операция	Группа оборудования	Производительность оборудования (шт/час)		Фонд времени оборудования, станко-часы
		А	Б	
1	Токарная	2	6	280
2	Фрезерная	3	5	260

Determine the number of products that will allow for maximum utilisation of equipment operating time.

Task 2. A confectionery shop is preparing for the school holiday period. The shop owner must decide how many bags of the special mix and how many bags of the

regular mix of nuts and raisins (Peanut/Raisin Delite) to prepare for sale. The special mix contains 2/3 pound of raisins and 1/3 pound of nuts, and the standard mix contains 1/2 pound of raisins and 1/2 pound of nuts per bag. The shop has 90 pounds of raisins and 60 pounds of nuts in stock. Each component contains the following proportions of nutrients (in fractions of units): 22 - nuts: protein 0.6; fat – 0.2; carbohydrates – 0.1; other – 0.1. - raisins: protein 0.3; fat 0.15; carbohydrates 0.5; other 0.05. Nuts cost $0.60 per pound and raisins cost $1.50 per pound. The special mix will be prepared at $2.90 per pound, and the standard mix at $2.55 per pound. The shop owner expects to sell no more than 110 bags of one type.

Answer the following questions:

1. If the goal is to maximise profit, how many bags of each type should be prepared?

2. How many nuts and raisins should be included in each mixture to ensure the minimum nutrient content and the minimum cost?

Task 3. The following data is known for the general conditions of the task of designing a petrol station: the average interval between car arrivals is 4 minutes. The petrol station construction options have the following average car service times: 5 minutes, 3.5 minutes, 2 minutes, 1 minute, 0.5 minutes.

Calculate the main coefficients of the SMO problem and, based on a comparative analysis of the results obtained, select the most optimal option for the construction of the petrol station.

Task 4. Slick Oil has three warehouses from which it ships products (A1, A2, A3) to five retail outlets (B1, B2, B3, B4, B5). The demand for products, their stock in the company's warehouses, and the cost of transporting one can of product from the warehouses to the retail outlets are shown in the tables in the appendix.

Build a linear programming model to determine how much product needs to be shipped from each warehouse to each retail outlet ( ) to meet existing demand at minimum cost.

Topics for reports (presentations):

1. Economic interpretation of a dual linear programming problem.
2. Formulation and economic interpretation of a closed transport problem solved at minimum transport cost.
3. Formulation and economic interpretation of an open transport problem solved at minimum transport cost.
4. Application of the transport problem to the problem of developing a sales strategy.
5. Finding the initial basic solution to the transport problem using the northwest corner method.
6. Sequence of solving an open transport problem using the potential method with a given basic solution.
7. Sequence of solving a closed transport problem using the potential method with a given reference solution.

8. Formulation and economic interpretation of the assignment problem.
9. Economic applications of dynamic programming.
10. Bellman's optimality principle.

For interim assessment:

Sample exam questions:

1. Development of economic and mathematical modelling methodology: historical stages; main contemporary scientific and applied directions; scientific schools.
2. The first models in economics. F. Quesnay's economic table.
3. The initial stage of using mathematics in economics. The founder of classical political economy, W. Petty, and his book Political Arithmetic.
4. Mathematical economics. John von Neumann.
5. Statistical direction. W. Parsons and his Harvard barometer. The goal, principle and method of the statistical direction.
6. Econometrics. R. Frisch. Econometrics in the broad and narrow sense of the word.
7. Modelling as a method of scientific knowledge: definition of a model; features and main stages of the modelling process in economics; economic observations and measurements; the role of chance and uncertainty in economic and mathematical modelling.
8. The concept of a model and the modelling process. Classification of models.
9. Elements and stages of the modelling process. Model verification.
10. Forms of models. Structural models. Endogenous and exogenous variables.
11. Production and non-production consumption of material goods. Production-technological and socio-economic levels of economic-mathematical modelling.
12. The main tasks of systems theory, systems analysis. The role of systems theory in scientific knowledge. The subject, object, axiomatics and research apparatus of systems theory. The relationship between systems theory and mathematical programming, game theory, queuing theory, probability theory and other scientific fields. Systems theory and catastrophe theory. Synergetics - further generalisation and development of systems theory.
13. Concepts of systems theory. The concept of a system. Components and properties of a system. Emergence, purposefulness, self-organisation. The complexity of economic systems. Classification of systems. Patterns of functioning and development of systems. The birth and death of a system. The role of contradictions in a system. Transitional processes. Adaptive systems. System stability. Models of

economic systems. Black box model. Economic object management system and its components, cybernetic approach.

14. Features of mathematical modelling of economic systems. Formalisation of economic problems. Evaluation of actual data, the problem of measuring and comparing indicators, types of variables and parameters and general rules for determining the relationships between them, measurement of economic efficiency.

15. Model of firm behaviour in conditions of perfect and imperfect competition: basic assumptions and model classes, monopoly and monopsony; oligopoly and oligopsony; duopoly models.

16. Basic concepts of production and technological level models. Material goods and labour resources. Balance ratios.

17. The concept of production methods (technologies). Intensity of the production method. Production methods with limited intensity. The relationship between production methods and a linear homogeneous production cost function and a production function with constant proportions.

18. Basic concepts of production functions of output. Set of production possibilities. Definition and examples of single-factor and two-factor output functions.

19. Isoquants, isoclines: geometric representation for a two-factor output function. The problem of resource substitutability. Isoquant. Basic properties of an isoquant. Example for a two-factor production function of output and geometric representation of an isoquant. Marginal rate of substitution of resources. Elasticity of output for each type of cost. Examples. Elasticity of resource substitution.

20. Linear homogeneous production function of output as a special case of production functions of output with constant elasticity of substitution.

21. Production functions of output with constant elasticity of substitution of resources (PES functions), their properties and relationship to power production functions of output.

22. Production functions of output with constant proportions: their properties and relationship to production functions of output with constant elasticity of substitution of resources.

23. Production functions of costs (expenses) and their general properties. Marginal and average (specific) resource costs, the ratio of marginal costs to average costs.

24. Exponential production functions of output and their properties. The Cobb- Douglas production function.

25. The first property of production functions of output: the impossibility of producing output in the absence of at least one of the resources. Examples.

26. The second property of production functions: output growth with increased consumption of production factors. Differentiability of the production function. Marginal and average productivity of factors. Examples.

27. The third property of production functions: a decrease in marginal productivity when the cost of one resource increases while the others remain constant. Upward convexity of the production function. Examples.

28. The fourth property of production functions: returns to scale. Elasticity of production.

29. Modelling the sphere of consumption. Consumer preferences, preference relations and utility functions.

30. Types of utility functions. Logarithmic utility function. Marginal and average utility. Indifference surfaces and curves; their properties. Indifference surface map. Budget constraints.

31. Mathematical formalisation and consumer behaviour model. Coefficient (norm) of equivalence of goods. Proportionality of marginal utility values of goods to their prices.

32. Classical approaches to modelling individual demand. Demand model depending on constant prices of goods and consumer income. Consumer demand function and its properties. Stone's demand function from prices and income. Thornekvist's demand functions from income and their graphs. Elasticity of demand in relation to income and prices.