

**Ministry of Science and Higher Education of the Russian Federation
Federal State Autonomous Educational Institution of Higher Education**

National Research Lobachevsky State University of Nizhny Novgorod

Institute of Economics and Entrepreneurship

APPROVED by the decision of the Academic
Council of UNN protocol № 6 dated «31 » 05 2023

Study Program of the Course

Optimal Decision Methods

Level of Higher Education

Bachelor/Master

Area of Study

38.03.01 «Economics»

Program

World Economy

Form of Training

Full - Time

Nizhny Novgorod

2022

1. The Place of the Course in the Structure of the Main Education (Degree) Program

The course Optimal Decision Methods (Б1.О.14) is a part of core courses (Block 1)

№	The place of the discipline in the curriculum of the educational program	Стандартный текст для автоматического заполнения в конструкторе РПД
1	Block 1. Disciplines (modules). Core part	Academic discipline Optimal Decision Methods (Б1.О.14) is a part of core courses Area of Study 38.03.01 Economics.

2. The planned learning outcomes, correlated with the planned learning outcomes of the educational program (competencies and indicators of competencies achievement)

Competencies	The planned learning outcomes, in accordance with the indicator of achievement of competence		Assessment tools
	Indicator of competence achievement * (код, содержание индикатора)	Learning outcomes **	
UC-1 <i>Is able to search for information, critically analyse and synthesise it, apply systems approach to solving tasks</i>	UC-1.1 <i>Clearly describes the content and structure of the required data and information, and competently implements the processes of data collection, processing and interpretation</i>	<i>To know the classification of problems of finding optimal solutions _ To be able to work with information from various sources To have the skills of interpreting real strategic situations as tasks of finding an optimal solution</i>	<i>Test</i>
	UC-1.2 <i>Forms own judgments and evaluations in a competent, logical and well-argued manner.</i>	<i>To know the concept of a mathematical model of a strategic situation To be able to build a model of a strategic situation To have the skills to apply the algorithm for constructing a mathematical model of a strategic situation</i>	<i>Test</i>
	UC-1.3 <i>Distinguishes facts from opinions, interpretations, assessments, etc., in the reasoning of others involved in the activity.</i>	<i>To know the concept of optimality for different classes of optimal choice problems To be able to determine the type of the desired optimal solution for various situations of choice To have the skills to apply methods for finding optimal solutions for various classes of optimal choice problems</i>	<i>Test</i>
	UC-1.4 <i>Argues and logically presents his/her point of view through and on the basis of systematic description</i>	<i>To know the types of economic problems of optimal choice To be able to find the right technique for solving the economic problem of the optimal choice To have the skills to apply algorithms for finding the optimal solution to economic problems</i>	<i>Test</i>

GPC-5 <i>Is able to use modern information technologies and software in solving professional tasks</i>	GPC-5.1. <i>Is able to select tools and software to solve professional tasks</i>	<i>To know the algorithms for finding equilibrium situations in economic strategic situations_ To be able to apply algorithms to solve applied economic problems To have the skills of solving optimization problems using computer mathematics programs</i>	<i>Test</i>
	GPC-5.2 <i>Is able to use modern information technologies and software to solve professional tasks</i>	<i>To know modern information and communication technologies for searching, storing and processing information To be able to: build and research basic economic and mathematical models To have the skills of applying analytical methods of researching optimization models</i>	<i>Test</i>

3. The Structure and Content of the Course

3.1 Workload of the Course

	Full - Time
Total number of credits	4 Credits
Hours according to the curriculum	144
Including	
Contact work with the teacher:	44
- Lectures	14
- Seminars (practical classes / laboratory work)	28
Student's independent work	64
Control	2
Midterm Assessment - Exam or Test	Exam

3.2. Content of the Course

Modules or topics	Workload (hours)	Including				
		Contact Work				Independent work
		Lectures	Seminars	Lab classes	Total	
Topic 1	16	2	4		6	10
Topic 2	16	2	4		6	10
Topic 3	34	6	12		18	16
Topic 4	16	2	4		6	10

Topic 5	24	2	4		6	18
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Topic 1. Classification of optimal choice problems

Optimization problems. Stochastic optimization problems. Game theory problems.

Examples of tasks. Discussion of existing approaches to the solution.

Topic 2. Building a mathematical model of a strategic situation. Stages of building a model. Classification of problems in game theory.

Topic 3. Nash equilibrium. Definition. Finding the equilibrium of the best response function methods. Removing dominated strategies.

Topic 4. Cooperative approach. Pareto optimality. Finding Pareto-optimal solutions in multicriteria optimization problems

Topic 5. Economic models based on static games with complete information. Cournot duopoly. Cournot oligopoly.

Practical classes (seminars / laboratory work) are organized, including in the form of practical training, which provides for the participation of students in the implementation of certain elements of work related to future professional activities.

Practical training includes: solving problems, conducting testing, preparing reports, analyzing cases. For practical exercises (seminars / laboratory works) in the form of practical training, 22 hours are allocated

Practical training is aimed at the formation and development of:

- practical skills in accordance with the EP profile:

processing and analysis of information necessary to calculate economic indicators necessary for decision-making

- competencies - (UC-1 and GPC-5)

Able to search, critically analyze and synthesize information, apply a systematic approach to solving assigned tasks

Current monitoring of progress is carried out within the framework of seminar-type classes, group or individual consultations

4. Methodological support for students' independent work

Questions for final control, tasks for current control and Midterm Assessment based on the learning outcomes of the discipline are given in 5.2.

The course consists of lectures, seminars, independent work of students and the comprehensive final test.

In the course of their independent work, students familiarize themselves with theoretical material from textbooks and monographs given in the list of recommended literature, solve practical problems, prepare for seminars, answer self-test questions. Independent work can be done in the reading halls of the library or at home. Self-checks in the course of independent work may be in the form of electronic tests or credit tasks. At

the end of studies, there is a exam.

Independent work is intended to familiarize the student with certain sections of the course and additional materials, it gives the opportunity to study the main topics in-depth, to acquire new knowledge, skills, abilities. Independent work is based on the use of recommended materials and envisages tasks of various types.

Students' independent work includes:

- the collection and study of materials necessary for participation in interactive games, and other forms of interactive work;

- preparation of the tasks most relevant to discipline topics;

- preparation for current assignments and testing;

- preparation for the exam.

The main organizational principle of students' independent work is an integrated approach aimed at developing critical thinking of students and promoting diversified activities.

Control of students' knowledge includes:

- Monitoring the progress of testing based on the study of selected topics and modules of the discipline.

- The final assessment in the form of the final written exam.

- The final grade is based on the results of the student's work within practical classes and final testing.

Independent work is an out-of-class type of activities designed to familiarize the student with certain parts or topics of the course with the recommended materials and to prepare individual assignments for the course.

The main principle of organization of students' independent work is an integrated approach aimed at developing critical thinking of students and promoting diverse activities.

Monitoring students' current progress is envisaged after studying each module. The students will be evaluated by conducting tests, writing essays and tests on the subjects they have studied. Oral answers during seminars and practical classes will also be assessed. The results of current work and tests will be taken into account to determine the final grade.

INSTRUCTIONS FOR STUDENTS

The study of the theoretical material is determined by the curriculum of the discipline which is included into the plan of study and the list of recommended literature. It is necessary to recapitulate the material of previous topics, as well as the material of the preceding academic disciplines that serves as the base of the topic being studied. When preparing for the practical lesson, you must study the lecture materials and read the recommended literature. The material studied should be analyzed in accordance with the lesson plan, and then the degree of assimilation of the material should be verified.

Practical classes are inseparably connected with homework as the main part of independent work. They are part of a systematic study in combination with the theoretical material. The knowledge and skills acquired are assessed within the framework of interim and final attestation (tests and exams) .

Independent work is carried out with the purpose of deepening of knowledge and includes:

- recapitulation of the material studied in class, reading the recommended literature;

- preparation for practical classes;

- implementation of group and individual assignments;

- work with electronic sources;

- preparation for the exam.

Students' independent work consists of the study of literature complementing the material presented in the lectures.

It is assumed that, having listened to the lecture, students should refer to the literature from the main

bibliographical lists of books, then search for the necessary additional information and critically evaluate the material from the Internet sites.

Students should master the skills of bibliographic search, including search in the Internet resources, they should learn how to compare different points of view and determine research methods.

It is important to plan time for independent work for the entire semester and it is necessary to set aside some time for recapitulation of the material.

In their preparation for the final exams, students should be guided by the list of questions for the final control on the course. They must understand the basic concepts of the discipline.

5. Evaluation tools for Midterm Assessment based on the learning of the course material, includes:

5.1. Criteria for assessing learning outcomes

Learning outcomes	Assessment criteria						
	«Poor»	«Unsatisfactory»	«Satisfactory»	«Good»	«Very good»	«Excellent»	«Perfect»
	FAIL		PASS				
<u>Knowledge</u>	Lack of theoretical knowledge. Inability to assess the completeness of knowledge due to the student's refusal to answer	The level of knowledge is below minimum requirements. There has been serious errors.	Minimum acceptable level of knowledge. A lot of errors were made.	The level of knowledge corresponds to the program. A few errors were made	The level of knowledge corresponds to the program. A few minor flaws were made	The level of knowledge corresponds to the program. There are no flaws.	The level of knowledge exceeds the level required in the training program.
<u>Abilities</u>	Lack of minimal abilities and skills. Inability to assess the completeness of knowledge	Basic abilities and skills in solving standard tasks are not demonstrated. There has been serious	Basic abilities and skills are demonstrated. Typical tasks with non-serious errors were solved. All tasks are completed,	All basic abilities and skills are demonstrated. All the main tasks with non-serious errors have been solved.	All basic abilities and skills are demonstrated. All the main tasks have been solved. All tasks are completed, in	All the basic abilities and skills are demonstrated. All the main tasks are solved with some minor	All the basic abilities and skills are demonstrated. All the main tasks have been solved. All tasks are

	due to the student's refusal to answer	errors.	but not in full.	All the tasks were completed, in full, but some of them were incomplete.	full, but some with shortcomings.	shortcomings, all the tasks are completed in full	completed, in full, without any shortcomings
<u>Skills</u>	Lack of skills of the material. Inability to assess the completeness of knowledge due to the student's refusal to answer	Basic skills in solving standard tasks are not demonstrated There has been serious errors.	There is a minimal set of skills in solving standard tasks with some shortcomings	Basic skills in solving standard tasks are demonstrated with some shortcomings	Basic skills in solving standard tasks are demonstrated without errors and shortcomings	Skills in solving nonstandard tasks are demonstrated without errors and shortcomings.	A creative approach to solving non-standard tasks is demonstrated

Scale for the assessment of the learning outcomes:

Assessment		Training level
	Perfect	All competencies (parts of competencies) are formed at a level not lower than "Perfect". Knowledge, skills, and proficiency in the relevant competencies are demonstrated at a level higher than the program provides
PASS	Excellent	All the competencies (parts of competencies) are formed at a level not lower than "excellent", at least one competence is formed at the "Excellent" level.
	Very good	All the competencies (parts of competencies) are formed at a level not lower than "Very good", at least one competence is formed at the "Very good" level.
	Good	All the competencies (parts of competencies) are formed at a level not lower than "Good", at least one competence is formed at the level of "Good".
	Satisfactory	All the competencies (parts of competencies) are formed at a level not lower than "Satisfactory", at least one competence is formed at the level of "Satisfactory".
FAIL	Unsatisfactory	All the competencies (parts of competencies) are formed at a level not lower than "Unsatisfactory", no one competence is formed at the level of "Poor".
	Poor	At least one competence is formed at the "Poor" level

Typical assignments or other materials necessary for the assessment of learning outcomes. 5.2.1 QUESTIONS FOR PASS/FAIL FINAL CONTROL

Questions	Code of competence
1. Classification of optimal choice problems	UC-1, GPC-5
2. Optimization problems. Linear and nonlinear optimization. Examples. Basic approaches to solution	UC-1, GPC-5
3. Problems of stochastic optimization. Examples. Basic approaches to the solution	UC-1, GPC-5

4. Problems of game theory. Examples. Basic approaches to the solution.	UC-1, GPC-5
5. Construction of a mathematical model of a strategic situation	UC-1, GPC-5
6. Nash equilibrium. Nash Equilibrium Finding Algorithms	UC-1, GPC-5
7. Pareto optimality. Finding Pareto-optimal solutions in matrix games and multicrite optimization problems	UC-1, GPC-5
8 Relationship between linear programming and matrix game theory	UC-1, GPC-5
9. Dominance of strategies. Median Voter Theorem	UC-1, GPC-5
10. Economic models based on static games with complete information Cournot duopoly. Cournot oligopoly (with the assignment of output volumes	UC-1, GPC-5

5.2.2. Standard tests for assessing the competence formation UC-1

Example 1

In a small town there are 2 cafes A and B, which sell a fitness cocktail. The owners of the cafe are pondering what price to set for this cocktail. Options - 2 conventional units, 4 conventional units and 5 conventional units. The city has 4,000 local residents and 6,000 tourists arrive daily. They all drink 1 cocktail daily. Locals will always choose a cheap cocktail option (if the price is the same, then 50/50), and tourists are evenly distributed across both cafes. Which cocktail pricing strategy will give you the best Nash solution?

Example 2

Along the street, at the same distance from each other, there are 8 identical houses. Each of the two entrepreneurs decides on the placement of the store in one of the houses. What placement strategy provides a Nash-optimal solution if the residents of the houses are known to go to the store closest to them? It is known that if both stores are at the same distance from a house, then half of the residents of the house go to one store, half to the other.

5.2.3. Standard tasks for assessing the competence formation GPC-5

Example 1

Find equilibrium in mixed strategies for the game given by the matrix

[4 2 3 -1

-4 0 2 2]

Example 2

Find Nash Equilibria in Pure and Mixed Strategies and Pareto-Optimal Outcomes in a Bimatrix Matrix Game

[2 2 1] [2 0 5]

[0 7 8] [2 2 3]

6. Methodological and information support for the course

a) Main literature:

1. Strongin R.G. Operations research. Models of Economic Behavior: Textbook. - Nizhny Novgorod: Publishing house of the Nizhny Novgorod State University. N.I. Lobachevsky, 2002. -- 244p. (100 copies)
2. Strongin R.G. Operations research. Models of economic behavior. Electr. resource. Free access, <http://www.intuit.ru/studies/courses/1056/161/info>.
3. EMC "Operations Research" e-learning system of UNN (<https://elearning.unn.ru/course/view.php?id=344>)
4. Martin Osborne "Gamebook" <http://pioneer.netserv.chula.ac.th/~ptanapo1/gamebook.pdf>
5. Thomas S. Ferguson "Game Theory" http://www.math.ucla.edu/~tom/Game_Theory/Contents.html

б) Additional literature:

Joe Lorkowski, Vladik Kreinovich Bounded Rationality in Decision Making Under Uncertainty: Towards Optimal Granularity (2018) <https://link.springer.com/book/10.1007/978-3-319-62214-9>

b) Internet Resources and Software

<http://www.e-booksdirectory.com/listing.php?category=379>

2. www.math.ubc.ca/~jf/courses/340/games
 3. www.lcm.csa.iisc.ernet.in/gametheory/
 4. <http://www.cse.iitd.ernet.in/~rahul/cs905/lecture15/index.html>
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7. Logistical support for the course

Special classrooms are used for conducting lectures and seminars, group and individual consultations, ongoing monitoring and intermediate certification, as well as for students' independent work. These rooms are equipped with specialized furniture and technical teaching aids for presenting educational information to a large audience : computer, projector or LCD TV, speaker system and microphone (if necessary), whiteboard. There is a possibility of connection to the Internet and access to the electronic information and educational environment.

The program was compiled in accordance with the requirements of the UNN's own educational standard and the Educational Program in the field of "Economics", the profile is "World Economy".

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Markina M.V.

Reviewer: ()

G.V.Pogodina

Head of the Department M.L.Gorbunova

The program was approved at a meeting of the Methodological Commission of the Institute of Economics

and Entrepreneurship

14.11.2022, Protocol No. 6.