

*Federal state autonomous educational institution of higher education
Peoples' Friendship University of Russia*

Faculty of science
Recommended by MSSN

DISCIPLINE PROGRAM

Mathematical methods in Economics

Recommended for the study direction

01.06.01 « Mathematics and mechanics»

1. Goals and objectives of the discipline

The course is based on the concept of economic forecasting based on scenario-based numerical experiments with mathematical models of economic systems, which based on the principles of system analysis of the developing economy. The main purpose of the course is to provide students with an idea of the current state of the theory and practice of social and economic forecasting based on the use of mathematical models of economic systems.

2. The place of the discipline in the structure of HEP:

The discipline "Mathematical methods in Economics" refers to the subjects of choice of block 1 of the curriculum.

Table 1 shows the previous and subsequent disciplines aimed at forming the competencies of the discipline in accordance with the matrix of competencies of the HEP.

Table 1

Previous and subsequent disciplines aimed at the formation of competencies

No	Code and name of the competence	Previous disciplines	Subsequent disciplines (groups of disciplines)
Professional competencies			
	PC-3 ability to formulate the research task and the ways of its implementation, to summarize the results and formulate appropriate conclusions, to understand the practical aspects of the theoretical results.	Boundary value problems for differential equations; Theory of extremal problems.	-
Universal competencies			
	UC-1 ability to critically analyze and evaluate modern scientific achievements, generate new ideas in solving research and practical problems including interdisciplinary fields; UC-2 ability to design and implement comprehensive research including interdisciplinary research based on a holistic systematic scientific worldview using knowledge in the field of history and philosophy of science; UC-3 willingness to participate in the work of Russian and international	Boundary value problems for differential equations; Theory of extremal problems.	-

research teams to solve scientific and educational problems; UC-5 ability to plan and solve problems of their own professional and personal development.		
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3. Requirements for the results of mastering the discipline:

The process of mastering the discipline is aimed at the formation of the following competencies: UC-1, UC -2, UC -3, UC -5, PC -3

As a result of mastering the discipline, the student must:

Know:

- the concept of economic forecasting based on scenario numerical experiments with mathematical models of economic systems based on the principles of system analysis of the developing economy,
- the current state of the theory and practice of social and economic forecasting based on the use of mathematical models of economic systems.

Be able to:

- apply the principles of system analysis of the developing economy for economic forecasting;
- apply mathematical models of economic systems for social and economic forecasting.

Possess:

- modern mathematical apparatus required for the compilation of mathematical models of economic systems and scenario numerical experiments with mathematical models of economic systems.

4. The scope of the discipline and types of academic work

The total labor intensity of the course "Mathematical methods in Economics" is 4 credits.

Type of study work	Total hours	Semesters			
		1	2	3	
Classes (total)		1	2	3	
Including:	-	-	-	-	-
<i>Lectures</i>	20			20	
<i>Practicum (P)</i>	40			40	
<i>Seminars (S)</i>					
<i>Laboratory work (LW)</i>					
Individual work (total)	84			84	
Total labor intensity	144			144	
	4			4	

5. Content of the discipline

5.1. Content of the discipline sections

№	Units	Topics
1.	Leontiev's model of intersectoral balance	Leontiev's model of intersectoral balance. Statement of the problem of production productivity.
2.	Productive matrices	Productive matrices. Theorem on series expansion of the resolvent of a productive matrix.
3.	Frobenius-Perron theorem	Frobenius – Perron Theorem. Properties of the Frobenius-Perron number and their economic interpretation Indecomposable matrices and their properties. Theorem on stable matrices.
4.	Theorems of nonnegative matrices	Idempotent analogs of theorems on nonnegative matrices. The task of planning large research projects. The problem of finding arbitrage chains in the currency markets. Theorem Afriat-Veriana.
5.	Duality	Linear programming problems with mixed constraints. Duality.
6.	Economic interpretation of duality	Economic interpretation of duality: labor theory of value and its critique.
7.	The decomposition of the resource allocation problem	Decomposition of the resource allocation problem using Lagrange multipliers and its economic interpretation. Evaluation of the effectiveness of new technologies.
8.	Economic interpretation of the maximum principle	Economic interpretation of the maximum principle in models of optimal economic growth.
9.	The concept of highway	The concept of highway.
10.	The Cox-Ross-Rubinstein Model	The Cox-Ross-Rubinstein Model.
11.	Game in normal form	Game in normal form.
12.	Nash's Theorem	Nash's Theorem.
13.	The Model Of Arrow-Debreu	The Model Of Arrow-Debreu.

5.2. Sections and classes

№	Units	Lect.	Practicum and laboratory work			IW	Total
			P/S	LW	IF		
1.	Leontiev's model of intersectoral balance	2	4		4	6	12
2.	Productive matrices	1	2		2	7	10
3.	Frobenius-Perron theorem	2	4		4	6	12
4.	Theorems of nonnegative matrices	1	2		2	7	10
5.	Duality	2	4		4	6	12
6.	Economic interpretation of duality	1	2		2	7	10

7.	The decomposition of the resource allocation problem	2	4		4	6	12
8.	Economic interpretation of the maximum principle	1	2		2	7	10
9.	The concept of highway	1	2		2	7	10
10.	The Cox-Ross-Rubinstein Model	2	4		4	6	12
11.	Game in normal form	2	4		4	6	12
12.	Nash's Theorem	1	2		2	7	10
13.	The Model Of Arrow-Debreu	2	4		4	6	12
	Total:	20	40		40	84	144

6. Laboratory practice – not provided.

7. Practicum (Seminars)

№	Unit №	Practicum units (seminars)	Total labor intensity (hour)
1.	1	Leontiev's model of intersectoral balance	4
2.	2	Productive matrices	2
3.	3	Frobenius-Perron theorem	4
4.	4	Theorems of nonnegative matrices	2
5.	5	Duality	4
6.	6	Economic interpretation of duality	2
7.	7	The decomposition of the resource allocation problem	4
8.	8	Economic interpretation of the maximum principle	2
9.	9	The concept of highway	2
10	10	The Cox-Ross-Rubinstein Model	4
11	11	Game in normal form	4
12	12	Nash's Theorem	2
13	13	The Model Of Arrow-Debreu	4

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8. Material and technical support of the discipline:

Auditorium 495a, 398, 509 Ordzhonikidze str., 3, RUDN, group classrooms Ordzhonikidze str., 3, RUDN on the 3rd, 4th and 5th floors, display classes, laboratories (rooms 510 and 424).

9. Information support of the discipline:

Only licensed software installed in the RUDN is used:

- Microsoft Office software package;
- multimedia equipment and personal computers;
- full-text databases and resources accessed from the RUDN network;
- electronic library of the RFBR <http://www.rfbr.ru/rffi/ru/library>

10. Educational and methodological support of the discipline:

a) basic literature:

1. Ashmanov S. A. Vvedenie v matematicheskuyu ekonomiku. - M., Nauka, 1984.
2. Nikaido H. Vypuklye struktury i matematicheskaya ekonomika. - M., Mir, 1972. (

b) additional literature:

1. Oben ZH-P. Nelinejnyj analiz i ego ekonomicheskie prilozheniya. - M., Mir, 1988.
2. Mullen E. Teoriya igr s primerami iz matematicheskoy ekonomiki. - M., Mir, 1985.
3. Eklund I. Elementy matematicheskoy ekonomiki. - M., Mir, 1983.

b) databases, information and reference systems and search engines

1. Higher Attestation Commission RF <http://vak.ed.gov.ru>
2. RSL Electronic Library <http://www.rsl.ru/>
3. RUDN Library <http://lib.rudn.ru/>
4. Science Direct <http://www.sciencedirect.com> Description: The resource contains a collection of scientific, technical full-text and bibliographic information. The multidisciplinary database includes scientific journals in the exact and technical fields of science.
5. EBSCO <http://search.ebscohost.com>, Academic Search Premier (a database of complex topics, containing information on the humanities and natural sciences).
6. Oxford University Press <http://www3.oup.co.uk/jnls>. Journals in the exact and technical sciences of Oxford University Press presented in the collection HSS
7. Sage Publications <http://online.sagepub.com>. The Sage publication database includes journals in various fields of knowledge: Sage_STM – more than 100 journals in the field of natural sciences, engineering.
8. Springer/Kluwer <http://www.springerlink.com>. Journals and books publishing houses
9. Springer/Kluwer cover various fields of knowledge and are divided into subject categories.
10. Taylor & Francis <http://www.informaworld.com>. The collection of journals includes more than 1000 titles in all fields of knowledge.
11. American Mathematical Society <http://www.ams.org/> A resource of the American Mathematical Society.
12. European Mathematical Society <http://www.euro-math-soc.eu/> Resource of the European Mathematical Society.
13. Portal to Mathematics Publications <http://www.emis.de/projects/EULER/>
14. Catalog of mathematical Internet resources <http://www.mathtree.ru/>
15. Zentralblatt MATH (zbMATH) <https://zbmath.org>
16. All-Russian mathematical portal mathnet.ru
17. Web of Science <http://www.isiknowledge.com>

18. Resources of the Institute of Scientific Information on Social Sciences of the Russian Academy of Sciences <http://elibrary.ru>.
19. University Information System RUSSIA. <http://www.cir.ru/index.jsp>.
20. GOST standards system for information, library and publishing <http://www.ifap.ru/library/gost/sibid.htm>.
21. RUDN Electronic Library <http://www.rsl.ru/>

r) periodicals

Algebra i analiz, Diskretnaya matematika, Zhurnal vychislitel'noj matematiki i matematicheskoy fiziki, Izvestiya Rossijskoj akademii nauk. Seriya matematicheskaya, Matematicheskie zametki Matematicheskij sbornik, Matematicheskoe modelirovanie, Teoreticheskaya i matematicheskaya fizika, Teoriya veroyatnostej i ee primeneniya, Uspekhi matematicheskikh nauk, Funkcional'nyj analiz i ego prilozheniya, Trudy Matematicheskogo instituta im. V. A. Steklova, Sovremennye problemy matematiki, Vychislitel'nye metody i programmirovaniye, Trudy seminarov imeni I. G. Petrovskogo, Uchyonye zapiski Moskovskogo gosudarstvennogo universiteta Fundamental'naya i prikladnaya matematika, Review of Modern Physics, Annual Review of Astronomy and Astrophysics, Annual Review of Biochemistry, Chemical Reviews Nature Physics, Annual Review of Condensed Matter Physics, Annals of Mathematics, Journal of the American Mathematical Society, Acta Mathematica, Communications on Pure and Applied Mathematics Swarm and Evolutionary Computation Geometric and Functional Analysis Formal Aspects of Computing, Discrete Mathematics, Theory of Computing Systems Reports on Progress in Physics New Journal of Physics.

11. Methodological guidelines for students on the development of the discipline

The format of the seminar is the presentation of the key ideas of textbook sources - texts on the course. Specifically, the presentation looks like this: the student chooses one of the key ideas of the text discussed at the seminar, prepares his understanding and critical assessment in the form of theses (on 1-1.5 pages), then all this is presented and defended at the seminar. Abstracts are reproduced in advance and distributed to all participants of the seminar.

It is supposed to write an abstract on a topic agreed with the teacher. The volume of the abstract – no more than 15 thousand characters with spaces. The translation of an article by a foreign author, together with a detailed critical and analytical assessment of it, is also accepted as an abstract. Coordination of both the author and the text with the teacher is mandatory.

At the end of the semester an exam in the form of an essay on one of the units proposed (to choose from) by the teacher. After the interview, the final grade is issued. The results are determined by conducting an interim attestation with grades "excellent", "good", "satisfactory", "unsatisfactory" and in the ECTS system (A, B, C, E). The basis for their placement is the point-rating system adopted in the RUDN.

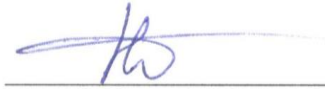
12. The fund of evaluation funds for conducting intermediate certification of students in the discipline (module)

Materials for assessing the level of development of educational material of the discipline " Mathematical methods in economics " (evaluation materials), which include a list of competencies indicating the stages of their formation, a description of indicators and criteria for evaluating competencies at various stages of their formation, a description of assessment scales, standard control tasks or other materials necessary for evaluating knowledge, skills, skills and (or) experience of activities that characterize the stages of competence formation in the process of mastering the educational program, methodological materials defining the procedures for evaluating knowledge, skills, skills and (or) experience activities that characterize the stages of competence formation are fully developed and are available to students on the discipline page in the TUIS PFUR.

The program is compiled in accordance with the requirements of the ES HE PFUR.

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