University of Gdańsk

Subject card

Subject name and code	Mathematical Methods for Economic Analysis, PG_00035939		
Field of study	Economics, International Economic Relations		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	Bachelor's studies	Subject group	Obligatory subject group in the field of study Optional subject group
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	English
Semester of study	6	ECTS credits	5.0
Learning profile	academic	Assessment form	credit
Conducting unit	Department of Microeconomics -> Faculty of Economics -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Elżbieta Babula	
	Teachers	dr Elżbieta Babula	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	0.0	30

E-learning hours included: 0.0

eNauczanie source address: https://mdl.ug.edu.pl/course/view.php?id=12910

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	0.0	0.0	30

Subject objectives

The purpose of this course is to help students develop advanced skills for formulating and analyzing mathematical models in the economics and finance. Rigorous mathematical analysis of theoretical models can lead to a better understanding of economic problems.

Additionally, the purpose is to help students develop skills for using the computer tools to solve mathematical models and to apply the knowledge in economic modeling.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[EKONL3_W06] have an advanced knowledge of selected methods and tools, including statistical and econometric techniques, for describing economic agents and structures as well as social institutions and the processes taking place in them	The student knows and understands the conditions for the existence of the solution of a linear system of equations; knows the types of constraint optimization problems and understands the solution methods; understands the qualitative solutions of basic dynamic problems; characterizes the dynamic programming and optimal control problems and knows its solution methods; understands the basic characteristics of Markov chains. The student knows the computer tools to support mathematical analysis.	[SW2] presentation/project/paper/ report [SW5] implementation of a problem task
	[MSGL3_W10] knows selected methods and tools, including IT tools and data acquisition techniques, which make it possible to describe and analyse economic entities operating on the international market; knows the processes and phenomena occurring in them and between them, and processes supporting decision-making	The student knows and understands the conditions for the existence of the solution of a linear system of equations; knows the types of constraint optimization problems and understands the solution methods; understands the qualitative solutions of basic dynamic problems; characterizes the dynamic programming and optimal control problems and knows its solution methods; understands the basic characteristics of Markov chains. The student knows the computer tools to support mathematical analysis.	[SW2] presentation/project/paper/ report [SW5] implementation of a problem task
	[EKONL3_U02] is able to use the knowledge of theory and data to analyse concrete economic and social processes and phenomena and to analyse these phenomena using methods developed in economics, finance and management sciences	The student classifies the systems of linear equations and solves the systems if possible; identifies the basic types of differential equations and applies the correct solution method; solves constraint optimization problems and interprets the solution; analyzes and interprets the qualitative solutions of basic dynamic problems; solves and analyzes optimal control problems; applies matrix methods to discuss properties of Markov chains; can find the invariant measure of Markov chain. The student recognizes the areas of application for the methods in economics and finance.	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written [SU5] implementation of a problem task
	[MSGL3_U02] can assess economic and social phenomena occurring in an open economy, interpret necessary statistical data and economic indicators, as well as forecast economic phenomena and processes, using standard methods and tools applied in economic sciences	The student classifies the systems of linear equations and solves the systems if possible; identifies the basic types of differential equations and applies the correct solution method; solves constraint optimization problems and interprets the solution; analyzes and interprets the qualitative solutions of basic dynamic problems; solves and analyzes optimal control problems; applies matrix methods to discuss properties of Markov chains; can find the invariant measure of Markov chain. The student recognizes the areas of application for the methods in economics and finance.	[SU2] presentation/project/paper/ report [SU4] test/exam - oral or written [SU5] implementation of a problem task
	[EKONL3_U15] is able to independently complement and improve the acquired knowledge and economic skills, is open to new ideas and techniques, tends to learn by any method and is willing to interact with other participants in the learning process	The student can cooperate in group to develop the solution for given task. The student applies the computer tools to solve problems that require mathemtical methods.	[SU5] implementation of a problem task [SU8] observation of student's independent or team work

Course outcome	Subject outcome	Method of verification
[MSGL3_K02] critically assesses the level of his/her knowledge in the field of economics; is willing to deepen and update this knowledge throughout his/her life	The student individually as well as in cooperation within group expands his or her awareness of possibilities and boundries of applying mathematics to a better understanding of economic problems.	[SK1] oral statement/conversation/ discussion [SK5] implementation of a problem task [SK8] observation of student's independent or team work
[EKONL3_K02] is aware of the level of knowledge in the field of economics and understands the need to deepen and update this knowledge throughout life	The student individually as well as in cooperation within group expands his or her awareness of possibilities and boundries of applying mathematics to a better understanding of economic problems.	[SK1] oral statement/conversation/ discussion [SK5] implementation of a problem task [SK8] observation of student's independent or team work
[MSGL3_U14] can interact and work in a team (including an international one), taking various roles within it	The student can cooperate in group to develop the solution for given task.	[SU8] observation of student's independent or team work
[MSGL3_U08] uses basic methods and computer programmes as well as marketing techniques and tools to acquire and analyse data necessary in his/her professional work to diagnose economic processes and make adequate economic decisions	The student applies the computer tools to solve problems that require mathemtical methods.	[SU5] implementation of a problem task

Subject contents

1. Review of basic linear algebra: determinants and matrix inverses; Cramers rule; rank of matrix; linear systems of equations; degrees of freedom. All tasks in this topic are conducted in a computer laboratory.
2. Linear programming: basic properties and examples of linear programs; basic solutions; the fundamental theorem of linear programming; the simplex method; dual linear programs. This topic is conducted with computer laboratory support.
3. Non-linear programming: constrained optimization with equality constrains (Lagrange problem) and with inequality constraints (Kuhn-Tucker problem).
4. Differential equations: constant coefficient linear differential equations; qualitative solution: phase portrait diagrams; nonlinear systems; fixed points; linearization of dynamic system in the plane. This topic is conducted with computer laboratory support.
5. Optimal control: maximum principle; transversality conditions.
6. Dynamic programming: dynamic programming problems; the principle of optimality.
7. Stochastic processes: Markov chains; stationary distributions. This topic is conducted with computer laboratory support.

Prerequisites and co-requisites

Completed Mathematical applications in economics and management course or other undergraduate mathematics course.

The course requires basic knowledge of:

- differential calculus (derivatives and integrals of elementary functions with basic rules of differentiation and integration);

- matrix algebra.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Assignments: tasks to be solved individually outside of class within given deadline	51.0%	30.0%
Quizzes and tests online at fixed dates outside of class	51.0%	10.0%
Group work in-class activities	51.0%	60.0%

Recommended reading

Basic literature	K. Sydsater, P. Hammond, A. Seierstad, A. Strom, Futher mathematics for economic analysis, Prentice Hall, 2005.

	Supplementary literature	1. Chiang A., Elements of dynamic optimalization, McGraw-Hill 1992. 2. Chiang A., Fundamental methods of mathematical economics, McGraw-Hill 1967. 3. Brzeźniak Z., Zastawiak T., Basic stochastic processes, Springer 2003.
	eResources addresses	
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	

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