University of Gdańsk

Subject card

Subject name and code	Mathematical Methods for Economic Analysis, PG_00102460						
Field of study	Logistics and Mobility						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2025/2026			
Education level	Master's studies		Subject group				
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	Polish			
Semester of study	4		ECTS credits	5.0			
Learning profile	academic		Assessment form				
Conducting unit	Department of Microeconomics -> Faculty of Economics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor	dr Elżbieta Babula					
	Teachers						
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
[LMMU2_W06] knows statistical and econometric methods and tools for description and macro- and microeconomic modelling of logistics and mobility processes and systems	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
[LMMU2_K02] is aware of the level of his/her knowledge in the field of logistics and mobility; understands the need to extend 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
[LMMU2_U13] can manage teamwork as well as interact and work in a team (including in an international environment) assuming a leading role in it	The student can cooperate in group to develop the solution for given task. The student applies the computer tools to solve problems that require mathematical methods.	[SU5] implementation of a problem task [SU8] observation of student's independent or team work
[LMMU2_U04] can forecast and model complex economic and social processes, as well as logistics and mobility processes and systems using quantitative and qualitative methods and tools developed by economic sciences (including statistics and econometrics)	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

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.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">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.</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Group work in-class activities</td><td>51.0%</td><td>60.0%</td></tr>
<tr><td>Quizzes and tests online at fixed dates outside of class</td><td>51.0%</td><td>10.0%</td></tr>
<tr><td>Assignments: tasks to be solved individually outside of class within given deadline</td><td>51.0%</td><td>30.0%</td></tr>
</table></td></tr>
<tr><td rowspan="2">Recommended reading</td><td>Basic literature</td><td colspan="2">K. Sydsater, P. Hammond, A. Seierstad, A. Strom, Futher mathematics for economic analysis, Prentice Hall, 2005.</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">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.</td></tr>
<tr><td></td><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3"></td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
</table>

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