GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Game theory, PG_00055432		
Field of study	Mathematics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Specialty subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish Information on English terminology
Semester of study	1	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Zakład Analizy Nieliniowej -> Instytut Matematyki Stosowanej -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Zdzisław Dzedzej	
	Teachers	dr hab. Zdzisław Dzedzej	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	30.0	60

E-learning hours included: 0.0

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	60	5.0	60.0	125

Subject objectives

The aim of the subject is to familiarize students with different aspects of game theory and their applications to different fields of science, for example, to economics (insurance, bargaining, negotiations) or biology (population dynamics). Among others students should master such notions like equilibrium, optimal strategy and different techniques of game solving.

During seminars additional applications aspects like combinatorial games will be touched.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U09] constructs mathematical models used in specific advanced applications of mathematics, can use stochastic processes as a tool for modeling phenomena and analyzing their evolution,constructs mathematical models used in specific advanced applications of mathematics, uses stochastic processes as a tool for modeling phenomena and analyzing their evolution, recognizes mathematical structures in physical theories	solving matrix games and small nonzero-sum games	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W02] has enhanced knowledge of a selected branch of mathematics,theoretical or applied, knows classical definitions and theorems and their proofs and connections with other fields,understands problems being examined	student finds and presents applications in various domains	[SW2] Assessment of knowledge contained in presentation

<table>
<tr><td>Subject contents</td><td>1. Uncertainty and chance, decision making under uncertainty, two-person matrix games.
2. Strategic form games, applications, Nash equilibrium, zero sum matrix game, saddle points.
3. Solving matrix games with mixed strategies.
4. Graphs and trees, single-person decisions.
5. Sequential games, the structure of sequential games.
6. Sequential games with perfect information.
7. Sequential games with imperfect information.
8. Sequential rationality, the market for lemons (cars market), beliefs and strategies.
9. Consistency of beliefs, expected payoff, examples, sequential equilibrium.
10. Coalitional games- Shapley value.
11. Evolutionary game theory, equations of evolution, the "Hawk-Dove" game, replikator dynamics.
12. Evolutionarily stable strategies, replicator dynamics equations, linearisation and asymptotic stability.
13. Examples of games with evolutionary stable strategies, dynamical systems.
14. Games with more than two strategies, equilibria and stability.
15. Combinatorial games</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Calculus I and II, linear algebra, elements of probability theory and statistics</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Test</td><td>50.0%</td><td>60.0%</td></tr>
<tr><td>general activity</td><td>0.0%</td><td>10.0%</td></tr>
<tr><td>seminar presentation</td><td>0.0%</td><td>30.0%</td></tr>
</table>
</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. Philip Straffin, Teoria gier, Scholar 2001.
2. James N. Webb, Game Theory. Decisions, Interaction and Evolution, Springer 2007
3. Tadeusz Płatkowski, Wstęp do teorii gier, Uniwersytet Warszawski, 2012.
4. G. Owen, Teoria gier, PWN 1975.</td></tr>
<tr><td>Supplementary literature</td><td>1. J. Hofbauer, K. Sigmund, Evolutionary Games and Population Dynamics, Cambridge UP
2002.
2. J. Watson, Strategia. Wprowadzenie do teorii gier, WNT 2005.
3. S. Stahl, A gentle introduction to game theory, AMS 1998.
4. M. J. Osborne, A. Rubinstein , A course in game theory, MIT Press 1998.
5. M. DeVoss, D. Kent, Game Theory, AMS 2016</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
</table>
</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Write the following game as a bi-matrix game and solve it:
Two firms (A and B) decide whether to design the devise they sell to use K1 or K2 extensions. Both players
will sell more devises if their their products are compatible. If they both choose for K1 extension the payoffs will be 2 for each. If they both choose for K2 extension the payoffs will be 1 for each. If they choose different extensions the payoffs will be 1 for each.
2. Finding Nash equilibria:
A man has two sons. When he dies, the value of his estate (after tax) is 100000 zł. In his will it states that the two sons must each specify a sum of money s_i that they are willing to accept. If $s_1 + s_2$ 100000, then each
gets the sum he asked for and the remainder (if there is any) goes to the local home for spoilt cats. If $s_1 + s_2 > 100000$, then neither son receives any money and the entire sum of 100000 zł goes to the cats home. Assume
that (i) the two men care only about the amount of money they will inherit, and (ii) they can only ask for whole złotys. Find all the pure strategy Nash equilibria of this game.
3. Finding fixed-points of replicator dynamics:
Consider a pairwise contest population game with action set A = {E,F} and payoffs (E,E) = 1 (E,F) = 1 (F,E) = 2 (F,F) = 0. Find all the fixed points of the replicator dynamics for this population game.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
</table>

Document generated electronically. Does not require a seal or signature.