COURSE DESCRIPTION CARD - SYLLABUS

Course name
Game theory [S1DSwB1>TG]

Course

Field of study
Data Science in Business

Year/Semester
2/4

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
30

Laboratory classes
0

Other
0

Tutorials
30

Projects/seminars
0

Number of credit points

5,00

Coordinators

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Lecturers

Prerequisites

The student should have the following skills and knowledge: - Basics of discrete mathematics - knowledge of sets, relations, functions, permutations and combinations, and mathematical logic; - Probability theory and statistics - basic concepts such as conditional probability, random variables, expected values, and the concept of independence; - Mathematical analysis - ability to solve optimization problems, knowledge of concepts such as maximum, minimum, and derivatives of functions, matrix operations, systems of linear equations, eigenvalues, and eigenvectors; - Basics of economics - understanding basic market concepts, decision-making mechanisms, and the ability to interpret data.

Course objective

The aim of the course is to introduce students to the fundamental concepts and methods of game theory and their practical applications in economics, business, and data analysis. Students will learn to analyze decision-making strategies in various contexts, understand the mechanisms of interaction between agents, and use mathematical tools for modeling and optimizing decisions. The course will equip students with the ability to model and analyze strategic situations, which is crucial for data analysis and decision-making in real-world business and economic problems.

Course-related learning outcomes

Knowledge:
1. Defines basic concepts of game theory, including zero-sum and non-zero-sum games, optimal strategies, and Nash equilibrium [DSB1_W01].
2. Characterizes dynamic games and games of incomplete information and describes their applications in business decision analysis [DSB1_W04].
3. Explains methods of modeling strategic interactions and analyzes the impact of game theory on decision-making under uncertainty [DSB1_W09].

Skills:
1. Identifies the structure of a game and selects appropriate methods for strategic analysis in a business context [DSB1_U05].
2. Calculates and interprets Nash equilibrium and other game solutions in various decision-making scenarios [DSB1_U03].
3. Models decision-making situations as strategic games and evaluates the impact of different strategies on the outcomes of interactions [DSB1_U07].
4. Analyzes dynamic games and games of incomplete information, considering risk and uncertainty in decision-making [DSB1_U09].
5. Applies game theory to optimize strategies in business, negotiations, and competitive management [DSB1_U08].

Social competences:
1. Assesses the risk and consequences of strategies employed in business interactions based on game theory [DSB1_K01].
2. Collaborates in strategic teams, arguing and negotiating solutions based on game theory models [DSB1_K02].
3. Considers the ethical aspects of strategic decision-making, analyzing the impact of actions in a competitive business environment [DSB1_K05].

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Two midterm exams, each graded on a 50-point scale. The final grade is determined by the total score from both exams. The first exam takes place in the middle of the course, while the second one is held at the end. The passing threshold is 50 points in total from both exams.

Programme content

The course covers fundamental concepts and tools of game theory, with a particular focus on their applications in economics, business, and data analysis. It will discuss various types of games, including zero-sum and non-zero-sum games, optimal strategies, Nash equilibrium, as well as dynamic games and games of incomplete information. Students will become familiar with methods for modeling strategic interactions, decision analysis under uncertainty, and the practical use of game theory in predicting behaviors and optimizing strategies.

Course topics

Introduction to game theory - basic concepts: players, strategies, payoffs, rules of the game.
Applications of game theory in economics, business, politics, and data analysis.
Zero-sum games and optimal strategies - pure and mixed strategies, decision optimization.
Von Neumann's minimax theorem and its application in optimal strategies.

Nash equilibrium and its interpretation - definition, properties, methods of finding equilibrium.
Non-zero-sum games - analysis of cooperation and negotiation, coalitions, and cooperation strategies.
The repeated prisoner's dilemma - strategies in repeated games, equilibrium in repeated interactions.
Dynamic games and decision optimization - sequential decision-making, analysis of strategic interactions over time.
Decision trees and representation of dynamic games - modeling and analyzing strategies in games with tree-like decision structures.
Applications in economic analysis and behavior modeling - market decisions, competition models, analysis of business strategies.
Games of incomplete information - Bayesian-Nash equilibrium - games with uncertainty, applications in auctions and negotiations.
Practical applications of game theory in data analysis - the impact of decision strategies on predictive models, analysis of user behavior.

Teaching methods

Practical classes in a computer lab. Analysis of teaching materials provided to students. Group work.

Bibliography

Basic:
Rida Laraki Renault Jerome Sylvain Sorin: Teoria gier. Podstawy matematyczne, Springer 2012.
Teoria gier Philip Straffin, Wydawnictwo Naukowe Scholar 2001.

Additional:
Beltrami, E. (2022). Przypadek? Nie sądzę...: prawdopodobieństwo, niepewność kwantowa, złudzenia poznawcze (W. Sikorski, Tłum.). Wydawnictwo Naukowe PWN.

Breakdown of average student's workload

	Hours	ECTS
Total workload	125	5,00
Classes requiring direct contact with the teacher	62	2,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	63	2,50