

Course name : Theory of games and decision		
Type of study: Mathematics	Type of study: Full-time	Examination: Exam
Course characteristics: Compulsory	Level: First (B.Sc.)	Year: Autumn Semester
Type of classes: lectures, laboratory	Hours per week: 2 L, 2 Lab	ECTS points: 6 ECTS

COURSE DESCRIPTION

COURSE OBJECTIVE

- C1.** To provide students with a foundation to normative decision theory, especially the theory of games, and equip them with basic mathematical concepts and tools that are used to analyze and solve decision problems
- C2.** To present various and sometime unexpected real-world applications of this abstract mathematical theory.
- C3.** To equip students with knowledge which is sufficient to recognize and assess archetypal decision-making situations in complicated real-world settings.

PREREQUISITES/ ASSUMED BACKGROUND

1. Basic probability theory, basic linear algebra, general mathematical maturity.

LEARNING OUTCOMES and COMPETENCES TO BE ATTAINED

- LO1.** – The student characterizes the theoretical and practical importance of the axioms, definitions and theorems occurring in the normative decision theory .
- LO2.** – Student lists the most important classes of models appearing in the theory, and makes appropriate and varied interpretations. He/she recognizes archetypal decision-making situations in exemplary real-world decision problem settings.
- LO3.** – Student explains different key concepts of solutions to the game problems. He/she explains the practical consequences of using particular concept of a solution. Student applies the theory to solve basic/classical problems in exemplary real-world settings.

COURSE CONTENT

Lectures - Topics	Hours
L1 – Overview of decision theory - introduction. Behavioral vs. normative theory. Classification of decision problems.	2

L2 – Fundamentals of (mathematical) utility theory. Axioms of the preference relation.	2
L3 – Utility function: basic concept, theorems, importance for normative decision theory.	2
L4 - Normal-form games. Various concepts of solutions.	2
L5 - Matrix games. Strictly and not strictly antagonistic games	2
L6 – Zero-sum two person game in pure strategies.	2
L7 – Zero-sum two person game in mixed strategies. Von Neumann minimax theorem.	2
L8 – Cooperative vs. non cooperative games. "Prisoner dilemma" problem and its various interpretations.	2
L9 – Two-person cooperative games. Nash bargaining axioms and theorem.	2
L10 – N-person cooperative games. Shepley theorem.	2
L11 – Statistical decision problems. Decision rules and their classification.	4
L12 – Multiple-criteria decision making. AHP	4
L13 – Final remarks	2
Σ	30
LABORATORY - Topics	Hours
Lab 1 – Introduction to lab.	1
Lab 2 - Linear algebra with the Maple – introduction to the Maple software	4
Lab 3 – Optimization with the Maple	3
Lab 4 – Matrix games examples, interpretation, concepts of solutions	4
Lab 5 – Zero-sum matrix games in pure strategies. Saddle points.	2
Lab 6 – Solution of zero-sum games in mixed strategies - exemplary problems	4
Lab 7 – Two-person cooperative games - exemplary analysis.	4
Lab 8 – N-person cooperative games. Computing Shepley value.	4
Lab 10 – Pairwise comparison based prioritization methods	4
Σ	30

TEACHING TOOLS

1. – multimedia presentations

2. – e-lecture notes
3. – problem sets for students
4. – work with computer algebra systems (lab) plus traditional face-to-face, blackboard supported tutorials

RECOMMENDED AND ADDITIONAL BIBLIOGRAPHY

RECOMMENDED readings (all available at various internet book-shops and libraries):
Morris P. , Introduction to game theory, Springer-Verlag 1994
Webb J. N., Game Theory: Decisions, Interaction and Evolution, Springer Verlag, London, 2007
Lindgren B.W., Elements of decision theory, Macmillan, London, 1971
Luce D. R., Raiffa H. , Games and decisions; introduction and critical survey, Wiley, New York, 1957.
Adams P., Smith K., Vyborny R., Introduction to Mathematics with maple, World scientific Publishing Co. Ltd., 2004.
ADDITIONAL readings:
Rasmusen E., Games And Information, An Introduction To Game Theory, Blackwell Publishers Inc., Oxford,UK,, 2007
Geçkil Il. K. Anderson, P.L , Applied game theory and strategic behavior, Taylor and Francis Group, 2010
Osborne M.J., Rubinstein A., A Course in Game Theory, MIT Press, 1994.
Hargreaves-Heap S.P. , Varoufakis Y. , <i>Game Theory-A Critical Introduction</i> , Taylor & Francis e-Library, London, New York 2003

TEACHERS

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ADDITIONAL NOTES

Links to course unit teaching materials can be found on the <http://www.pcz.pl/english/ects-subjects> website for current students.