

Game Theory

Code: 104420
ECTS Credits: 6

Degree	Type	Year	Semester
2503740 Computational Mathematics and Data Analytics	OT	4	2

The proposed teaching and assessment methodology that appear in the guide may be subject to changes as a result of the restrictions to face-to-face class attendance imposed by the health authorities.

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: Yes
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: Yes

Teachers

Marina Bannikova

Prerequisites

There are no prerequisites

Objectives and Contextualisation

To learn the basic elements of game theory and to develop an understanding of its applications to economic analysis.

Non-cooperative games: Games in normal form and games in extensive form with perfect and imperfect information.

Solution concepts: Dominance, Nash equilibrium and subgame perfect Nash equilibrium.

Applications: Bargaining, Voting and Cost-sharing.

Cooperative games: Games in characteristic form, the core and the value of a game.

Competences

- Apply a critical spirit and rigour for the validation or rejection of your own arguments and those of others.
- Demonstrate a high capacity for abstraction and translation of phenomena and behaviors to mathematical formulations.
- Design, develop and evaluate efficient algorithmic solutions to computational problems in accordance with the established requirements.
- Formulate hypotheses and think up strategies to confirm or refute them.
- Make effective use of bibliographical resources and electronic resources to obtain information.

- Relate new mathematical objects with other known objects and deduce their properties.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Using criteria of quality, critically evaluate the work carried out.
- Work cooperatively in a multidisciplinary context assuming and respecting the role of the different members of the team.

Learning Outcomes

1. Apply a critical spirit and rigour for the validation or rejection of your own arguments and those of others.
2. Describe the distinct components of a system and the interactions between them.
3. Develop autonomous strategies for solving problems such as identifying the ambit of problems within the course, discriminate routine from non-routine problems, design an a priori strategy to solve a problem, evaluate this strategy.
4. Make effective use of bibliographical resources and electronic resources to obtain information.
5. Relate these concepts to methods and objects in other areas.
6. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
7. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
8. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
9. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
10. Understand basic results in game theory and balance.
11. Use numerical methods to solve problems in game theory.
12. Using criteria of quality, critically evaluate the work carried out.
13. Within a problem, distinguish what is important from what is not so as to construct the mathematical model and its resolution.
14. Work cooperatively in a multidisciplinary context, taking on and respecting the role of the distinct members in the team.

Content

Module 1. Introduction to Game Theory and Examples

- The aim of Game Theory
- Decision Theory with one agent
- Decision Theory with at least two agents: Game Theory
- History of Game Theory
- Non-Cooperative Games *versus* Cooperative Games
- Examples

Module 2. Games in Normal Form

- Definition and examples
- Nash equilibrium
- Interpretations and problems of Nash equilibrium

- The mixed extension of a game
- Existence of Nash equilibrium: The Nash Theorem
- Computing Nash Equilibria

Module 3. Games in Extensive Form

- Preliminaries
- Perfect information
- Backwards induction, Nash equilibrium and Kuhn's Theorem
- Imperfect information

Module 4. Nash equilibrium and related issues

- Introduction
- Dominant strategies
- Elimination of dominated strategies
- Subgame perfect equilibrium

Module 5. Cooperative Games

- Preliminaries
- The Core
- The Shapley value

Module 6. Applications

- Axiomatic and strategic bargaining
- Voting
- Dominant strategy implementation
- Cost-sharing

Methodology

Teaching will be offered on campus.

This course combines lectures with more applied sessions devoted to the resolution of problem sets and exercises.

The proposed teaching methodology may undergo some modifications according to the restrictions imposed by the health authorities on on-campus courses

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Exercises and group discussions	10.5	0.42	1, 12, 10, 2, 3, 13, 9, 8, 6, 7, 5, 14, 4, 11
Lectures	33	1.32	1, 12, 10, 2, 3, 13, 9, 8, 6, 7, 5, 14, 4, 11
Type: Supervised			
Tutorials	15	0.6	1, 12, 10, 2, 3, 13, 9, 8, 6, 7, 5, 14, 4, 11

Type: Autonomous

Readings	15	0.6	1, 12, 10, 2, 3, 13, 9, 8, 6, 7, 5, 14, 4, 11
Study. Preparation of exercises and discussions	70.5	2.82	1, 12, 10, 2, 3, 13, 9, 8, 6, 7, 5, 14, 4, 11

Assessment

Evaluation

There will be a continuous assessment of student progress by way of one partial exam, a final exam and two short tests. Final grades will be computed according to the weights of 48% the final exam, 32% the partial exam and 10% each short test.

A student will only be eligible to the "not evaluable" status if he or she has not taken part in any of the assessments.

Calendar of evaluation activities

The dates of the evaluation activities (midterm exams, exercises in the classroom, assignments, ...) will be announced well in advance during the semester.

The date of the final exam is scheduled in the assessment calendar of the Faculty.

"The dates of evaluation activities cannot be modified, unless there is an exceptional and duly justified reason why an evaluation activity cannot be carried out. In this case, the degree coordinator will contact both the teaching staff and the affected student, and a new date will be scheduled within the same academic period to make up for the missed evaluation activity." **Section 1 of Article 115. Calendar of evaluation activities (Academic Regulations UAB).** Students of the Faculty of Economics and Business, who in accordance with the previous paragraph need to change an evaluation activity date must process the request by filling out an Application for exams' reschedule

https://eformularis.uab.cat/group/deganat_feie/application-for-exams-reschedule

Grade revision process

After all grading activities have ended, students will be informed of the date and way in which the course grades will be published. Students will be also be informed of the procedure, place, date and time of grade revision following University regulations.

Retake Process

All students are required to perform the evaluation activities. If the student's grade is 5 or higher, the student passes the course and it cannot be subject to further evaluation. If the student grade is less than 3.5, the student will have to repeat the course the following year. Students who have obtained a grade that is equal to or greater than 3.5 and less than 5 can take a second chance exam. The lecturers will decide the type of the second chance exam. When the second exam grade is greater than 5, the final grade will be a PASS with a maximum numerical grade of 5. When the second exam grade is less than 5, the final grade will be a FAIL with a numerical grade equal to the grade achieved in the course grade (not the second chance exam grade).

A student who does not perform any evaluative task is considered "not evaluable", therefore, a student who performs a continuous assessment component can no longer be qualified with a "not evaluable".

The date of the retake exam will be posted in the calendar of evaluation activities of the Faculty.

Irregularities in evaluation activities

In spite of other disciplinary measures deemed appropriate, and in accordance with current academic regulations, *"in the case that the student makes any irregularity that could lead to a significant variation in the grade of an evaluation activity, it will be graded with a 0, regardless of the disciplinary process that can be*

instructed. In case of various irregularities occur in the evaluation of the same subject, the final grade of this subject will be 0". Section 10 of Article 116. Results of the evaluation. (UAB Academic Regulations).

The proposed evaluation activities may undergo some changes according to the restrictions imposed by the health authorities on on-campus courses.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	48%	2	0.08	1, 12, 10, 2, 3, 13, 9, 8, 6, 7, 5, 14, 4, 11
Partial exams	32%	2	0.08	1, 12, 10, 2, 3, 13, 9, 8, 6, 7, 5, 14, 4, 11
Short tests	20%	2	0.08	1, 12, 10, 2, 3, 13, 9, 8, 6, 7, 5, 14, 4, 11

Bibliography

Basic references

- Roy Gardner. *Games for Business and Economics*. John Wiley & Sons, Inc. (1995).
- Robert Gibbons. *A Primer in Game Theory*. Princeton University Press (1992).
- Martin J. Osborne. *An Introduction to Game Theory*. Oxford University Press (2004).

Advanced references

- Michael Maschler, Eilon Solan, and Shmuel Zamir. *Game Theory*. Cambridge University Press (2013).
- Roger B. Myerson. *Game Theory: Analysis of Conflict*. Harvard University Press (1991).
- Martin J. Osborne and Ariel Rubinstein. *A Course in Game Theory*. The MIT Press (1994).
- Fernando Vega Redondo. *Economics and the Theory of Games*. Cambridge University Press (2003).

Software

There are no prerequisites