DEGREE CURRICULUM

GAME THEORY AND APPLICATIONS

Coordination: MIQUEL FERNÁNDEZ, SILVIA MARIA

Academic year 2017-18

GAME THEORY AND APPLICATIONS 2017-18

Subject's general information

Subject name	GAME THEORY AND APPLICATIONS
Code	101354
Semester	2nd Q(SEMESTER) CONTINUED EVALUATION
Typology	<table><tr><th>Degree</th><th>Course</th><th>Typology</th><th>Modality</th></tr><tr><td>Bachelor's Degree in Business Administration and Management</td><td>4</td><td>OPTIONAL</td><td>Attendance-based</td></tr></table>
ECTS credits	6
Groups	1GG
Theoretical credits	3
Practical credits	3
Coordination	MIQUEL FERNÁNDEZ, SILVIA MARIA
Department	MATEMATICA
Teaching load distribution between lectures and independent student work	One and a half hours of independent student work for each one-hour-lecture
Important information on data processing	Consult this link for more information.
Language	English

GAME THEORY AND APPLICATIONS 2017-18

Teaching staff	E-mail addresses	Credits taught by teacher	Office and hour of attention
MIQUEL FERNÁNDEZ, SILVIA MARIA	smiquel@matematica.udl.cat	6	

Subject's extra information

Game Theory studies conflict problems (non-cooperative games) and cooperative problems (cooperative games) between two or more agents (players) and what actions the solution of a problem depends on.

The most important point in **non-cooperative situations** or conflict situations is the existence of strategic interdependence. That is to say, what each player gets depends not only on what her decision is, but also on what are the decisions taken by the other players. Throughout the majority of the course, we assume rational agents acting in their own interest as we give students a firm grounding in the logic and methods of non-cooperative game theory. We apply standard techniques such as domination of strategies, Nash Equilibrium and backwards induction across a wide variety of games.

As will be seen, in many games like the Prisoner's Dilemma, game theory predicts suboptimal outcomes, since each agent acts in their self-interest, which may not be the common interest. One way to escape this is to allow agents to write binding agreements with each other, which enables us to shift the focus from strategies to payoffs. We take a brief venture into cooperative game theory to see how agents will split the gains from forming coalitions.

Thus, binding agreements are allowed in **cooperative situations** and we are interested on how agents split the gains from forming coalitions.

Relationship with other subjects of the curriculum: Game Theory is a branch of applied mathematics which is very close to microeconomics.

Requirements: Although no prior knowledge of any specific mathematical discipline is required, a familiarity with logical and mathematical reasoning is desirable.

Learning objectives

Course Aims

As students will discover, game theory is an essential tool for understanding of a wide range real world phenomena. Among others, this course aims to answer two vital questions:

- What is game theory about?
- How do I apply game theory?

Students should develop an appreciation for how the details of a game such as when players move and what they know can have a large impact on outcomes.

This course aims to equip students with a wide range of game theoretic skills, which will be used in formulating and solving models of their own. By exposing students to a wide variety of topics and applications, this course gives students some idea of the vast range of phenomena one can use game theory to model and explain. This course will also improve powers of logic and encourage students to think strategically in their future everyday life.

Learning outcomes

By the end of this module, students should be able to:

- Understand the different types of games and their uses in strategic thinking.

- Analyze different games and use a variety of tools to find equilibria.
- Analyze the market structure from the point of view of game theory.
- Interpret an auction as a non-cooperative game and analyze the strategies of participants.
- Assess the importance of information in games and how this can change behaviours.
- Determine rational solutions in cooperative problems.
- Apply different solution rules to cooperative problems, analyzing and comparing their properties.
- Determine the power index of an agent in a voting situation.
- Understand the way in which game theoretic models can be applied to a variety of real-world scenarios in economics.

Competences

The previous learning outcomes guarantee the following competences:

Strategic competence:

- Knowledge of a foreign language. Since the course is given in English.

General competences:

- Capacity for analysis and synthesis.
- Capacity for organisation and planning.
- Capacity for critical judgement and self-appraisal.

Specific competences:

- To apply instrumental techniques to the analysis and resolution of business problems, and to the decision-making process.

Subject contents

1 Static games with complete information

1.1 Strategic and extensive form game

1.2 Two-player games

1.3 Nash equilibrium

1.4 Games with 3 or more players and the tragedy of the commons

1.5 Games with infinite strategies

1.6 Mixed strategies and the existence of the Nash equilibrium

1.7 Market games: Cournot's duopoly and Bertrand's duopoly

2 Dynamic games with complete information

2.1 Extensive form games

2.2 Strategic form of a dynamic game

2.3 Subgame perfect Nash equilibrium

2.4 Dynamic games with perfect information: backward induction

2.5 Market games: Stackelberg's duopoly

2.6 Repeated prisoner's dilemma

3 Static games with incomplete information

3.1 Introduction to games with incomplete information

3.2 Decision trees with chance moves

3.3 Static bayesian games and Nash bayesian equilibrium

3.4 Prisoner's dilemma with incomplete information, a simple auction

3.5 Applications: Cournot's duopoly with incomplete information, auctions

4 Cooperative games

4.1 Coalitions and the characteristic function

4.2 Efficient allocations

4.3 Coalitional rationality: the core

4.4 The Shapley value

4.5 Cost allocation problems

4.6 Voting games and power indices

Methodology

Each session will be comprised of a lecture and time for students to work in pairs on their exercise list.

Lecture notes and the exercise list will be available each week before the class takes place.

Development plan

This subject takes place in the second semester. There will be 3.5 hours of teaching per week, comprising two hours of lectures and one and a half hours in small working group. Towards the end of the eighth week, students will have completed the first and second blocks. The next two blocks will be completed in the second part of the semester.

Topic	Dates
1. Static games with complete information	5th February - 12 March
2. Dynamic games with complete information	13th March - 8th April
3. Static games with incomplete information	16th April - 7th May
4. Cooperative games	8th May - 31st May

Evaluation

The assessment consists of two parts:

- 20% of the mark: Four assignments consisting of a list of exercises.

- 80% of the mark: Two mid-term 2-hour examinations. Both are open book exams and have equal weighting.

Bibliography

Dixit A. and Skeath S. (2004) Games of Strategy. W.W. Norton & Company, London.

Watson J. (2008) Strategy. W.W. Norton & Company, London.

Binmore K. (2007) Game Theory: A Very Short Introduction. Oxfor University Press [in spanish: La Teoría de Juegos: Una Breve Introducción. Alianza Editorial].

Gardner R. (2003) Games for Business and Economics. John Wiley & Sons [in spanish: Juegos para empresarios y economistas. Antoni Bosch Editors].

Osborne MJ. (2004) An Introduction to Game Theory. Oxford University Press.

Pérez J., Jimeno Pastor JL. and Cerdá Tena E. (2010) teoría de Juegos. Prentice Hall, Madrid.

Rafels Pallarola C. (1999) Jocs Cooperatius i Aplicacions Econòmiques. Edicions Universitat de Barcelona