Game Theory - Syllabus

Rudolf Kerschbamer and Fabian Petutschnig

Winter Term 2021/22

General Remarks

The course Game Theory consists of a weekly 3-hours lecture (LV-Nr.: 432120) and a 1-hour proseminar (LV-Nr.: 432122 or 432123). The 3-hours lecture has 5 ECTS and is given by Rudolf Kerschbamer, the 1-hour proseminar has 2,5 ECTS and is given by Fabian Petutschnig. The lecture will be held online via Big Blue Button (BBB). The proseminar will be held as an in-person class as long as the situation permits.

Registration for the course will be online, however **attendance in the first meeting (October 5) is required!**

Requirements

Basic knowledge of microeconomics as well as the willingness to deal with formal models.

Target Group

First year students in the Master Program Applied Economics and second year students in the Master Program Banking and Finance.

Course Credits within the Curriculum

This course is compulsory for the Master Program Applied Economics and elective for the Master Program Banking and Finance.

Time and Place

The lecture will take place weekly on Tuesdays from 08:00-10:45 and is held online via BBB, starting October 5, 2021. The preliminary meeting for the whole course is on Tuesday, October 5, 08:00, in a virtual classroom of BBB.

Lecture Schedule

When	Where	What
Di, 05.10, 08.00 - 10.45	online	Lectures 0 & 1
Di, 12.10, 08.00 - 10.45	online	Lectures 2 & 3
Di, 19.10, 08.00 - 10.45	online	Lectures 4 & 5
Di, 09.11, 08.00 - 10.00	Aula	First Exam
Di, 16.11, 08.00 - 10.45	online	Lecture 6
Di, 23.11, 08.00 - 10.45	online	Lecture 7
Di, 30.11, 08.00 - 10.45	online	Lecture 8
Di, 07.12, 08.00 - 10.00	Aula	Second Exam
Di, 14.12, 08.00 - 10.45	online	Lecture 9
Di, 11.01, 08.00 - 10.45	online	Lectures 10 & 11
Di, 18.01, 08.00 - 10.45	online	Lecture 12
Di, 25.01, 08.00 - 10.45	online	Lecture 13
Di, 01.02, 08.00 - 10.00	Aula	Final Exam

Proseminar Schedule

The 1-hour proseminar will take place weekly on Wednesday – starting October 6, 2020 – either from 14:00-14:45 or from 15:00-15:45 in SR 4. In case the Covid-Situation does not permit an in-person class anymore, we will switch to an online format during the semester. In this case we will merge the two groups into one seminar, which will then last from 14:00-15:45.

When	Where	What
Mi, 06.10, 14.00 - 15.45	SR 9	Problem Set 1
Mi, 13.10, 14.00 - 15.45	SR 9	Problem Set 2
Mi, 20.10, 14.00 - 15.45	SR 9	Problem Set 3
Mi, 27.10, 14.00 - 15.45	SR 9	Problem Set 4
Mi, 03.11, 14.00 - 15.45	SR 9	Problem Set 5
Di, 09.11, 08.00 - 10.00	Aula	First Exam
Mi, 17.11, 14.00 - 15.45	SR 9	Problem Set 6
Mi, 24.11, 14.00 - 15.45	SR 9	Problem Set 7
Mi, 01.12, 14.00 - 15.45	SR 9	Problem Set 8
Di, 07.12, 08.00 - 10.00	Aula	Second Exam
Mi, 15.12, 14.00 - 15.45	SR 9	Problem Set 9
Mi, 12.01, 14.00 - 15.45	SR 9	Problem Sets 10 & 11
Mi, 19.01, 14.00 - 15.45	SR 9	Problem Set 12
Mi, 26.01, 14.00 - 15.45	SR 9	Problem Set 13
Di, 01.02, 08.00 - 10.00	Aula	Final Exam

Course Requirements

Regular attendance in class: Regular attendance and participation in class is highly recommended but not mandatory. You do not have to inform us about non-attendance for any reason.

Problem sets: To help you to gain ease in applying the tools of non-cooperative game theory, there will be weekly problem sets. Please work on the problems in small groups (comprising no more than four students each).

Participation in three written exams: The three exams include material from both parts of the course. You find the exam dates and places on one of the earlier pages. Participation in all three exams is **mandatory**.

Grading

Each exam has 100 points but they are weighted 30-30-40%, i.e. the points you score in exam 1 & 2 will be multiplied by three, the ones from the final exam by 4. Thus you can reach a maximum of 1000 points. The final grade will be computed according to the following table:

Points	Grade
> 900	1
> 800	2
> 700	3
> 600	4
≤ 600	5

Missing at the Exam: If you miss either of the first two exams but attend the third your points will be weighted 40-60% and you don't have to take a compensatory exam. However if you miss either two exams **or** the third exam you have to take a compensatory exam in February.

Course Outline

Below is an outline of the course that roughly but not precisely corresponds to each class session:

Representation of Games

Lecture 1 Representation of Games: normal-form representation, extensive-form representation, information sets, random moves, histories, pure strategies, relationship between extensive-form and normal-form, mixed strategies and expected utility

Dominance

Lecture 2 Static Games of Complete Information - Dominance: (strictly) dominant strategies, (strictly) dominated strategies, iterated deletion of strictly dominated strategies, iterated deletion and rationality, mixed strategies and dominance

Static Games of Complete Information: Nash Equilibrium

Lecture 3 Static Games of Complete Information - Pure Strategy Nash Equilibrium in Finite Games: definition of Nash equilibrium (NE), finding NE, best-response correspondences and NE, motivating NE, relation between NE and iterated deletion, existence of NE in pure strategies in finite games, multiplicity

Lecture 4 Static Games of Complete Information - Mixed Strategy Nash Equilibrium in Finite (Discrete) Games: definition of mixed strategy NE, finding mixed strategy NE, mixed best-response correspondences and mixed NE, motivating mixed NE, existence of (possibly mixed) NE in finite games

Lecture 5 Static Games of Complete Information - Nash Equilibrium in Infinite (Continuous) Games: finding NE in games with continuous strategy spaces, best-response correspondences and NE with continuous strategy spaces, strategic substitutes vs. strategic complements, applications in economics and finance, existence of NE in games with continuous strategy spaces

Dynamic Games of Complete Information: Subgame Perfect Equilibrium

Lecture 6 Dynamic Games of Complete Information - Subgame Perfect Nash Equilibrium in Finite Games: incredible threats and incredible promises, subgames, definition of subgame perfect Nash equilibrium (SPNE),

finding SPNEs in games of perfect information (Backward Induction Procedure), finding SPNE in games of imperfect information (Generalized Backward Induction Procedure), NE versus SPNE, existence of SPNE in finite games

Lecture 7 Dynamic Games of Complete Information - Subgame Perfect Nash Equilibrium in Continuous Games with Perfect Information: finding SPNE in continuous games of perfect information, SPNE outcome vs. SPNE, games of positive externalities vs. games of negative externalities, NEs of simultaneous-move vs. SPNE of sequential move games, costs and benefits of precommitment: first-mover advantage vs. second-mover advantage, strategic effect and direct effect of first-stage behaviour, applications

Lecture 8 Dynamic Games of Complete Information - Subgame Perfect Nash Equilibrium in Continuous Games with Imperfect Information: finding SPNE in continuous games of imperfect information, strategic precommitments to affect future interactions, formal analysis of incentives for precommitment, strategic effects and direct effects, Tirole's animal terminology to characterize commitment strategies, a graphical analysis of precommitment effects

Lecture 9 Dynamic Games of Complete Information - Subgame Perfect Nash Equilibrium in Games with (Potentially) Infinite Sequences of Moves: finding SGPE in games with (potentially) infinite sequences of moves, motivation for repeated games, finitely and infinitely repeated games, finitely repeated games with unique and with multiple NE in stage-game, one-stage-deviation principle, infinitely repeated games and discounting, applications of infinitely repeated games (cooperation in social dilemmas, collusion), characterizing SPNE outcome paths in payoff space (folk theorems), infinite horizon, infinite action bilateral bargaining

Static Games of Incomplete Information: Bayesian Equilibrium

Lecture 10 Static Games of Incomplete Information - Bayesian Equilibrium in Finite (Discrete) Games: incomplete information, Harsanyi transformation, definition of Bayesian equilibrium (BE), finding BE in finite games, correlated types, applications, existence of BE in finite games

Lecture 11 Static Games of Incomplete Information - Bayesian Equilibrium in Infinite (Continuous Action and/or Continuous Type Spaces) Games: definition of BE in games with continuous action and/or continuous type spaces , finding BE in games with continuous action and/or continuous type spaces, Cournot with asymmetric information on cost, purification of mixed strategies, first price auction

Dynamic Games of Incomplete Information: Perfect Bayesian Equilibrium

Lecture 12 Dynamic Games of Incomplete Information - Perfect Bayesian Equilibrium in Finite Games: motivation for definition of perfect Bayesian equilibrium (PBE), elements of PBE, definition of PBE, finding PBE, applications

Lecture 13 Dynamic Games of Incomplete Information - Perfect Bayesian Equilibrium in Signalling Games: definition of signalling game, translation of definition of PBE (for general games) to a definition of PBE for signalling games, finding PBE in signalling games, applications of signalling in economics and finance

Lecture 14 Dynamic Games of Incomplete Information – Refinements of Perfect Bayesian Equilibrium: implausible beliefs off-the-equilibrium-path, forward induction, domination-based refinements on beliefs, intuitive criterion, other refinements, applications

Lecture 14 will not be covered in class and it is not relevant for the exams. The slides will be available, though.

Useful References

Although the slides are pretty much self-contained, it does make sense to take a look at a textbook. Useful references are:

- Martin J Osborne and Ariel Rubinstein. *A course in game theory.* MIT press, 1994
- Roger B Myerson. *Game theory.* Harvard university press, 2013
- Drew Fudenberg and Jean Tirole. *Game Theory.* MIT press, 1994

Most of the material is (at a somewhat lower level) also covered in:

- Robert Gibbons et al. *A primer in game theory.* Harvester Wheatsheaf New York, 1992

Most of the material is (to some extent) also covered in:

- Andreu Mas-Colell, Michael Dennis Whinston, Jerry R Green, et al. *Microeconomic theory.* Vol. 1. Oxford university press New York, 1995

Find all basic concepts also in:

- Martin J Osborne et al. *An introduction to game theory.* Vol. 3. 3. Oxford university press New York, 2004