Zeppelin University
Politics, Administration and International Relations
123131 Entscheidungs- und Spieltheorie
Tilko Swalve, M.A.

Introduction to Decision and Game Theory

Syllabus Spring 2018

Office : A5, 6, B 301 (Mannheim)
Office Hour: By appointment before or after classes
Phone: +49 (0) 621-181-3475
E-Mail: tswalve@mail.uni-mannheim.de

Course Description

Social sciences in general are an attempt to understand the ways in which people behave and make decisions, as individuals and in group settings. Decision and game theory provides a formal *language* to describe situations of conflict and cooperation between rational decision makers. Over the past decades, decision and game theory has become an indispensable tool in the social sciences and natural sciences, especially in economics, but also in political science, international relations, sociology, law, psychology, computer sciences and biology. Its influence and success has been recognized by multiple Nobel prizes in economics.

This course will introduce students to the fundamentals of decision and game theory. We cover the basics of rational choice theory, single-person decision problems with and without risk, static games, Nash equilibrium, dynamic games with complete information, backwards induction, subgame-perfect Nash equilibrium, Bayesian Nash equilibrium, etc.. We will apply all these concepts to problems in various contexts such as international relations, economics, politics and law.

I will use lecture slides to introduce important definitions and concepts. Primarily, however, I will teach the course on the blackboard. We will work out examples and exercises to every single slide stating a more formal definition or abstract concept. Students will also solve problems on their own or in groups during the sessions.

Guidelines

- Decision and game theory is a branch of applied mathematics. There is no game theory without mathematics. This said, there is nothing to be afraid of. We will not go beyond anything that you have not seen in high school before. We will use formal notation,

but even though it will take some effort to understand at first, it will be helpful in the end. The hard part of decision and game theory is not the mathematics.

- Learning decision and game theory means you are learning a language. Learning a language requires to learn vocabularies and grammar rules. Without spending time on exercises and the problem sets you won't get far. Take them seriously!
- Don't get frustrated. You may find that despite your best efforts a solution may evade you or that you got stuck with an exercise. This is normal. You can always ask for help!
- The readings will help you to follow the lecture, but at the same time the lecture will help you to understand the readings. You may decide to read the assigned readings before the class session, or after the class session, or both. Reading won't be necessary to follow the class session but it might help.
- I will give you a practice exam. There won't be any "surprises" on the real one.

Examination

There will be a 90 minute exam either at the end of the semester or earlier if a midterm date can be arranged.

Attendance Policy

Attendance at Zeppelin University is generally voluntary, but I strongly encourage you to attend as many sessions as possible. I will upload all readings and lecture slides but the most important part of the course are the examples and exercises during the class sessions.

Resources

I will make all readings available online. However, you may want to obtain a copy of one of the following books:

T: Tadelis, S. (2013). *Game Theory: An Introduction.* Princeton University Press
The lecture slides are based on this book.

O: Osborne, M. (2002). *An Introduction to Game Theory.* Oxford University Press

B: Behnke, J. (2013). *Entscheidungs- und Spieltheorie.* Nomos
Least technical in this list, German.

Schedule

We meet every day from January 22rd to 26th, 2017 from 10.00am to 4.00pm/5.00pm. There will be a lunch break and two coffee breaks.

Jan 22 Decision Theory
Jan 23 Static Games of Complete Information
Jan 24 Dynamic Games of Complete Information
Jan 25 Static Games of Incomplete Information
Jan 26 More Applications and Repetition

Decision Theory, 22.01.2018

What is a rational decision? How should a rational decision-maker choose when faced with risk? In this session we develop a (formal) language to analyze single-person decision problems. We will also discuss the assumptions behind the rational-choice approach, and how deviations from these assumptions affect our ability to make predictions.

Choose one of the following:

- T: 1, 2
- B: 2, 3

Key concepts: action, outcome, preference, payoff function, lottery, expected payoff, St. Peterburg Paradox, risk aversion, backwards induction, discount factor, Allais' Paradox, Prospect Theory

Static Games of Complete Information, 23.01.2018

In many situations deciding what to do involves thinking about what other people might do. In this session we extend single-person decision problems to allow strategic interaction with other players. We will describe strategic situations as games and introduce different solution concepts, most prominently, the Nash Equilibrium.

Choose one of the following:

- T: 3-6 (until p. 114)
- B: 4-6, 9
- O: 2-4

Key concepts: common knowledge, normal form, pure strategy, Pareto efficiency, dominant strategy, iterated elimination, best response correspondence, Nash equilibrium, Cournot competition, mixed strategy

Dynamic Games of Complete Information, 24.01.2018

So far we have analyzed situations in which players make decisions simultaneously. In this session we lay out a framework that allows us to formally describe strategic interaction when players move sequentially. We introduce a new solution concept for these kinds of problems: subgame-perfect Nash equilibrium.

Choose one of the following:

- T: 7, 8
- B: 7, 11
- O: 5-7

Key concepts: extensive form, game tree, imperfect information, equilibrium path, sequential rationality, backwards induction, subgame, subgame-perfect Nash equilibrium, Stackelberg competition

Static Games of Incomplete Information, 25.01.2018

How can we think of situations in which players have some idea about their opponents' characteristics but don't know for sure what these characteristics are? In this session we extend our framework to allow for uncertainty over the preferences of other players. We introduce a formalization of learning and a new solution concept: Bayesian Nash equilibrium.

Choose one of the following:

- T: 12
- O: 9

Key concepts: type, belief, common prior, conditional probability, Bayesian Nash equilibrium, Harsany's purification theorem

More Applications and Repetition, 26.01.2018

We will use the last session to catch up on material we didn't manage to cover in the previous days, to see more applications of decision and game theory, and to repeat and practice. If we have enough time, we discuss dynamic games of incomplete information.