Universität Zürich[UZH]

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Game theory and strategic interaction

Prof. Dr. Heiko Rauhut, PD Dr. Heinrich Nax

Course outline, credits and administrative points

Outline

– This lecture gives an introduction to models of social interactions in the social sciences. A focus is on game theoretical models, actor models and models about micro-macro transitions. Typical examples and empirical findings from the social sciences are discussed.

▪ Credits:

– *For BA students:* The course is worth 4 ECTS credits. The course is not graded and is examined on a pass/fail basis.

– *For MA students:* The course is worth 6 ECTS credits. The course is not graded and is examined on a pass/fail basis.

– To receive credit, students are expected to read the literature, participate in group work and discussions during the lecture and pass the exam. The exam is written in the last session of the course. If the exam is not passed the course is failed. In this case, students are advised to take the course “Modellbildung” in the upcoming spring term 2020.

Course outline, credits and administrative points

Literature

- **Core literature:** Diekmann, Andreas: Spieltheorie. Rowohlt 2009.
- **Further literature:**

  Dixit, Avinash K., and Susan Skeath. Games of Strategy. WW Norton & Company, 2015.

  Braun, Norman & Gautschi, Thomas (2011), Rational Choice Theorie. Juventa; Weinheim, München.

  Herbert Gintis (2000): Game Theory Evolving. Princeton, NJ.: Princeton University Press.

  Ken Binmore (1992): Fun and Games. Lexington: Heath.

  Eric Rasmusen (2000): Games and Information. 3.,veränderte Aufl., Oxford: Blackwell.

  Camerer, Colin (2003): Behavioral Game Theory. Experiments in Strategic Interaction. Princeton: Princeton University Press.

  Shelling, Thomas C.: Micromotives and macrobehavior. WW Norton & Company.

Course outline, credits and administrative points

Course-relevant websites:

www.Gametheory.online

www.scienceexperiment.online

PART I: Introduction and Course credits			
1	19.2.19	HR	**Introduction** Course credits and introduction
PART II: Game Theory			
2	26.2.19	HH	**Practical exercise: Class room experiment on the beauty contest game** Literature: – Camerer, Colin F. Behavioral game theory: Experiments in strategic interaction. Princeton University Press, 2011. Chapter 1: Introduction, p. 1-24. – Selten, Reinhard, and Rosemarie Nagel. "Das Zahlenwahlspiel-Hintergründe und Ergebnisse." Spektrum der Wissenschaft, February (1998): 16-22. – Diekmann, Andreas. "Rational choice, evolution and the "Beauty Contest". In: Raymond Boudon. A Life in Sociology. Oxford: Bardwell (2009).
3	5.3.19	HH	**Cooperative vs noncooperative game theory** Literature: – Serrano, Roberto. Cooperative games: Core and Shapley value. No. 2007-11. Working Paper, Brown University, Department of Economics, 2007 – Gale, David, and Lloyd S. Shapley. "College admissions and the stability of marriage." The American Mathematical Monthly 69.1 (1962): 9-15.
4	12.3.19	HH	**Non-cooperative game theory: Normal form, Best replies, Nash equilibrium** Literature: – Nash, John. "Non-cooperative games." Annals of mathematics (1951): 286-295.
5	19.3.19	HH	**Non-cooperative game theory: dynamics, Sub-game perfection** Literature: – Exercises and notes will be distributed.
6	26.3.19	HH	**Experimental game theory, Behavioral game theory, Learning in games** Literature: – Camerer, Colin F. "Progress in behavioral game theory." Journal of economic perspectives 11.4 (1997): 167-188.
7	2.4.19	HR	**Cooperation and punishment: Class experiment and discussion** Literature: – Fehr, Ernst, and Herbert Gintis. "Human motivation and social cooperation: Experimental and analytical foundations." Annu. Rev. Sociol. 33 (2007): 43-64.
8	9.4.19	HH	**Bargaining, Markets**
PART III: Sociological applications and experiments			
9	16.4.19	HR	**Cooperation and punishment: Experimental evidence** Literature: – Chaudhuri, A. (2011). "Sustaining cooperation in laboratory public goods experiments: a selective survey of the literature." Experimental Economics, 14(1), 47-83. – Henrich, Joseph, et al. "Costly punishment across human societies." Science 312.5781 (2006): 1767-1770. – Herrmann, Benedikt, Christian Thöni, and Simon Gächter. "Antisocial punishment across societies." Science 319.5868 (2008): 1362-1367.
–	23.4.19		– *Easter break*
10	30.4.19	HR	**Normative conflict** Literature: – Winter, Fabian, Heiko Rauhut, and Dirk Helbing. "How norms can generate conflict: An experiment on the failure of cooperative micro-motives on the macro-level." Social Forces 90.3 (2012): 919-946. – Nikiforakis, Nikos, Charles N. Noussair, and Tom Wilkening. "Normative conflict and feuds: The limits of self-enforcement." Journal of Public Economics 96.9-10 (2012): 797-807.
11	7.5.19	HR	**Lying, ignorance and social dynamics** Literature: – Rauhut, Heiko. "Beliefs about lying and spreading of dishonesty: Undetected lies and their constructive and destructive social dynamics in dice experiments." PloS one 8.11 (2013): e77878. – Abeler, J., D. Nosenzo, and C. Raymond (2016). "Preferences for truth-telling". Working Paper. [Meta-analysis] – Gächter, Simon, and Jonathan F. Schulz. "Intrinsic honesty and the prevalence of rule violations across societies." Nature 531.7595 (2016): 496.
12	14.5.19	HR	**Signaling** Literature: – Gambetta, Diego. "Signaling." The Oxford handbook of analytical sociology (2009): 168-194. – Rebecca Bliege Bird and Eric Alden Smith: "Signaling theory, strategic interaction, and symbolic capital." Current anthropology 46.2 (2005): 221-248. – Diekmann, Andreas, and Wojtek Przepiorka. "Soziale Normen als Signale: Der Beitrag der Signaling-Theorie." Soziologische Theorie kontrovers. Vol. 50. VS Verlag für Sozialwissenschaften, 2010. 220-237.
PART IV: Exam			
13	21.5.19	HR/HH	**Questions & Answers, Discussion, further specialization**
14	28.5.19		**Exam**

Questions?

What is game theory?

Discuss with your neighbour for about 5 minutes

and present your result!

John Nash

- Born 13. june 1928
- Ph.D. 1950, Princeton University with work on «Non-cooperative Games»
- Extension of the game-theoretical work of Oskar Morgenstern and John von Neumann by introducing the so-called Nash equilibrium
- Nobel prize 1994 (joint with Reinhard Selten and John Harsanyi)

Terms and definitions in game theory

- Player

  Finite

  Endliche set of interdependent decision makers (e.g. persons, organisations) and possibly nature as fictitious player

- Choice set

  Possible moves or choice alternatives of the players. We differentiate between simultaneous and sequential games

  ## Information

  Knowledge of the player at each time point at the game. This knowledge can mean the rationality of the players, the structure of the game or moves of nature. Common knowledge is when all involved players have the same information and everybody knows that everybody knows the same etc.

Terms and definitions in game theory

- ## Strategy

  A **pure** strategy is a rule which defines for each move which choice the player has to make given the information. A **mixed** strategy is a distribution of probabilities over pure strategies.

- ## Payoffs

  Expected utility of the players after every player (and possibly nature) have made their decisions.

Terms and definitions in game theory

- ## Sequential game

  At least one player has more than one move and the moves are determined by the previous moves of the other players.

- ## Iterated games

  There are games which are played once (one shot), finitely repeated games and infinitely repeated games. Typically, it is assumed that players have common knowledge about the iteration protocol.

Games in normal form

– The rows indicate the choice alternatives of the row-player, the columns indicate the choice alternatives of the column player

		Column player	
		Strategy A	Strategie B
Row player	strategy 1		
	Strategy 2		

Games in normal form

- The rows indicate the choice alternatives of the row-player, the columns indicate the choice alternatives of the column player
- The first number indicates the payoff of the row-player, the second number the payoff of the column player

		Column player	
		Strategy A	Strategie B
Row player	strategy 1	4, 4	3, 3
	Strategy 2	6, 6	5, 5

Definitions and equilibria concepts

- **Strategy combination**

  Is defined by the strategies of the players

- **Equilibrium**

  Strategy combination for which no player has an incentive to deviate unilaterally

- **Strictly dominant strategy**

  Strictly the best reply to each possible strategy of all other players.

- **Weakly dominated strategy**

  Strategy which is at least once a better an never a worse reply to all other strategies.

Definitions and equilibria concepts

- Equilibrium selection

  A rule which defines which equilibrium is to be selected based on all possible strategy combinations and payoffs (e.g. equilibrium in dominant strategies)

Equilibrium in dominant strategies

- Step 1: Assume you are one of the players
- Step 2: Assume the opponent has chosen a given strategy
- Step 3: Determine your best reply and delete the other alternative
- Step 4: Look for the best reply for all other choice alternatives and delete the alternatives
- Step 5: If a complete choice alternative is cancelled out, this alternative is dominated
- Step 6: Repeat steps 1-5 for the opponent
- Step 7: If there is only one combination left, this is the equilibrium in dominant strategies

Equilibrium in dominant strategies

		Column player	
		strategy A	strategy B
Row player	strategy 1	4, 4	3, 3
	strategy 2	6, 6	5, 5

Equilibrium in dominant strategies

		Column player	
		strategy A	strategy B
Row player	strategy 1	4, 4	3, 3
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Equilibrium in dominant strategies

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		strategy A	strategy B
Row player	strategy 1	~~4~~, 4	3, 3
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Equilibrium in dominant strategies

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Equilibrium in dominant strategies

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Equilibrium in dominant strategies

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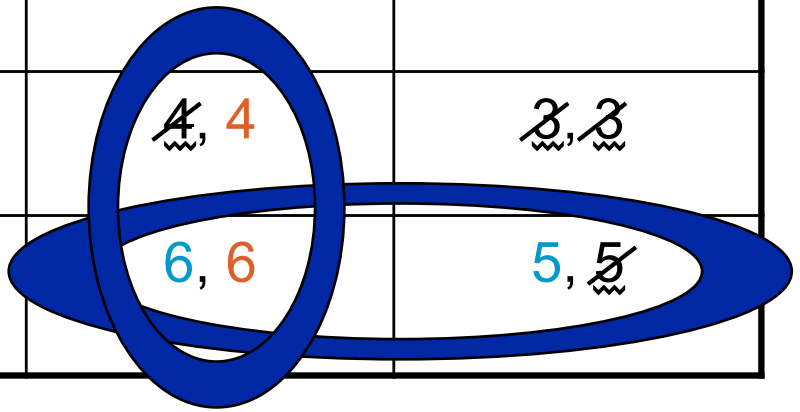

Equilibrium in dominant strategies

		Column player	
		strategy A	strategy B
Row player	strategy 1	~~4~~, 4	~~3~~, ~~3~~
	strategy 2	6, 6	5, ~~5~~

Equilibria concepts

- ## Nash-equilibrium

  A Nash equilibrium is a combination of best replies, i.e. if each player chooses the best strategy given the choices of the opponent. A Nash equilibrium can exist in pure strategies and in mixed strategies.

Nash equilibrium

- Step 1: Assume you are one of the players
- Step 2: Assume the opponent chooses a given alternative
- Step 3: Determine the best reply and mark it
- Step 4: Look for the best reply for each of the alternatives of teh opponent and mark it
- Step 5: Each combination of both-sided marked entries is a Nash equilibrium

Example: A simple coordination game

- You are in holidays in Paris and loose your travel partner
- Your battery of your mobile is off
- You want to meet him or her without communication possibility

		Column player	
		Eifel tower	Hotel
Row player	Eifel tower	3, 3	1, 0
	Hotel	0, 1	2, 2

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		Eifel tower	Hotel
Row player	Eifel tower	**3**, **3**	1, 0
	Hotel	0, 1	**2**, **2**

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- You are in holidays in Paris and loose your travel partner
- Your battery of your mobile is off
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		Column player	
		Eifel tower	Hotel
Row player	Eifel tower	**3**, **3**	1, 0
	Hotel	0, 1	**2**, **2**

«Golden Balls»

- What is the normal form of the game?
- How do you think will the players decide?

«Golden Balls»

- What is the normal form of the game?
- How do you think will the players decide?

Sarah

Steven

	split	steal
split		
steal		

Sarah

Steven

	split	steal
split	50’075, 50’075	
steal		0, 0

Sarah

Steven

	split	steal
split	50’075, 50’075	0, 100’150
steal	100’150, 0	0, 0

Equilibrium in weakly dominant strategies

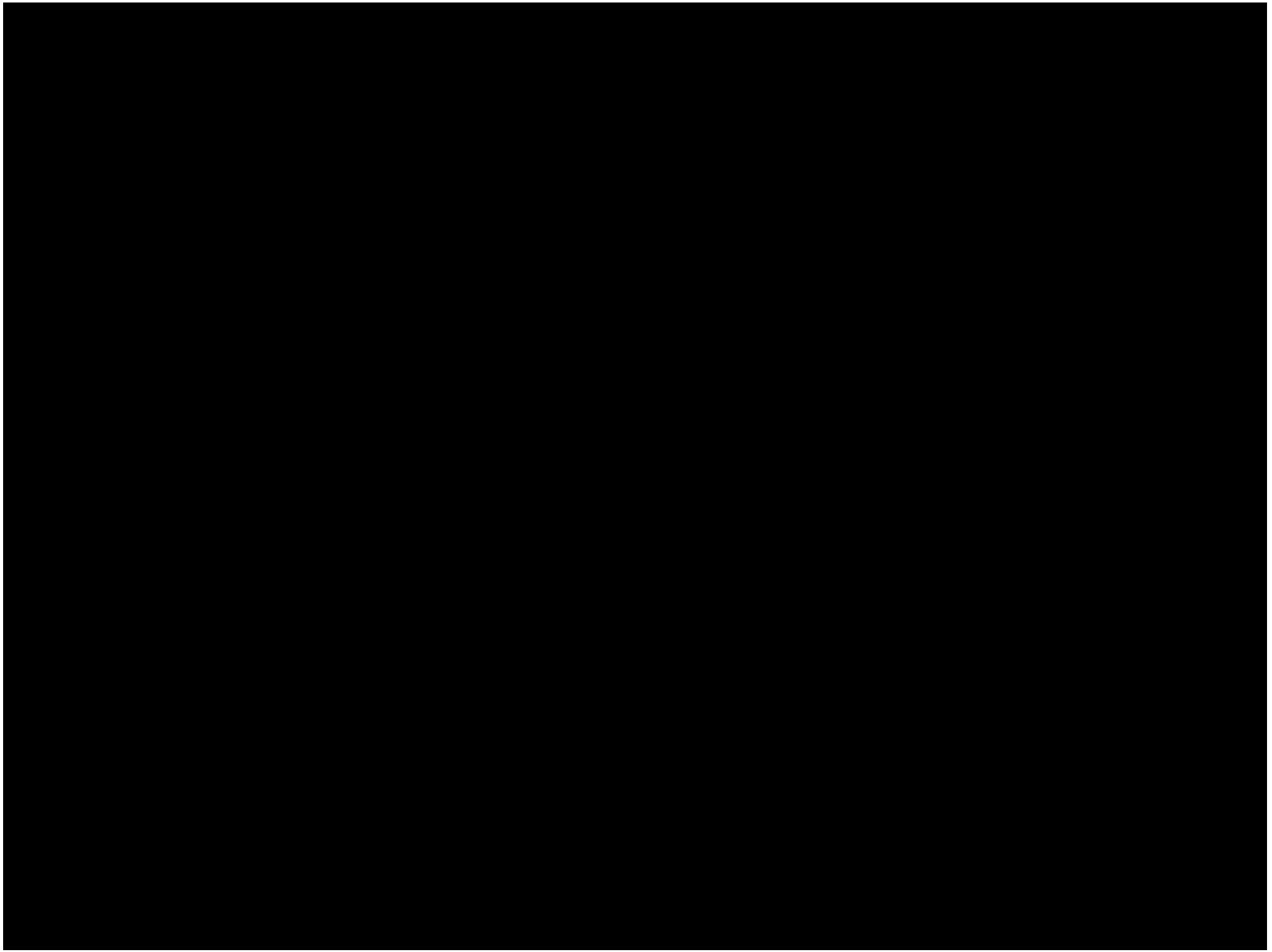
Sarah

Steven

	split	steal
split	50'075, 50'075	0, 100'150
steal	100'150, 0	0, 0

«Beautiful Mind»

- What is the normal form of the game?



Reduktion to two players

		Bob	
		Blonde	Friend B
John	Blonde		
	Friend A		

Reduktion to two players

		Bob	
		Blonde	Friend B
John	Blonde	0, 0	2, 1
	Friend A	1, 2	1, 1

Reduktion to two players

		Bob	
		Blonde	Friend B
John	Blonde	0, 0	2, 1
	Friend A	1, 2	1, 1

Reduktion to two players

		Bob	
		Blonde	Friend B
John	Blonde	0, 0	2, 1
	Friend A	1, 2	1, 1