Game Theory

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EC3224 Autumn Lecture #01
Introduction, Normal Form Games

- Reading
  - Osborne Chapters 1, 2.1-2.5
- By the end of this week you should be able to:
  - identify areas and problems for which game theory can be useful and be able to explain what game theory can do (and what it can not).
  - set out games in normal form

Game theory applies to everything

From love

To war

And everything in between: fights with your flatmate, relationship with parents, bargaining for a used car, haggling in Cairo, being a prisoner in North Korea…

GT is used in many disciplines

- Economics
  - About 8 Nobel Prize winners
- Political Science
- Sociology
- Psychology
- Biology
- …
- Why?

Game Theory - Motivation

- Outcomes of (economic) decisions frequently depend on others' actions
  - effect of price policy depends on competitors
  - outcome of wage negotiations depends on choices of both sides
  - outcome of elections depends on others' votes
  - …
- Decision makers should thus take expectations of others' decisions into account
- Such situations are plausibly modeled as a **strategic game,** a model of interactions where the outcome depends on others' as well as one's own actions
- this definition and the scope of game theory is much broader than the everyday definition of a game
  - e.g., game theory is not only concerned with "winning" a competitive game

Game Theory - Motivation

- as economics in general, game theory serves as **positive** as well as **normative** theory
  - Started mostly as normative
  - Developing continuously to be positive
- as every theory, it simplifies in order to capture the essence without getting lost in details
- finding the right balance between abstraction and detail is crucial and difficult

Ingredients – Rational Choice

- set of possible **actions** A
- decision maker faces subset of A
- not influenced by the preferences
- decision maker's **preferences** are rational:
  - **complete**
  - **transitive**
- no further restrictions, e.g. **altruism** is permitted
- preferences can be represented by **payoff function** (utility function)
  - $u(a) > u(b)$ if and only if a is preferred over b
- payoff functions are **ordinal**
- **rational choice:** for every available subset of A choose the action (or one of the actions) that is best according to preferences,
  - i.e. maximize utility function
- if we do not know preference, each single action is consistent with rational choice, but not each set of choices

Game Theory Enters

- the set of actions and the preferences over these actions frequently depend on others' actions
- then we are in the realm of **game theory**

Strategic Games

Definition

A **strategic game** (with ordinal preferences) is defined by

- a set of **agents** (**players**),
- for each player a set of **actions** (or **strategies**)
- for each player, **preferences** over the action profiles

Actions are taken "simultaneously" (i.e. without information about others' moves) and cannot be revised over the course of the game

alternative names: "Simultaneous move games", "normal-form games", "games in strategic form"

Classical Examples of important classes of games
Example 1: the Prisoner's Dilemma

- Strategic games (with 2 players and not too many strategies) can be represented in tables

		Player 2	
		C(ooperate)	D(efect)
Player 1	C(ooperate)	2,2	0,3
	D(efect)	3,0	1,1

- This game captures many situations where a player prefers to defect, but prefers both to cooperate over both to defect:
  - joint work, duopoly, arms races, environmental agreements
- But it also tends to get overused for analogies that do not apply

Example 2: the "Battle of the Sexes"

		Player 2	
		Ball	Theatre
Player 1	Ball	2,1	0,0
	Theatre	0,0	1,2

- This game captures many situations where players agree that they want to **coordinate** but disagree about the action to coordinate on:
  - firms agreeing on an industry standard
  - merging firms deciding on some procedures or technology
  - language used in multinational companies or other institutions

Example 3: Matching Pennies

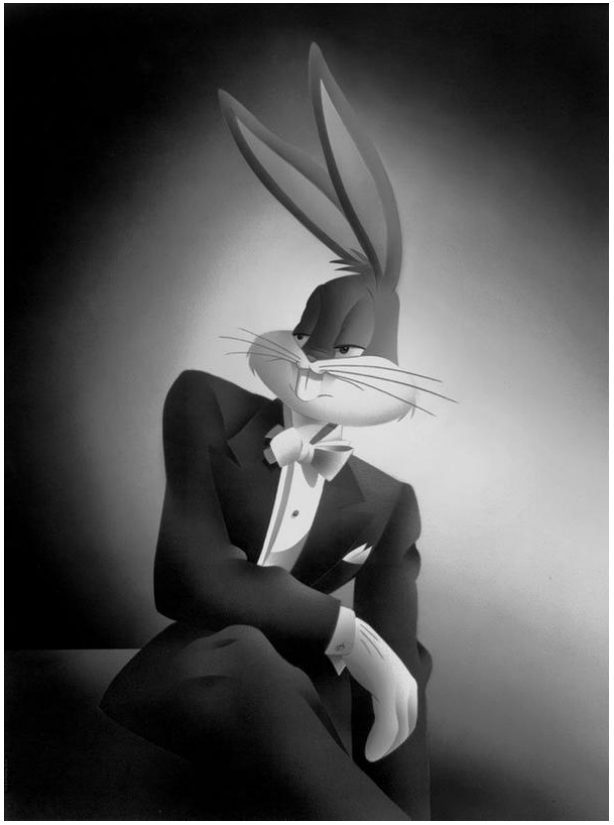
		Player 2	
		Head	Tail
Player 1	Head	1,-1	-1,1
	Tail	-1,1	1,-1

- Player 1 wants both to choose the same action, player 2 to choose different actions.
- This is an example of a **strictly competitive game,** illustrates situations such as
  - goalkeeper and kicker in penalty kick
  - established firm and imitator
- Board games and sports competition are typically strictly competitive games (which does not mean there is no room for collusion if there are more than two players)

Stag Hunt (due to *Jean Jacques Rousseau*)

- Go hunting for stag
  - (tasty but hard to catch, need two persons)

- Or a hare
  - (boring but easier)



Example 4: Stag-Hunt

		Player 2	
		Stag	Hare
Player 1	Stag	2,2	0,1
	Hare	1,0	1,1

- Stag-Hunt models situation where players have a common interest to cooperate, but may want to play a save strategy if they are not sure whether the other will cooperate
  - agreement on sharing homework
- Particularly interesting if there are more players
  - think of a comparable situation with 100 players, what would you do?

A variant of the Stag-Hunt: the Security Dilemma

		Player 2	
		Refrain	Arm
Player 1	Refrain	3,3	0,2
	Arm	2,0	1,1

- Situation is similar to Stag-Hunt, only difference is that if a second player chooses “arm”, this also harms the first who already is armed
- Alternative model of an arms race
  - countries are rather peaceful in this example in contrast to prisoner’s dilemma model, they do not want advantage but just fear being disadvantaged

Problem set #01

NOTE: I expect that you have tried to solve the exercises *before* the seminar

1. Osborne, Ex 5.3
2. Osborne, Ex 16.1
3. Osborne, Ex 17.1
4. Osborne, Ex 18.1
5. (Osborne, Ex 20.1)
6. We have recently been reintroduced to the phenomenon of the bank run. Which of the examples can be used to capture the dilemma in a bank run? Write down a payoff table for two players.