

# STATIC OR SIMULTANEOUS GAMES

## 1. Normal Form and the elements of the game

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# Simultaneous games.

## Definition

- Each player chooses an action without knowing what the others choose.
- The players choose **simultaneously**.
- Three elements:
  - **Players**
  - **Possible strategies**
  - **Payoffs**

# Simultaneous games.

## The normal form

- Set of players:  $N = \{1, \dots, n\}$ .
- Set of possible actions or strategies for each player:  $S_i = \{s_i^1, s_i^2, \dots, s_i^{m_i}\}$ .
- (Expected) utility function for each player for each possible result:


$$u_i: X_{i=1}^n S_i \rightarrow \mathcal{R}$$

$$u_i = u_i(s_1, s_2, \dots, s_n)$$

- The normal form is  $(N, (S_i)_{i=1}^n, (u_i)_{i=1}^n)$ .

# Identifying the elements of a game

We will identify the elements of a game in the most famous games that differ in their degree of conflict.

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1. Coordination (no conflict)
  2. Election de standards
  3. The Battle of the Sexes
  4. The Chicken Game
  5. The Prisoners' Dilemma
  6. Matching pennies (maximum conflict)

# 1. Coordination

- Two executives in a firm use the same parking lot with only one access door. These two executives frequently coincide while entering or exiting.
- The door is wide, and if both decide to enter and exit the parking using their right side, they will not have an accident. The same applies if they both use their left side. However, if their decisions do not match, there will be a small accident and they will lose the company's car. To use the company's car gives them a utility of 1.

# 1. Coordination

- Players:  $N = \{1,2\}$ .
- Strategies:  $S_1 = \{\text{Left}, \text{Right}\}$ ,  $S_2 = \{\text{Left}, \text{Right}\}$ .
- Utilities:

		Player 2	
		Left	Right
Player 1	Left	1, 1	0, 0
	Right	0, 0	1, 1

Pure cooperation

# Simultaneous games

## The matrix form

- For 2-player games, we often represent simultaneous games in a **matrix form**, where we use a table that contains the three elements of the game.
- In a payoff matrix (table), the **rows** represent the strategies available to Player 1 and the **columns** represent the strategies available to Player 2.
- For each available strategy profile, in each pair in a (row, column) entry, the **first number** in each cell represents Player 1's expected utility, and the **second number** Player 2's expected utility.

## 2. Election of standards

- Same as “Coordination”, but one coordination is better than the other.

		Player 2	
		A	B
Player 1	A	1, 1	0, 0
	B	0, 0	2, 2

- Pure cooperation, little conflict.



## 2. Election of standards

- Video tapes: Beta vs VHS
- TV color system: Pal vs NTCS
- Type of computer: Mac vs PC
- System of measurements: Metric vs Imperial
- In which party should left/right wing voters coordinate their vote, on the old corrupt one or on the new one?
- Form of government for republicans: monarchy presidential republic or parliamentary republic.

# 3. The Battle of the Sexes

- Cristina and Alex decided to go to the **football game** or to the **opera** in the evening, but did not specify where. They work in different places and now each one needs to choose where to go (they have no phones and they go directly after work).
- Both would like to spend the evening **together**. However, **Cristina prefers to be together watching the game, whereas Alex prefers the opera**.
- They are very much in love, so if they are not together, it means that “**the evening is ruined**”.

# 3. The Battle of the Sexes

- Players: Cristina and Alex.
- Strategies: Football and Opera.

		Alex	
		Football	Opera
Cristina	Football	2, 1	0, 0
	Opera	0, 0	1, 2

- Cooperation and conflict.

# 3. The Battle of the Sexes

- Some of the examples in “election of standards” may be battle of sexes if there is disagreement on which is the best alternative.
- Social network: Instagram vs Facebook.
- App for messages: WhatsApp vs Telegram (or Signal or Threema...).
- Catalonia: the provinces “prefer” to be together rather than separated, but some prefer to be together within Spain and some as an independent country.

# 4. Chicken game

- In the film “Rebel without a cause”: two cars go against each other in a collision course. The one who swerves is a chicken.
- Players: Jim and Buzz.
- Strategies: Keep going and Swerve.

		Buzz	
		Keep going	Swerve
Jim	Keep going	0, 0	4, 1
	Swerve	1, 4	2, 2

- Conflict with the possibility to “save face”.

## 4. Chicken game

- Negotiations between Greece and the Troika for the financial bailout.
- Brexit negotiations between the UK and the EU.
- Who is in charge of housekeeping.

# 5. The Prisoners' Dilemma

- Two suspects (Al Capone and Tony Soprano) are arrested and cannot communicate with each other.
- The police suspects they committed a crime (punishable with up to **5 years in prison**), however, they only have the proof of a minor crime (**1 year in prison**).
- The police propose each prisoner the same deal: if one testifies against his partner he will be **set free**, and the partner will be sentenced to 5 years in jail. If both testify against each other, the sentence will be reduced from 5 to **4 years** (for each prisoner). If no one testifies, they will be sentenced for only a minor crime.

# 5. The Prisoners' Dilemma

- Players: Al Capone and Tony Soprano
- Strategies: Confess and Not to confess

		Tony Soprano	
		Not to confess	Confess
Al Capone	Not to confess	-1, -1	-5, 0
	Confess	0, -5	-4, -4

- High level of conflict with difficult cooperation.



# 5. The Prisoners' Dilemma

- This game illustrates a **cooperation problem** due to gains derived from unilateral deviations.
- Some economic examples with similar characteristics:
  - competition among oligopolistic companies,
  - public good provision,
  - the tragedy of the commons,
  - pollution,
  - green house gas emissions.

# 6. Matching Pennies

- Equivalent to Spanish “pares y nones”.
- Two players simultaneously show one side of a penny that each have on their hands.
- If they show the same side, Player 2 pays one euro to Player 1, if they show different sides, Player 1 pays one euro to Player 2.

		Player 2	
		Heads	Tails
Player 1	Heads	1, -1	-1, 1
	Tails	-1, 1	1, -1

- Pure conflict.

## 6. Matching Pennies

- This is a **zero sum game, i.e. of pure conflict**: the interests of the players are in pure conflict with each other.
- In each possible circumstance, the winnings of one player is the loss of the other.
- These games represent situations of pure conflict (relatively **infrequent** in economic problems).

# Some other Games.

## Common project

- Two neighbors are thinking about constructing of a common swimming pool at a cost of 20 units. Each neighbor's value of the swimming pool is 30 units.
- They agree on the following decision rule:
  - Each one sends a closed envelop to a mediator stating a decision whether or not to construct the pool.
  - If they are both in favor, they share the cost equally.
  - If only one is in favor, he pays for the whole cost.
  - If both are against it, the pool is not constructed.

# Some other Games.

## Common project

- Players: Neighbors 1 and 2.
- Strategies: F (in favor) and NF (not in favor).
- Payoffs: Utility - Monetary Payment.

		Neighbor 2	
		F	NF
Neighbor 1	F	20, 20	10, 30
	NF	30, 10	0, 0

- ¿Which game of the previous ones is similar to this one?

# Some other games.

## Promotion

- Two live music venues, Amadeus and Bachata, are located near each other and each has a loyal clientele, estimated to be 100 people per night for Amadeus and 50 for Bachata. Both venues must decide whether or not to hire a famous musician that will attract more clients than usual.
- Amadeus can hire the pianist Nizable, and Bachata can hire the singer Lizza. If Amadeus hires Nizable and Bachata does not hire anyone, Amadeus will get 40 extra clients and Bachata will lose 10.
- Similarly if Bachata hires Lizza while Amadeus doesn't hire anyone, then it will get 50 extra clients, while Amadeus will lose 30.
- Finally, if both venues hire the musicians then they will get 20 and 10 extra clients respectively.
- The benefit of each extra client is 10 euros each for Amadeus and 20 euros each for Bachata.

# Other games.

## Promotion

- Players: Amadeus and Bachata
- Strategies:
  - Amadeus: {Contract Nizalbe (C), Not to contract (NC)}
  - Bachata: {Contract Lizza (C), Not to contract (NC)}
- Payoffs: Profits = Revenues – Cost of hiring.

		Bachata	
		C	NC
Amadeus	C	1200 – N, 1200 – L	1400 – N, 800
	N	700, 2000 – L	1000, 1000

- ¿Which game of the previous ones is similar to this one?