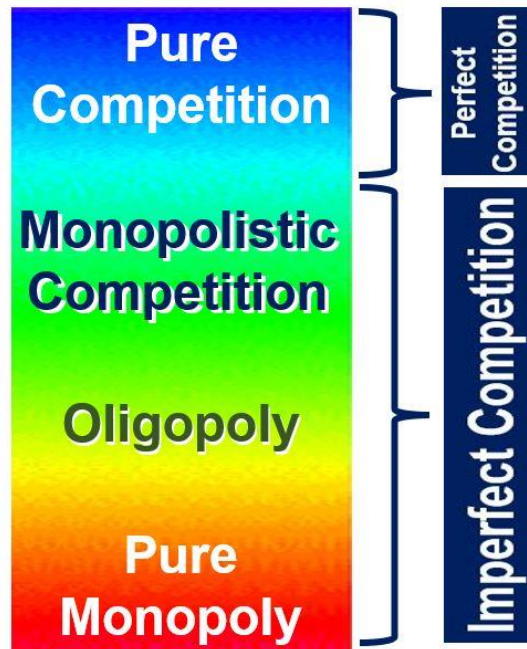




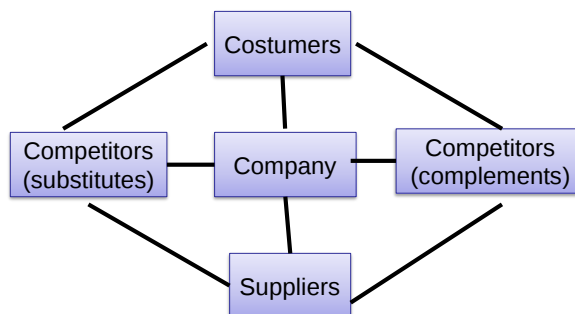
Oligopoly

- **Few large companies**
 - Strategic considerations
- **Strategic interdependence**
 - The profits of each company depend on the choices of both the company itself and its rivals:
- **Game theory: a tool for studying oligopolistic competition**

Game Theory

- **Strategic interdependence**
 - Each player's best choice depends on what she expects other players to do
 - Outcome depends on choices by all players
- **Rational players**
 - Maximise their payoffs
- → **players have to think strategically**

Who are the players?



Elements of a game

- Set of players (firms)
- Strategies for each player (prices, quality ..)
 - Outcomes
 - Payoffs (profits)
- Rules (timing and information)

At the bar

"A beautiful mind, the movie

https://www.youtube.com/watch?v=2d_dtTZQyUM EN

- **The situation** It is a game
- **Players:** boys
- **Strategies:** "go for the blonde" or "go for a brunette"
- **Rules:** Each boy has to decide what to do without knowing what the others will do.

The prisoners' dilemma

- **The Suspects:** Two individuals are arrested on suspicion of a serious crime. The police don't have enough evidence to convict them of the main crime, but they do have enough evidence to convict both of a lesser offense (e.g., carrying a concealed weapon).
- **The Offer:** The police place the two prisoners in separate interrogation rooms, so **they cannot communicate** with each other. A police officer presents each of them with the same deal:
 - **If you confess and your partner remains silent:** You will be set free immediately, and your partner will get the maximum sentence of 3 years in prison.
 - **If both you and your partner confess:** You will both be convicted of the serious crime, but the sentence will be reduced for your cooperation. You will both get 2 years in prison.
 - **If both you and your partner remain silent:** You will both be convicted of the lesser offense and will each serve only 1 year in prison.

The prisoners' dilemma

<i>1 \ 2</i>	NC	C
NC	2 2	0 3
C	3 0	1 1

Definitions

- *Dominant strategy*: maximises player's payoff regardless of strategies chosen by the others.
 - In the PD **C** is the dominant strategy
- *Dominated strategy*: there is always another choice that gives higher payoffs → it is never a good choice
 - In the PD **NC** is dominated by **C**

Nash equilibrium

- A strategy profile is a Nash equilibrium if each player's strategy is a **best response** to the strategies chosen by other player(s)
- → in equilibrium, no player can change strategy and do better (*no-regret*)

Nash equilibrium: an example

$R \setminus C$	L	C	R
T	4 0	2 2	2 3
M	1 2	1 0	4 0
B	2 1	3 3	2 2

Nash equilibrium: an example

- **(B, C)** is a NE
- To find a NE, write the BR functions
 - For Row player
 - $BR^R(L)=T$
 - **$BR^R(C)=B$**
 - $BR^R(R)=M$
 - For Column player
 - $BR^C(T)=R$
 - $BR^C(M)=L$
 - **$BR^C(B)=C$**

Nash equilibrium: an example

$R \setminus C$	L	C	R
T	<u>4</u> 0	2 2	2 <u>3</u>
M	1 <u>2</u>	1 0	<u>4</u> 0
B	2 1	<u>3</u> <u>3</u>	2 2

Problems

- There may be multiple NE
- An equilibrium may not exist

Multiple NE: a coordination game

$R \setminus C$	L	R
T	3 3	0 0
B	0 0	1 1

Multiple NE: the «stag hunt»

	Stag	Rabbit
Stag	3 3	0 2
Rabbit	2 0	1 1

The Battle of the Sexes

- The Players:** Alice and Bob.
- The Options:** They have two choices for their evening out: a soccer match or a movie.
 - The Preferences:**
 - Bob prefers to go to the match.
 - Alice prefers to go to the cinema.
 - The Common Goal:** Despite their different preferences, both Alice and Bob would rather spend the evening together than go to their preferred event alone.
 - The Dilemma:**

The "battle" arises from their conflicting preferences. They have to choose **simultaneously and independently**, without knowing what the other will do.

 - If they both choose to go to the match, they will be together, and Bob will be happy, while Alice will be slightly less happy.
 - If they both choose to go to the cinema, they will be together, and Alice will be happy, while Bob will be slightly less happy.
 - If Alice goes to the cinema and Bob goes to the match, they will be apart, and they will both be unhappy.

The Battle of the Sexes

	C	S
C	2 3	0 0
S	1 1	3 2

Matching pennies

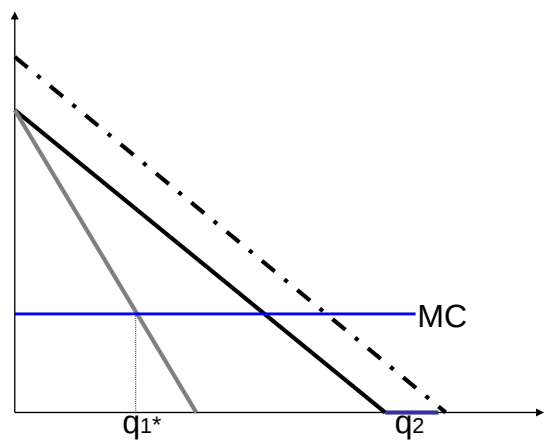
	H	T
H	1 -1	-1 1
T	-1 1	1 -1

Cournot Competition

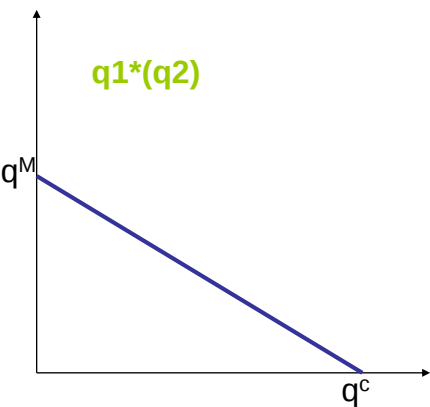
- **Assumptions:**
 - Duopoly ($n=2$)
 - Homogeneous product
 - Firms **simultaneously** choose **output**

Nash-Cournot Equilibrium

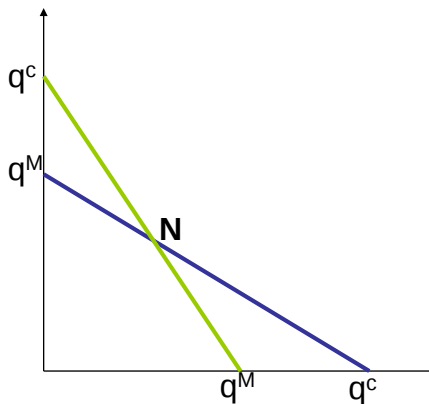
Graphically



Firm 1 Best Response function



Nash-Cournot Equilibrium



- A pair of strategies which are **mutually best response**
- Graphically, it is where best response functions intersect

Price competition

- In a wide variety of markets firms compete in prices
 - Internet access
 - Restaurants
 - Consultants
 - Financial services
- With monopoly setting price or quantity first makes no difference
- In oligopoly it matters a great deal
 - nature of price competition is much more aggressive the quantity competition

Bertrand Competition

- **Assumptions:**
 - Duopoly ($n=2$)
 - Homogeneous product
 - Firms **simultaneously** choose **price**
- **Bertrand Paradox:**
 - Nash equilibrium $p_1=p_2=MC$ (as in perfect competition)
(no firm wants to deviate)
- Crucial assumption: homogenous product

Price competition with differentiated products

- With **differentiated products** a firm setting a price higher than rival does not lose all customers
- Demand for each firm depends on prices set by both firms
- Firms have **market power** ($P > MC$)

An example of product differentiation

Coke and Pepsi are similar but not identical. As a result, the lower priced product does not win the entire market.

Econometric estimation gives:



$$Q_C = 63.42 - 3.98P_C + 2.25P_P$$



$$Q_P = 49.52 - 5.48P_P + 1.40P_C$$

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Horizontal differentiation: Hotelling model

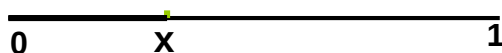
- **Two stages:** first, firms choose their locations; then, they compete in prices.
- **Backward induction:** given their locations, firms simultaneously set prices.
- Imagine a unit-length road with firms located at the two extremes.
- Consumers are uniformly distributed along the road (each consumer's location corresponds to their preferred characteristics). Each consumer buys one unit of the product.

Horizontal differentiation: Hotelling model

- Consumers' preferences for one product or the other depend on distance (horizontal differentiation).
- The disutility from consuming a product different from the preferred one is measured by the unit transport cost t .
- Each consumer purchases from the firm that, after accounting for transport costs, offers the lowest price.

Horizontal differentiation: Hotelling model

- Along the unit-length road, the indifferent consumer is located at point x .
- All consumers to the left of x buy from firm "0", while all those to the right buy from firm "1".



Horizontal differentiation: Hotelling model

- Unlike in the homogenous product case (Bertrand model), the firm that sets a higher price does not lose all its consumers.
- The reason is that the products sold by the two firms are not identical in the eyes of consumers.
- t is a measure of transport costs.
- It is also an implicit measure of the value consumers derive from obtaining their preferred variety.
- When t is large, competition weakens and profits increase.
- When t is small, competition intensifies and profits decrease.

Choice of location (product differentiation)

- Is it worthwhile to differentiate the product?
- The result depends on transport costs and on the distribution of consumers through two effects:
- **DIRECT effect:** it is advantageous to locate close to the rival in order to capture part of their demand → convergence toward the center.
- **STRATEGIC effect:** it is advantageous to move away from the rival to soften price competition → incentive for differentiation.

Vertical differentiation

- Two stage: first, firms choose product quality; then, they compete in prices.
- **Backward induction:** given product quality, firms simultaneously set prices.
- It makes no sense for everyone to try to be the best “ice-cream maker” in town, because this would lead to such intense price competition that no one would be able to earn even a single euro from mountains of excellent ice cream.
- It is better instead for some ice-cream shops to cater to a less demanding clientele, satisfied with good ice cream sold at a slightly lower price.