Game Theory and Economics

- Game theory is the study of how people behave in strategic situations.

- Strategic decisions are those in which each person, in deciding what actions to take, must consider how others might respond to that action.

Game Theory and Economics

- If the market is only a few firms, each firm must act strategically.

- Each firm affects the market price changing the quantity produced.

- Suppose 2 firms produce 100 units. If one of the firms decides to increase production by 10 units, market supply will increase from 200 to 210 and price has to drop to reach an equilibrium.

Game Theory and Economics

- Therefore, it also affects the profits of other firms.

- Each firm knows that its profit depends not only on how much it produced but also on how much the other firms produce.

Strategic Behavior

- **Game Theory**
  - Players
  - Strategies
  - Payoff matrix

- **Nash Equilibrium**
  - Each player chooses a strategy that is optimal given the strategy of the other player
  - A strategy is dominant if it is always optimal

Game Theory

Advertising Example

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Game Theory

What is the optimal strategy for Firm A if Firm B chooses to advertise?

If Firm A chooses to advertise, the payoff is 4. Otherwise, the payoff is 2. The optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Game Theory

What is the optimal strategy for Firm A if Firm B chooses not to advertise?

If Firm A chooses to advertise, the payoff is 5. Otherwise, the payoff is 3. Again, the optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Game Theory

Regardless of what Firm B decides to do, the optimal strategy for Firm A is to advertise. The <u>dominant strategy</u> for Firm A is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Game Theory

What is the optimal strategy for Firm B if Firm A chooses to advertise?

If Firm B chooses to advertise, the payoff is 3. Otherwise, the payoff is 1. The optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Game Theory

What is the optimal strategy for Firm B if Firm A chooses not to advertise?

If Firm B chooses to advertise, the payoff is 5. Otherwise, the payoff is 2. Again, the optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Game Theory

Regardless of what Firm A decides to do, the optimal strategy for Firm B is to advertise. The <u>dominant strategy</u> for Firm B is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Game Theory

The dominant strategy for Firm A is to advertise and the dominant strategy for Firm B is to advertise. The <u>Nash Equilibrium</u> is for both firms to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Game Theory

A Second Advertising Example

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Game Theory

What is the optimal strategy for Firm A if Firm B chooses to advertise?

If Firm A chooses to advertise, the payoff is 4. Otherwise, the payoff is 2. The optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Game Theory

What is the optimal strategy for Firm A if Firm B chooses not to advertise?

If Firm A chooses to advertise, the payoff is 5. Otherwise, the payoff is 6. In this case, the optimal strategy is <u>not</u> to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Game Theory

The optimal strategy for Firm A depends on which strategy is chosen by Firms B. Firm A does not have a dominant strategy.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Game Theory

What is the optimal strategy for Firm B if Firm A chooses to advertise?

If Firm B chooses to advertise, the payoff is 3. Otherwise, the payoff is 1. The optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Game Theory

What is the optimal strategy for Firm B if Firm A chooses not to advertise?

If Firm B chooses to advertise, the payoff is 5. Otherwise, the payoff is 2. Again, the optimal strategy is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Game Theory

Regardless of what Firm A decides to do, the optimal strategy for Firm B is to advertise. The <u>dominant strategy</u> for Firm B is to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(6, 2)

Game Theory

The dominant strategy for Firm B is to advertise. If Firm B chooses to advertise, then the optimal strategy for Firm A is to advertise. The <u>Nash equilibrium</u> is for both firms to advertise.

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(4, 3)	(5, 1)
	Don't Advertise	(2, 5)	(3, 2)

Prisoners' Dilemma

Two suspects are arrested for armed robbery. They are immediately separated. If convicted, they will get a term of 10 years in prison. However, the evidence is not sufficient to convict them of more than the crime of possessing stolen goods, which carries a sentence of only 1 year.

The suspects are told the following: If you confess and your accomplice does not, you will go free. If you do not confess and your accomplice does, you will get 10 years in prison. If you both confess, you will both get 5 years in prison.

Prisoners' Dilemma

Payoff Matrix (negative values)

		Individual B	
		Confess	Don't Confess
Individual A	Confess	(5, 5)	(0, 10)
	Don't Confess	(10, 0)	(1, 1)

Prisoners' Dilemma

Dominant Strategy
Both Individuals Confess

(Nash Equilibrium)

		Individual B	
		Confess	Don't Confess
Individual A	Confess	(5, 5)	(0, 10)
	Don't Confess	(10, 0)	(1, 1)

Prisoners' Dilemma

Application: Price Competition

Dominant Strategy: Low Price

		Firm B	
		Low Price	High Price
Firm A	Low Price	(2, 2)	(5, 1)
	High Price	(1, 5)	(3, 3)

Prisoners' Dilemma

Application: Nonprice Competition

Dominant Strategy: Advertise

		Firm B	
		Advertise	Don't Advertise
Firm A	Advertise	(2, 2)	(5, 1)
	Don't Advertise	(1, 5)	(3, 3)

Prisoners' Dilemma

Application: Cartel Cheating

Dominant Strategy: Cheat

		Firm B	
		Cheat	Don't Cheat
Firm A	Cheat	(2, 2)	(5, 1)
	Don't Cheat	(1, 5)	(3, 3)