

EE481: Industrial Economics

Game Theory (Static Game)

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Game Theory

- In many circumstances, there are more than 1 player.
- The decision of 1 player can affect the payoffs to other players.
- Game theory analyzes how each player makes strategic decisions

Strategic decisions = .

Static Game =

Elements of a Game

- Game = Situation in which players (participants) make strategic decisions that take into account each other's actions and responses.
- Players =
- Payoff =
- Action = Choice of each player.
- Strategy =
- Optimal Strategy =

Noncooperative vs. Cooperative Games

- Cooperative game = Participants can negotiate _____ that allow them to make joint-strategies.

Example:

- Noncooperative game = Negotiation and enforcement of binding contracts between players is _____.

Example:

Dominant and Dominated Strategies

- Dominant Strategy =
- Dominated Strategy =
- For a game, each player “may” or “may not” have any **dominant** strategy.
- For a game, each player “may” or “may not” have any **dominated** strategy.

Find Dominant Strategies

		Column Player	
		Cooperate	Defect
Row Player	Cooperate	3,3	0,4
	Defect	4,0	1,1

Payoff (row player, column player)

- Defect is ...
- This game is a _____ type of game.
Why?

Nash Equilibrium

Nash Equilibrium = A solution concept for a game proposed by Prof. John Nash.

- Dominant Strategies: I'm doing the best I can _____ *what another person do*. You're doing the best you can _____ *what I do*.
- Nash Equilibrium: I'm doing the best I can _____ *what you are doing*. You're doing the best you can _____ *what I am doing*.
 - At the Nash Equilibrium, ...

Nash Equilibrium

- Let s_i be the strategy taken by player i , s_{-i} be the strategy taken by other player(s).
- Let $s_i = B_i(s_{-i})$ be ...
- The Nash equilibrium is $s_i^* = B_i(s_{-i}^*)$ where s_{-i}^* is ...
- At the Nash equilibrium $\pi_i(s_i^*, s_{-i}^*) \geq \pi_i(s_i', s_{-i}^*)$.

Pure Strategies vs. Mixed Strategies

- Pure Strategy = Players make specific choice or take a specific action.
- Mixed Strategy =

Example: Amy

		John	
		Micro	Macro
Amy	Micro	9,9	0,8
	Macro	8,0	7,7

Payoff (Amy, John)

- How many Nash Equilibria are there in this game?

Finding Mixed Strategies

- Let the probability that John ..
- Let the probability that Amy ..

		John	
		Micro ()	Macro ()
Amy	Micro ()	9,9	0,8
	Macro ()	8,0	7,7

Payoff (Amy, John)

- If Amy believes that John will choose Micro with 100% certainty ($y = 1$), then Amy would choose Micro $x = 1$.
- If Amy believes that John will choose Macro with 100% certainty ($y = 0$), then Amy would choose Macro $x = 0$.
- At a value of “ y ”, ...

Finding Mixed Strategies

For Amy, she would choose Micro if

		John		$E(\text{Amy's Payoff})$
		Micro (y)	Macro ($1 - y$)	
Amy	Micro (x)	9,9	0,8	
	Macro ($1 - x$)	8,0	7,7	

Payoff (Amy, John)

$$E(\text{Amy's payoff from Micro}) > E(\text{Amy's payoff from Macro})$$

$$>$$

$$>$$

$$>$$

- When $y = \frac{7}{8}$, Amy is indifferent between Micro and Macro.

Finding Mixed Strategies

For John, she would choose Micro if

		John	
		Micro (y)	Macro ($1 - y$)
Amy	Micro (x)	9,9	0,8
	Macro ($1 - x$)	8,0	7,7

$E(\text{John's Payoff})$

Payoff (Amy, John)

$$E(\text{John's payoff from Micro}) > E(\text{John's payoff from Macro})$$

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- When $x = \frac{7}{8}$, John is indifferent between Micro and Macro.

Best Response Function ($BR_i(s_{-i})$)

Describing all Nash Equilibria

Cournot Nash Equilibrium

Assume that there are 2 firms. The output of each firm are q_1 and q_2 . Thus, the total demand is $Q = q_1 + q_2$. Let the marginal cost (MC) be constant and is the same for both firms (for ease of computation). Let the market demand be where $P = a - bQ$. Find the best response function of each firm $BR_1(q_2)$ and $BR_2(q_1)$ Then, plot them on a graph with q_1 on the y-axis and q_2 on the x-axis.

Cournot Nash Equilibrium (BR-Graph)

Bertrand Nash Equilibrium

- Each firm independently choose price. **They do not cooperate or fail to cooperate.**
- Bertrand is a **static (single-period)** game of a **homogenous product** market.
- Results:
 - Since firms do not cooperate, the result is a ...
 - $P = MC$...
 - If firms do not have the same MC, ...

Bertrand Nash Equilibrium (BR-Graph)

- Find the best response function of each firm $BR_1(p_2)$ and $BR_2(p_1)$
Then, plot them on a graph with p_1 on the y-axis and p_2 on the x-axis.

Reference and Further Reading I



Carlton, D.W. and J.M., Perloff.
Modern Industrial Organization. 4th Edition.
Pearson Addison Wesley Press, 2005.



Church, J. and R. Ware, *Industrial Organization: A Strategic Approach*,
International Edition, McGraw-Hill, 2000.



Pindyck, R.S. and D.L., Rubinfeld.
Microeconomics. International Edition.
Pearson Education Press, 2001.



Paul Klemperer & Margaret Meyer.
"Price Competition vs. Quantity Competition: The Role of Uncertainty," .
RAND Journal of Economics, The RAND Corporation, vol. 17(4), pages
618-638, Winter. 1986.