



MANAGERIAL ECONOMICS

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Lecture No - 36 : Game Theory

Session Outline

Application of Game Theory in Economics

Nash Equilibrium

It proposes a strategy for each player such that no player has the incentive to change its action unilaterally, given that the other player follow the proposed action.

It is the optimal collective strategy in a game involving two or more players, where no players has anything to gain by changing his/her strategy.

Payoff Matrix

Firm 2's Decision

Advertise

Do not Advertise

Advertise

Firm 1's
Decision

Do not
Advertise

	Advertise	Do not Advertise
Advertise	20 50	10 60
Do not Advertise	30 40	25 65

Nash Equilibrium

The new assumption – Firm 1 uses an expensive advertising agency and would shift the burden of increased cost to the consumer by increasing the price of the product, so that company gets a lesser market share when it advertises, as compared to when it does not advertise.

Nash Equilibrium

If Firm 2 does not advertise, then it is better for Firm 1 not to advertise and get larger share of the market.

Nash Equilibrium

Firm 1 and Firm 2 do not have dominant strategies.

What would happen to the equilibrium outcome in this case?

Nash Equilibrium

Two Nash equilibrium

1. It occurs when both companies advertise
2. When both do not advertise

Each firm is better off if it plays the same strategy as the other firm and both Nash equilibrium occur when both the firms simultaneously play the same strategy.

Nash Equilibrium

Any Maxmin strategy profile confers to Nash equilibrium.

A Minmax strategy by both players also leads to Nash equilibrium.

The Prisoners' Dilemma

- The **prisoners' dilemma** provides insight into the difficulty in maintaining cooperation.
- Often people (firms) fail to cooperate with one another even when cooperation would make them better off.
- The prisoners' dilemma is a particular “game” between two captured prisoners that illustrates why cooperation is difficult to maintain even when it is mutually beneficial.

The 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 Prisoners' Dilemma

- 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.

The Prisoners' Dilemma

Prisoner 1's Decision

Confess

Remain Silent

Confess

Prisoner 2's
Decision

Remain
Silent

	Prisoner 1 gets 5 years Prisoner 2 gets 5 years	Prisoner 1 gets 10 years Prisoner 2 goes free
	Prisoner 1 goes free Prisoner 2 gets 10 years	Prisoner 1 gets 1 year Prisoner 2 gets 1 year

The Prisoners' Dilemma

- The **dominant strategy** is the best strategy for a player to follow regardless of the strategies chosen by the other players.
- Cooperation is difficult to maintain, because cooperation is not in the best interest of the individual player.

Jack and Jill Oligopoly Game

Jack's Decision

Sell 40 Gallons

Sell 30 Gallons

Sell 40 Gallons

Jill's Decision

Sell 30 Gallons

Jack gets \$1,600 Revenue Jill gets \$1,600 Revenue	Jack gets \$1,500 Revenue Jill gets \$2,000 Revenue
Jack gets \$2,000 Revenue Jill gets \$1,500 Revenue	Jack gets \$1,800 Revenue Jill gets \$1,800 Revenue

An Arms-Race Game

Decision of the Country 1

Arm

Disarm

Arm

Decision
of the
Country 2

Disarm

Country 1 at risk	Country 1 at Risk
Country 2 at risk	Country 2 safe and powerful
Country 1 safe and powerful	Country 1 safe
Country 2 at risk and weak	Country 2 safe

Types of Game

Games are classified on the basis of

- Relation between players
- Strategies
- Outcome

Types of Game

Cooperative and Non Cooperative Game

- Cooperative game are essentially those which entails cooperation among players. In real business world such cooperation is considered to be illegal.
- Non cooperative games are where there is no possibility of tie up among players like in case of cut throat competition.

Types of Game

Normal form and Extensive form Games

- Normal form game lists each player's strategies and possible outcome they derive from each strategy of the opponent. An outcome is revealed by the payoff matrix and each player's payoff is denoted by a number to measure the utility derives from each strategy.

Types of Game

Normal form and Extensive form Games

- Extensive form of Game or Game tree gives complete plan of action of the players over a period of time.
- It gives chronological order in which players take their action at that particular point of time, dependent on what they know at that point.

Types of Game

Two person Games and n person Games

- Classification is on the basis of number of players

Types of Game

Simultaneous Move and Sequential Move Games

- In simultaneous game, both players act at the same time.
- Even if the players do not act at the same time, the second player is informed of the first player's move.
- This game is used for understanding behavior of oligopoly firms.
- Example – Cournot's model

Types of Game

Simultaneous Move and Sequential Move Games

- In sequential game, one player acts, followed by others.
- Second player knows the move adopted by the first player and takes its decision contingent on that taken by the first player.
- Example – Stackelberg's model

Types of Game

Constant Sum, Zero Sum and Non Zero Sum Games

- The extent to which the goals of players coincide is the basis for classification.
- Extent of rivalry and outcomes

Types of Game

Constant Sum, Zero Sum and Non Zero Sum Games

- In constant sum game, total benefit of players, given each strategy is constant and the players have to share the profit.
- Games of total conflict
- Games of pure competition
- Poker – combined wealth of players remain constant.
- Player of share A increases, player B must decrease.

Types of Game

Constant Sum, Zero Sum and Non Zero Sum Games

- In Zero Sum game, total benefit of players , given each strategy zero.
- Whatever is gained by one player is lost by the other player.
- Sum of gain and loss is zero.

Types of Game

Constant Sum, Zero Sum and Non Zero Sum Games

- In non zero Sum game, total benefit of players added together, given each strategy is more than zero or the constant.
- Both the players of the game ends up in win-win or loss- loss situation.
- Strategic alliance or joint venture

Types of Game

Symmetric and Asymmetric Games

- In symmetric games, the payoffs do not depend on the players of the game, but on the strategies of the game.
- Example - Prisoner's dilemma

- Asymmetric games do not have identical strategies for both the players, they are asymmetric.
- Example – market entry game.

Application of Game theory in Economics

Market Entry Game

- Game of entry of potential firm in an industry which already has a monopoly firm.
- The incumbent has to decide whether to enter the market or stay out.
- Monopolist has two options, colludes or fights with entrant firm.

Session References

Micro Economics :ICFAI University Press

Managerial economics – Geetika, Ghosh and Choudhury

Managerial Economics – D N Dwivedi

Managerial Economics – Dr Atamanand