Lecture-25
Sir

Game Theory

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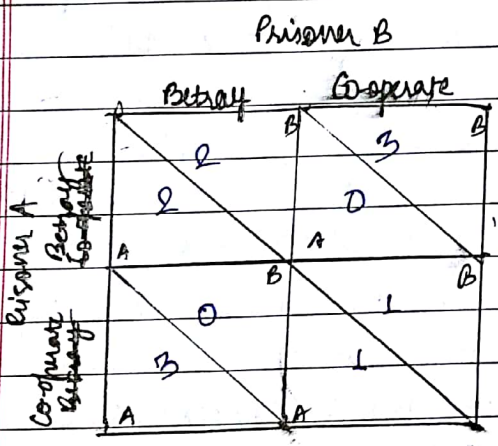
Page

Prisoner's dilemma

- Consider the situation where the police arrests two criminals for a crime. Each prisoner is offered a bargain - either remain silent or betray the other by testifying that he committed the crime.
- The police offer the following to each criminal.
  - i) If A is silent but B betrays, then A will be sentenced for 3 years and B will walk free.
  - ii) If both A and B betray each other, both shall be sentenced for two years.
  - iii) If both remain silent, each shall be sentenced for 1 year.
- This can be represented in the following way -



- The interesting part is: from the perspective of each individual, it is better to betray than to cooperate. So, the dilemma is. So the dilemma is: mutual cooperation yields better outcome than mutual betrayal. But it is not a rational outcome because the choice to co-operate is irrational for a self interested individual.

Game theory -

Game theory is the formal study of conflict and co-operation. Game theoretic principles apply whenever the actions of several agents are inter-dependent. These agents maybe

Date
Page

individuals, groups or firms or any combination of these. The concepts of game theory provide a language to formulate structure, analyze and understand strategic situations.

- A game has finite no. of participants called players.
- Each player has finite alternatives called strategies.
- Every game results in an outcome, which is called the pay-off.
- A strategy can be of two types-
  - Type 1 - If the players select the same strategy every time, then it is a pure strategy. This happens when a player knows exactly what the other player will do and the objective is to maximize the gains or minimize the loss.
  - Type 2 - When the players use a combination of strategies and each player keeps guessing the other players' strategy. Then it is a mixed strategy. In this case the objective is to maximize gain or minimize loss with a certain probability.
- An optimum strategy is the course of action which puts the player in the most favourable position irrespective of the strategies of ~~its~~ ~~com~~ his competitors.
- The expected payoff when all players follow their optimum strategy is called the value of the game. A game is fair if the value is zero, and unfair otherwise.
- The payoffs for the strategies used by each player can be represented in a matrix form called the payoff matrix. For a zero-sum game, the loss of one player should be equal to the gain of the other. So, one player's pay-off matrix will be the same of the other with only the signs changed.
- The payoff matrix for prisoners dilemma for prisoner A would be as follows.

Pay off matrix for Pris. A → point of view of B

PA : Pris B

Pris A	B	C
B	2	0
C	3	1

PB : Pris B

Pris A	B	C
B	2	3
C	0	1

- A game problem is viewed in such a manner that each player is interested in determining his optimal strategy. Because of the conflicting nature of the problem involving opposite interests. This optimality is ~~into~~ based on rather pessimistic principle. This principle is known as maximin/minimax principle.

Maximin / Minimax principle -
If a player lists the worst possible outcomes of all his potential strategies then he'll choose that strategy to be the most suitable which corresponds to the best of his worst outcomes.