



Course Name **Game Theory for Economics**

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Module 1: "Introduction to game theory"

Lecture 1: "Game Theory: Basic Introduction"

The Lecture Contains:

- ☰ What is Game Theory??
- ☰ Examples
- ☰ Analysis of the NIM Game
- ☰ Description of a game
- ☰ Description of the game with examples
- ☰ Some common Examples of Games

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What is Game Theory??

- What is a Game
 - A game is a formal representation of a situation in which a number of individuals interact in a setting of strategic interdependence.
 - Strategic interdependence
 - Each agent's payoff depends upon :
 - not only on its own decision, but
 - also on the decision taken by other agents
 - Therefore each agent has to act strategically

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Examples

- Examples from everyday life-
 - Group Project
 - Students jointly working to write a term paper
 - A certain minimum amount of work required to complete the term paper.
 - If one student slacks off some body else will have to work hard to complete the term paper.
 - Strategic interdependence among students.
 - Random Drug Testing(at Olympics)
 - Interaction b/w both the athletes and the International Olympics Committee.
 - Players have to decide whether to dope or not based on their chances of being caught.
 - IOC have to determine drug testing procedures & punishments on the basis of testing cost and the value of a clean reputation.
 - Strategic interdependence b/w players and also IOC

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Examples (contd.)

- Examples from Animal Kingdom
 - Animals in wild compete for scarce resources
 - Fertile females, carcasses of dead animals
 - Fighting may occur to snatch the resources from rivals
 - Fighting is costly as there is physical damage
 - Think strategically
 - Whether to fight or not
 - Take into consideration the decisions of the competitors

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Examples (contd.)

- Nim Game
 - Rules
 - Two player & two piles of matches
 - Game starts with player 1 and then players take turn
 - Each player can remove some number of matches if either pile has matches remaining & can remove matches from one pile at a time.
 - Whichever player removes the last match wins the game.

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Analysis of the NIM Game (balanced)

- Two piles balanced if there are equal number of matches in each pile.
- In case of balanced piles, player 2 has winning strategy.
- (x,y) refers to x matches in pile 1 and y matches in pile 2
- Consider $(1,1)$ - Player 2 wins
- Consider $(2,2)$ → After player 1's first move,
 - It can be $(0,2)$
 - Then player 2 removes the remaining 2 matches and wins.
 - It can be $(1,2)$
 - Then player 2 removes 1 match from other pile & moves to $(1,1)$
Player 2 wins again
- Check that if piles are unbalanced, player 1 will win the game.

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Description of a game**To describe a game one needs the following things**

- The Players
 - Who are involved.
- The Rules
 - Who moves when??
 - Whether move simultaneously or sequentially
 - What do they know when they move ??
 - Game of complete information or incomplete information
- The Strategies
 - What are the actions of the players when they move
- Outcome
 - For each possible combination of strategies chosen by all the players, what is the outcome of the game ?
- Payoffs/Preference:
 - Payoffs to each player at every possible outcome of the game.



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Description of the game with examples

- Class Project Example
 - Players: Students jointly writing the term paper
 - Strategies: Whether to write or not
 - Outcome: Completion/ Not completion of term paper
- Drug Testing Example
 - Players: Athletes & IOC
 - Strategies: Athletes:- Whether to dope or not; IOC: which athletes should be tested
 - Outcome: Athletes dope & Get Caught/Athletes dope & not get Caught/Athletes do not dope & not get caught.

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Some common Examples of Games

- Matching Pennies Game
 - Players: Player 1 and Player 2
 - Strategies/Actions: Each player simultaneously tosses a coin
 - Either gets Head(H) or a Tail(T)
 - Outcomes: HH, HT, TH, TT.
 - Payoffs: If the two coins match, player 1 pays Re1 to player 2; otherwise player 2 pays Re1 to player 1.
- Battle of sexes
 - Players: Husband and wife
 - Strategies: Whether to go for boxing match or a movie in the evening.
 - Rules:
 - Decisions taken simultaneously.
 - Both prefer to spend evening together.
 - Husband likes to see boxing.
 - Wife wants to see movie.
 - Outcome:
 - Both end up watching boxing match.
 - Both end up watching movie.
 - Husband watches boxing, wife watches movie.
 - Wife watches boxing, husband watches movie.
 - Payoffs: We will describe later.