International Winter School Manipal University Jaipur (IWSMUJ2022)

Course Overview

Name of course: Introduction to Game Theory

Name of instructor: Dr Suddhendu DasMahapatra & Mr Devesh Chandra
Session: January 2022
Language of instruction: English
Number of contact hours: 36
Credit awarded: 03

Objective of course

Game theory is the mathematical modelling of strategic interaction among rational (and irrational) agents. This can be found in all walks of life. For examples of such scenarios, different bidders participating in an auction for wireless spectrum, coal blocks, two firms competing for market share, politicians contesting elections etc. Game theory delivers a suitable framework to model and interpret the behaviour of agents in such strategic interactions. Hence it can be applied to solve a wide variety of problems involving diverse areas such as Markets, Auctions, Online Retail, Cold War, Paying Taxes, Bargaining, Elections, Portfolio Management etc. Therefore, undergraduate and postgraduate students from diverse backgrounds such as Science, Engineering, Management, Economics, Mathematics, Law etc. will find the course content useful. The aim of this course is to introduce students to the novel concepts of Game Theory with special emphasis on its applications in diverse fields and current research.

At the end of the course, students will be able to:

- Understand best response for an agent in a given competitive game scenario.
- Demonstrate Nash Equilibria for different game scenario that develops strategy making skills among students.
- Analyse extensive form of game that will enhance employability of students.
- Illustrate Evolutionary Stable Strategy (ESS) for evolutionary repeated games.

Syllabus

Introduction Examples: Markets/ Politics/ Auctions; Prisoners' Dilemma, Best Response and Nash Equilibrium, Dominant Strategies, Stag Hunt – Coordination and Bank Runs. Multiple Nash Equilibria, Tragedy of Commons, Cournot Duopoly, Mixed Strategies, Battle of Sexes, Best Response Dynamic, Paying Taxes; Portfolio Management Game, Rationality, Choice and Common Knowledge, Iterated Elimination of Domination Strategies, Auction: As a Normal Form Game, Traffic at Equilibrium and Braess's Paradox; Extensive Form Games, Strategies in Extensive from Games, Sub Game Perfect Equilibrium, The Art of War, Ultimatum Game, Stackelberg Model, Bayesian Games, Bayesian Nash Equilibrium, Yield vs Fight, Bayesian Cournot Game, Bayesian Games with mixed strategies, Auctions, Sealed Bid First Price Auction, Expected Revenue, Bayesian Second Price Auction, Second Price Auction, All Pay Auction; Evolutionary Biology, Evolutionary stable Strategy

(ESS), Repeated Games, Multiple Equilibriums, Chain-Store Paradox, Non – Cooperative Bargaining; Extensive Form Game with Incomplete Information, Introduction to perfect Bayesian Equilibrium, Obtaining PBE, Gift Game.

Organization of course

Total contact hrs 36		
1st week:	10 hrs (classes)	2 hrs (self-study/project)
2nd week:	10 hrs (classes)	2 hrs (Mid term exam/assessment/discussion)
3rd week:	10 hrs (classes)	2 hrs (End term exam)

Mode of lectures: online lecture/ discussion/ hands-on

Course Plan

Lecture no.	Topic	Lecture mode	Instructor
L: 1-6	Introduction Examples: Markets/ Politics/ Auctions Prisoners' Dilemma, Best Response Nash Equlibrium Nash Equlibrium Dominant Strategies Stag Hunt – Coordination and Bank Runs	online lecture/ discussion/ hands-on	Dr. Suddhendu DasMahapatra/ Mr Devesh Chandra
L: 7-12	Battle of Sexes (Introduction) Tragedy of Commons Cournot Duopoly Mixed Strategies Battle of Sexes (Best Response Dynamics)	online lecture/ discussion/ hands-on	Dr. Suddhendu DasMahapatra/ Mr Devesh Chandra
L: 13-18	Paying Taxes Portfolio management game Rationality, choice and common knowledge Iterated elimination of dominant strategies Auction- as a normal form game Traffic at equilibrium and Braess's paradox Linear Market	online lecture/ discussion/ hands-on	Dr. Suddhendu DasMahapatra/ Mr Devesh Chandra
L: 19-24	Extensive form Game Game tree and information set Strategies in extensive form game Extensive form games with simultaneous move and their normal form representation Sub game perfect equilibrium Art of war Ultimatum game Stackelberg Model	online lecture/ discussion/ hands-on	Dr. Suddhendu DasMahapatra/ Mr Devesh Chandra

L: 25-30	Bayesian Game Bayesian Game (BOS) Bayesian Nash Equilibrium Yield vs Fight Bayesian Cournot Game Bayesian Game with mixed strategy	online lecture/ discussion/ hands-on	Dr. Suddhendu DasMahapatra/ Mr Devesh Chandra
L: 31-36	Auctions: First price Auction: Bayesian second price Auction : All price ESS and NE Repeated game Chain-store paradox	online lecture/ discussion/ hands-on	Dr. Suddhendu DasMahapatra/ Mr Devesh Chandra

Brief profile of the instructor

Dr. Suddhendu DasMahapatra, Ph.D, is Assistant Professor at Electronics and Communication Engineering Department, Faculty of Engineering, Manipal University Jaipur. He has total 12 years of teaching, research and industry experience. He has completed his PhD from Faculty of Engineering, Manipal University Jaipur in the year 2020 and obtained M.Tech in ECE from West Bengal University of Technology in 2010. His Research interest includes signal processing, spectrum sensing and spectrum management in Cognitive Radio, wireless communication and security.

Profile: https://jaipur.manipal.edu/foe/schools-faculty/faculty-list/suddhendu-dasmahapatra.html

Mr. Devesh Chandra is an Assistant Professor in Department of Electronics and Communication Engineering. He holds Master of Engineering in Microelectronics from BITS Pilani, India. His research interests are in computational modeling of physical systems, nanoelectronics and electronic materials.

Profile: https://jaipur.manipal.edu/foe/schools-faculty/faculty-list/Deveshchandra.html