MATH4321 -- Game Theory
Course Outline
Spring Semester 2023-2024

1. **Instructor**

Name: Dr. Leung Chi Man (Call me LCM if you wish)
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Office hours: (Thurs) 2:00p.m.- 3:00p.m.

2. **Meeting time and Venue**

Lecture: Tues 4:30p.m.- 6:50p.m. @Room 2306
Thurs 4:30p.m.-5:50p.m. @Room 2306
(*The tutorial on Tuesday is combined with the lecture)

3. **Course Description**

Credit point: 3 credits
Prerequisites: Multivariable Calculus (MATH2010, MATH2011, MATH2021 or MATH2023) and Linear Algebra (MATH2111, MATH2121, MATH2131 or MATH2350). A little bit knowledge in probability theory (calculating various probabilities, conditional probabilities and expected values) will be also useful.

The objective of this course is to study the optimal decisions made by decision makers when there is interaction between different parties. The course will study various types of games such as static games, dynamic games under perfect information and imperfect information, bargaining games, games under incomplete information (signalling games). We will examine various methodologies in studying the *equilibrium* of these games and explore the applications of game theory in solving real-life problems

4. **Student Learning Resources**

We will use our own Lecture notes in this course. Additional problem sets (optional) will be provided. All materials can be found in canvas: (https://canvas.ust.hk)
The following reference books are also useful:
1. "Game theory: An introduction" by Tadelis, S..
2. "Game Theory" by D. Fudenberg and J. Tirole

(*The lecture material is written based on these two books. I would recommend the first book if you are new to game theory.)

5. Intended Learning Outcomes

Upon successful completion of this course, students should be able to understand the basic theory on non-zero sum static games, dynamic games and games with incomplete information.

In addition, students would also acquire the following abilities:

1. Appreciate how to use quantitative tools to analyse issues related to game theory
2. Recognize the importance of applying rigorous and numerate approach to analyse and solve problem in game theory.
3. Apply mathematical modelling and analytic proofs to describe and explain phenomena in game theory.
4. Communicate the solutions of mathematical models of game theory using mathematical terminology and English language.

6. Teaching and Learning Activities

Lectures (4 hours per week)

7. Tentative Course Schedule

Chapter 1: Static games of complete information and Nash equilibrium

(Ref: Chapter 3,4,5,6 of Tadelis and Chapter 1, 2 of Fudenberg)

- Games in normal form: Basic definition
- Solving the games
  - Dominated strategy and iterative scheme of eliminating dominated strategy
  - Nash equilibrium
  - Equilibrium refinement: Pareto-dominance and risk-dominance
  - Mixed strategy
- Existence of Nash equilibrium

Chapter 2: Dynamic games and repeated games

(Ref: Chapter 7,8,9,10 of Tadelis and Chapter 3, 4, 5 of Fudenberg)

- Games in extensive form: Basic definition
- Dynamic games under perfect information: Finding equilibrium using dynamic programming.
- Dynamic games under imperfect information and concept of subgame perfect Nash equilibrium
- Multi-stage games and repeated games

Chapter 3: Games under incomplete information

(Ref: Chapter 12,15, 16 of Tadelis and Chapter 6,8 of Fudenberg)

- Static games (Bayesian games) and Bayesian Nash equilibrium
- Dynamic games and perfect Bayesian equilibrium (PBE).
- Signaling games and its application in economics and finance.

(*Additional topic may be covered if there is time left)

8. **Grading scheme**
    1. **Assignments (25% of your total grade + Bonus, CILO 1,2,3,4)**
       There will be several assignments in this course and each assignment will contain some compulsory problems and 1-2 bonus problems
    2. **Final examination (75% of your total grade, CILO 1,2,3,4)**
       It will be a 2.5-3 hour closed-book exam and the exam will cover all materials covered in this course.
        - The final exam will be scheduled within the final exam period and the exact date of the final examination will be confirmed by the university.
        - You may use standard calculator (scientific or financial one) in the exam.

To pass this course, you need to

- get at least 40% overall in the course and
- get at least 20 marks (out of 100 marks) in the final examination.