MATH4321 -- Game Theory
Course Outline
Spring Semester 2024-2025

1. **Instructor**
   Name: Dr. Leung Chi Man (Call me LCM if you wish)
   Office: Room 3419 (Lift 17-18)
   E-mail: chimanleung@ust.hk
   Office hours: (Every Fri) 5:00p.m.- 6:30p.m.

2. **Meeting time and Venue**
   Lecture: *Mon 4:30p.m.- 6:50p.m. @Room 2306
   　　　　　 Fri 12:00p.m.- 1:20p.m. @Room 2306
   (*The tutorials on Monday will be used as 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 (both static games and dynamics). 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, CILO 1,2,3,4)**
        There will be several assignments in this course and each assignment will contain 4-5 compulsory problems and 1-2 bonus problems

    2. **Final examination (75% of your total grade, CILO 1,2,3,4)**
        It will be a 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.

8. **Assessment Scheme**
    There are 3 assessment tasks in this course:

	Weight	CILOs assessed
Assignment	25% + Bonus	1,2,3,4
Final examination	75%	1,2,3,4

    (a) Assignment (25% of the total grade + Bonus)
    There will be 4-5 assignments for this course.
    Each assignment contains required problems and optional problems. You are required to complete all required problems. Also, you may complete some of the optional problems for bonus score (which may improve your final grade).

    (b) Final Examination (75% of the total grade)
    It will be a 3 hours closed book exams. The final exam will cover all materials (including proof) covered in the course. The date and venue of the final exam will be confirmed by ARR. The detailed arrangement of the exam will be announced later.
    - You may use standard calculator (scientific or financial one) in the exam.

Determining the final grade
We will adopt criterion-referencing scheme when assigning your final grade: Your final grade will be assigned based on your overall performance in this course only.
- You are guaranteed to pass the course and receive C- or above if you obtain at least **40%** in overall total (including bonus score).
- You are guaranteed to receive B- or above if you obtain at least **60%** in overall total (including bonus score).
- You are guaranteed to pass the course and receive A- or above if you obtain at least **80%** in overall total (including bonus score).
- You are guaranteed to get the highest grade A+ of the course if you can obtain at least **88%** in overall total (including bonus score).

Grade Descriptors:

Letter Grades	Short Description	Elaboration of subject grading description
A+/A/A-	Excellent Performance	The student has mastered all knowledge and techniques on game theory. In particular, the student is able to understand all concepts taught and is able to apply those knowledge in solving various type of games and some real life problems involving the use of game theory.
B+/B/B-	Good Performance	The student has good understanding on knowledge and techniques on game theory. The student is able to apply the knowledge in solving some common real life problems related to game theory.
C+/C/C-	Satisfactory Performance	The student meets the minimum expectation of the instructor: He has acquired good understanding on basic concepts and techniques involved in game theory. In addition, the student is able to apply the knowledge in solving some simple real life problems related to game theory.
D	Marginal Pass	The student only know some very basic concepts game theory. He is able to complete some simple calculation only.
F	Fail	

Regarding Use of GenAI policy
- The students are allowed to use GenAI to support their study in this course. However, they are expected to write the assignments on their own.
- On the other hand, the use of GenAI is not allowed in the on-campus final exam