Shih Chien University

STP Program (Dec 22-Jan 16)

ECON 335 Game Theory of Economic and Financial Applications

Course Outline

Course Code: ECON 335

Instructor: TBA

Home Institution: TBA

Office Hours: TBA

Email: TBA

Credits: 4

Class Hours:

This course will have 144 class hours, including 50 lecture hours, 30 professor office hours, 20-hour TA discussion sessions, 10-hour review sessions, 34-hour additional class hours.

Course Description:

This graduate-level course provides an introduction to game theory with a focus on its major applications in diverse economic and financial settings. Students will explore topics such as reputation, herding, auctions, strategic information revelation, and information accumulation in markets. The course combines standard game theory concepts with practical insights, enhancing students' ability to incorporate strategic thinking into economic and financial models.

Through this course, you will expand your mathematical modeling skills by

integrating strategic dimensions into interactions where beliefs, expectations, and coordination play a crucial role. Game theory offers a structured framework to analyze complex market dynamics, helping you understand scenarios such as:

- Market Coordination: Beauty contests and market coordination challenges
- Financial Stability: Bank runs and currency attacks
- Information Dynamics: The impact of public and private information in markets
- Market Behaviors: Bubbles, crashes, and the role of reputation
- Strategic Interactions: Bargaining theories, herding, and information cascades
- Information Transmission: When strategic information is hidden versus revealed
- The course will also cover the "reverse engineering" aspect of game theory—mechanism design. You will learn when agents are likely to report information truthfully and achieve socially desirable outcomes, as well as when incentives may lead to dishonesty. Additionally, you will explore how to design optimal auctions, matching markets, and other strategic environments.

Prerequisites:

- Intermediate Microeconomics
- Basic Game Theory
- Basic Optimization and Multivariate Calculus
- Basic Matrix Theory

Course Preparation: You should be familiar with the fundamentals of game theory, including concepts such as Nash Equilibrium and Backward Induction. Additionally, you should have completed an upper-level undergraduate course related to microeconomics.

A solid understanding of mathematical notation is essential, along with foundational knowledge in the following areas:

- **Multivariate Calculus:** Intermediate-level proficiency, including partial

derivatives and multiple integrals.

- **Optimization Theory:** Familiarity with the Lagrangian method and basic optimization techniques.
- **Real Analysis:** Understanding of mathematical rigor and foundational analysis concepts.
- **Probability Theory:** Basic principles and applications.
- **Matrix Theory:** Fundamental matrix operations and concepts.

The expected mathematical sophistication aligns with the material covered in *Simon & Blume's Mathematics for Economists*. You should feel confident with intermediate-level calculus, logic, optimization methods, and the relevant mathematical tools used in economic modeling.

Required Textbook:

- *Steven Tadelis, Game Theory: An Introduction*, Princeton University Press, ISBN: 9780691129082

Recommended Texts:

- *M. Osborne and A. Rubinstein, A Course in Game Theory* (Freely available online)
- *Mas-Colell, Microeconomic Theory*, Chapters 7, 8, 9
- *G. Mailath and L. Samuelson, Repeated Games and Reputations*
- *D. Fudenberg and J. Tirole, Game Theory*
- *P. Bolton and M. Dewatripont, Contract Theory*

Homework and Exams: There will be weekly homework assignments, one midterm and a final.

Grading & Evaluation:

Attendance and participation:	10%
Homework:	40%
Midterm 1:	20%
Final:	30%

Grading System (1 ~ 100):

A+ : 96 - 100	A : 91 - 95
B+ : 86 - 90	B : 81 - 85
C+ : 76 - 80	C : 71 - 75
D+ : 66 - 70	D : 60 - 65
F : 0 - 59	
Pa : Pass	Fa : Fail

Detailed Course Outline:

Week 1:

1. Decision Theory Overview
We begin with a brief summary of decision theory, describing a generic choice situation involving actions, outcomes, and preferences. We'll cover how choices among alternatives can be represented as "preferences" and, in turn, by "utility functions." The course will then extend this choice framework to decisions involving risky prospects, introducing expected utility and von Neumann-Morgenstern (VNM) preferences, as well as decisions over time.
Reading: Chapter T: 1, 2

---

2. Introduction to Game Theory
The course will contrast strategic situations with decision-theoretic ones. We'll define a game and its components: actions/strategies, outcomes, payoffs, and solution concepts. Key distinctions will include:

- **Complete vs. Incomplete Information Games:** Are the "rules" and payoffs known?
- **Static vs. Dynamic Games:** Are games played in one-shot simultaneous moves or over time?

We start with Static Games with Complete Information, focusing on normal form games. The rationality and informational assumptions of players will be discussed, along with the concept of a solution.
Reading: Chapter T: 3

---

3. Dominant and Dominated Strategies
We'll define dominant and dominated strategies and explore the Iterated Elimination of Dominated Actions (IEDA) process. This method "purges" strategies not expected to be played by rational players. We will connect best response strategies with those surviving iterated elimination and apply these concepts to a Cournot Duopoly example.
Reading: Chapter T: 4, R: 4

---

4. Nash Equilibrium
The first major solution concept, Nash Equilibrium, will be introduced alongside classic economic examples such as:

- **Cournot and Bertrand Competition**
- **Tragedy of the Commons**
- **Battle of the Sexes**
- **Prisoner's Dilemma**
- **Electoral Competition Game**

We will explore mixed strategies, randomization, and extend the solution concept to Mixed Nash Equilibrium, proving its existence in finite games.
Reading: Chapter T: 5, 6; R: 2, 3

Week 2:

---

5. Dynamic Games with Complete Information
Moving to extensive form games, we'll discuss why Nash Equilibrium may not sufficiently address incredible threats. Topics include:

- **Sequential Rationality and Backward Induction**
- **Subgame Perfect Nash Equilibrium**

Reading: Chapter T: 7, 8, 9; R: 6

---

6. Repeated Games and Folk Theorems
We will prove the one-shot deviation principle and delve into repeated games, exploring:

- **Dynamic Tacit Collusion**

- **Cooperation and Reputation**
- **Folk Theorems**

The course will cover perfect/imperfect public monitoring and private monitoring repeated games, applying models to Rubinstein bargaining and a legislative bargaining scenario.
Reading: Chapter T: 10, 11; R: 7, 8

---

7. Games of Incomplete Information
Introducing uncertainty and informational concerns, we will extend strategies and beliefs with Bayesian updating to define Bayesian Nash Equilibrium. We will study incomplete information games, highlighting scenarios like:

- **Inefficient Trade**
- **Adverse Selection**

Reading: Chapter T: 12; R: 2, 11

Week 3 :

8: Midterm: covering chapter T: 1-12, R: 1-11

---

9. Mechanism Design and Auction Theory
Focusing on the "reverse engineering" of game theory, we'll discuss how to design market games that drive efficient or desirable outcomes among self-interested agents.
Auction Theory
We will analyze different auction formats, including:

- **First Price, Second Price**
- **Dutch and English Auctions**

We'll cover optimal bidding strategies, auctioneer revenues, and the Revenue Equivalence Theorem. The Winner's Curse in common value auctions will also be discussed.
Reading: Chapter T: 13
General Mechanism Design
From a broader theoretical perspective, the course will present:

- **The Revelation Principle**
- **Vickrey-Clarke-Groves (VCG) Mechanisms:** Exploring both their strengths and limitations

Reading: Chapter T: 14

---

10. Dynamic Games with Incomplete Information

We will analyze why subgame perfection may not be adequate in this context. The course will introduce:

- **Sequential Equilibrium**
- **Perfect Bayesian Equilibrium**

Reading: Chapter T: 15; R: 12

Week 4 :

---

11. Signaling Games

We will examine the education signaling model (Spence, 1973) and define:

- **Separating and Pooling Equilibria**
- **Forward Induction Refinements**

Reading: Chapter T: 16; R: 12.3

---

12. Reputation Building

The repeated Prisoner's Dilemma with reputational concerns will be explored through the "Gang of Four" model. Reputation will be modeled as others' favorable beliefs about an individual's "type."

Reading: Chapter T: 17; R: 12.3

---

13. Information Transmission and Cheap Talk

We will analyze situations where an informed party and a decision-maker with conflicting preferences interact. This section will cover:

- **Cheap Talk Scenarios:** Where information is free and unverifiable
- **Legislative Organization Models**

Reading: Chapter T: 18

14: Final Exam

Student responsibilities/expectations: The primary course material will be delivered through lectures, complemented by a discussion session every Friday. This session provides students with an opportunity to engage with the teaching assistant (TA) on course content and assigned problems. Students are encouraged to stay on track with the material as it is presented, which means attending all classes and discussion sessions, arriving on time, and dedicating adequate time to homework.

If a student must miss a class, they should make it a priority to obtain the notes and understand the missed material before the next session. Questions and requests for additional assistance are highly encouraged to help students keep pace with the course. Active participation is expected, so students should come prepared to contribute.

Please ensure that cell phones are turned off and unrelated materials are set aside before class begins. It is important for students to demonstrate responsibility and respect towards their peers. Late arrivals or early departures from class will not be tolerated.

Examinations: There will be one midterm exam and a final exam.