MATH 3860: Evolutionary Game Theory

2023 Summer Session	
Total Class Sessions: 25 **Class Sessions Per Week: 5** **Total Weeks: 5** **Class Session Length (Minutes): 145** **Credit Hours: 4**	**Instructor: Staff** **Classroom: TBA** **Office Hours: TBA** **Language: English**

Course Description:

This course on evolutionary game theory will enable students to study basic concepts about game theory and the historical background in the creation of this innovative concept as a tool to elucidate potential decision making in different areas of life. Students should be familiar with calculus, and basic concepts in probability theory and ordinary differential equations.

The following topics will be covered in this course: definition of game theory and its historical background, fundamental concepts in the game theory, eliminating dominating strategies, Nash equilibria, games in extensive form with complete and incomplete information, the Folk theorem, the Samaritan's Dilemma, and evolutionary dynamics.

Learning Objectives:

Upon completion of this course, students will be able to:

1. Understanding the potential applications of the Game Theory in different aspects of the daily life.
2. Gain experience in creating basic conceptual decision diagrams.
3. Understand the different implications of each decision making branch.
4. Determining the probabilities in the potential decision making in different

Main Course Materials:

Game Theory in Action. An Introduction to Classical and Evolutionary Models by Steve Schecter & Herbert Gintis. Princeton University Press. 2016.

Evolutionary Game Theory by J¨orgen Weibull. MIT Press. 1995

Attendance:

Attendance will not be taken but is strongly recommended. Each student will have three allowed absences and no grade deduction will be made for the first three absences. More than three unexcused absences will result in an automatic reduction in your participation grade, for instance from A- to B+. Your active participation in the class is expected and encouraged.

Course Assignment:

Quizzes

There will be 5 quizzes. Each quiz will be on the material covered that week. There will be NO make-ups for quizzes.

Midterm Exam

The midterm exam will be based on concepts covered in class. No excuse will be accepted if students cannot attend to make the midterm exam unless legitimate excuses for absence is provided.

Weekly Projects:

There will be five hands-on projects based on course need. The projects will enrich student's knowledge on developing the decision-making analysis of different cases. The scores will be given based on the correctness in the decision-making analyses.

Final Exam:

The final exams will be based on the concepts covered in class. Note that the final exam will not be taken during the normal class time. The exact time and location for the final exam will be announced in advance.

Course Assessment:

Quizzes	15%
Weekly Projects	35%
Midterm Exam	20%
Final Exam	30%
Total	**100%**
Quizzes	15%

Grading Scale (percentage):

A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
98-	**93-**	**90-**	**88-**	**83-**	**80-**	**78-**	**73-**	**70-**	**68-**	**63-**	**60-**	**<60**

100	**97**	**92**	**89**	**87**	**82**	**79**	**77**	**72**	**69**	**67**	**62**	

Academic Integrity:

Students are encouraged to study together, and to discuss lecture topics with one another, but all other work should be completed independently.
Students are expected to adhere to the standards of academic honesty and integrity that are described in the Chengdu University of Technology's *Academic Conduct Code.* Any work suspected of violating the standards of the *Academic Conduct Code* will be reported to the Dean's Office. Penalties for violating the *Academic Conduct Code* may include dismissal from the program. All students have an individual responsibility to know and understand the provisions of the *Academic Conduct Code*.

Special Needs or Assistance:

Please contact the Administrative Office immediately if you have a learning disability, a medical issue, or any other type of problem that prevents professors from seeing you have learned the course material. Our goal is to help you learn, not to penalize you for issues which mask your learning.

Tentative Course Schedule:

Week/Class	***Topics***	***Assignments***
Week 1 /Class 1-5	Go through syllabus and introduction of the course **A historical background of the Game Theory** Historical context of the appearance of the theory Why the Game Theory? How to "play the game?" How can the Game Theory be applied? **Review on basic concepts of calculus, probability and differential equations.** **Games in extensive form with complete information (backward induction)** Basic strategies Continuous games	Quiz #1 Quiz #2 Project #1
	Eliminating dominated strategies	Quiz #3

Week 2 /Class 6-10	Prisoner's dilemma Global warming Backward induction and iterated elimination of dominated strategies **Nash equilibria** Definition of Nash equilibria Finding Nash equilibria by inspection Finding Nash equilibria by iterated elimination of dominated strategies Finding Nash equilibria using best response	Project #2
Week 3 /Class 11-15	**Games in extensive form with incomplete information and mixed strategy Nash equilibria** The case of buying fire insurance The case of buying a used car Mixed strategy: tennis The Ultimatum minigame A case about water pollution **Some Game Theory's theorems and dilemmas** The Folk Theorem The Samaritan's Dilemma The Rotten Kid Theorem Examples of games in extensive form with complete information	Quiz #4 Project #3 Midterm Exam
Week 4 /Class 16-20	**Symmetries of games** Examples of symmetries of games **Alternatives to the Nash Equilibrium** Correlated equilibrium Epistemic game theory Evolutionary stability Examples **Differential equations**	Quiz #5 Project #4

	Differential equations and scientific laws Vector fields Functions and differential equations Linear differential equations	
Week 5 */Class 21-25*	**Introduction to evolutionary dynamics** Replicator system Evolutionary dynamics with two pure strategies Equilibria of the replicator system Dominated strategies and the replicator system Asymmetric evolutionary games Examples **Summary of the course** **Review For Final Exam**	Quiz #6 Project #5 Final Exam

Final Exam, Cumulative, TBA