Doctoral School in Finance and Economics

F2_ECOFIN_ECON/145 Differential Game and Application to Environmental Economics

1. Course details

Semester:	summer semester
Credit rating:	1 ECTS /15TU
Pre-requisite(s):	
Lecturer(s):	Prof Benteng Zou
Administrator:	Roswitha Glorieux
Tutor(s):	
Seminar times and rooms:	Spring semester CK B02
Tutorial times and rooms:	May 3, 6, 10, 13 and 17: 14-17h
Communications	**It is important that students should regularly read their University e-mails, as important information will normally be communicated this way.**
Mode of assessment:	Presentation of selected paper
Examination Periods:	June tbd
Course WebPage:	Moodle.uni.lu

2. Aims and objectives

Aims

- Understand what are differential games, the differences among different strategies.
- Obtain the first knowledge about dynamic Nash equilibrium, the role of the information available to the players, and the concept of subgame perfectness.
- How are differential games applied in environmental economics—non-renewable resources, pollution control and so on.

Learning Objectives

The professor will give a short review of optimal control theory which include the maximum principle and dynamic programming. Then the professor will introduce the basic Nash equilibrium and Stackelberg equilibrium of differential games. This will be the first two chapters, which will take about 5TU. During this part, the students just follow the presentation of the professor.

In the remaining three chapters (each chapter will take 3TU), the professor will present some classical and influential economics models via differential games focusing on the intuition, strategic choice and modeling. The students have to complete the reading of the original papers presented by the professor after class. In the meantime, there will be some more papers related, which the student can choose to read and present.

3. Plan of semester

May 3, 6, 10, 13 and 17: 14-17h

4. Course details (by topics)

Chapter 1. Review dynamic optimization – Maximum principle and Dynamic Programming
Chapter 2. Introduction of differential game: definition of strategies – Nash equilibrium under open-loop, closed-loop and Markovian strategies, subgame perfectness, and Stackelberg equilibrium.
Chapter 3. Differential games applied to non-renewable resource control
Chapter 4. Differential games applied to transboundary pollution control
Chapter 5. Differential games with uncertainty

5. Reference list/ Bibliography

6. Benchekroun and Chaudhui (2014). Transboundary pollution and clean technologies. **Resource and Energy Economics**, 601-619.
7. Benchekroun and Long (1998). Efficiency inducing taxation for polluting oligopolist. **Journal of Public Economics**, 325-342.
8. Bertinelli, Camacho and Zou (2014). Carbon capture and storage and transboundary pollution: A differential game approach. **European Journal of Operational Research**, 721-728.
9. Dasgupta, Gilbert and Stiglitz (1983). Strategic considerations in invention and innovation: The case of natural resources. **Econometrica**, 51(5), 1439-1448.
10. Dockner and Long (1993). International pollution control: cooperative vs noncooperative strategies. **Journal of Environmental Economics and Management,** 24, 19-26.

11. Dockner, S. Jongensen, N. Long and G. Sorger (200). **Different Games in Economics and Management Science**. Cambridge University Press.
12. Dutta abd Sundaram (1993). The tragedy of the Commons? **Eeconomic Theory**, 3(3), 413-426.
13. Jorgensen, Martin-Herran, Zaccour (2010). Dynamic games in economics and Management of pollution**. Environmental Modeling and Assessment**, 15, 433-467.
14. Jorgensen and Yeung (1996). Stochastic differential game model of a common property fishery**. Journal of Optimization Theory and Application**, 90(2), 381-403.
15. Harris and Vickers (1995). Innovation and natural resources: A dynamic game with uncertainty. **RAND Journal of Economics**, 26(3), 418-430.
16. Kamien and Schwartz 1991, 1992, 1993, 1995, 1998, 2003). **Dynamic Optimization**. Elsevier.
17. Lambertini (2013). **Oligopoly, the Environment and Natural Resources**. Routledge Taylor and Francis Group.
18. Levhari and Mirman (1980). The great fish war: an example using a dynamic Cournot-Nash solution. **The Bell Journal of Economics**, 11(1), 322-334.
19. Reinganum and Stokey (1985). Oligopoly extraction of a common property natural resource: the importance of the period of commitment in dynamic games**. International Economic Review**, 26(1), 161-173.
20. Salant (1976). Exhaustible resources and industrial structure: a Nash-Cournot approach to the world oil market. **Journal of Political Economy,** 84(5), 1079-1094.

21. Further information about assessment

Examination(s)	1	
Weighting:	Presentation of selected paper	
Date:	June 2022	
Length:		
Structure:	Pass/Fail	Pass/Fail