THE UNIVERSITY OF SOUTHERN CALIFORNIA
Marshall School of Business
IOM 672 – Optimization Models in Operations Management – Fall 2007

Time: Fridays, 2:00-4:50 pm
Room: HOH 302
Instructor: Dr. Greys SOSIC
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Office hours: Fridays, 1:00-2:00 pm

COURSE SCOPE AND OBJECTIVES

Supply chains involve multiple agents, and game theory has become an essential tool in their analysis. This course is intended for graduate students, and will cover some basic concepts from game theory (both non-cooperative and cooperative) and their application to supply chain problems, with the emphasis on the most recent papers in the supply chain area. Topics covered include:

- Introduction to game theory (game representation in normal and extensive form, Nash equilibrium, etc.)
- Equilibrium models (Cournot, Stackelberg, Bertrand)
- Repeated games (subgame perfect Nash equilibrium, folk theorem)
- Cooperative games (the core, Shapley value)
- Dynamic (farsighted) stability concepts (LCS, EPCF)
- Principal-agent models (revelation principle, moral hazard, adverse selection)
- Bargaining and negotiation

TEXTBOOK AND READINGS

The course does not require a particular textbook. Recommended references are:

- *Game Theory for Applied Economists* by Robert Gibbons, Princeton University Press, (1992);
- *Game Theory* by Drew Fudenberg and Jean Tirole, MIT Press (1991).

Helpful material can also be found in the following papers:

- (**C&N**) *Game Theory in Supply Chain Analysis* by Gerard Cachon and Serguei Netessine, in *Handbook of Quantitative Supply Chain Analysis: Modeling in the eBusiness Era*. edited by David Simchi-Levi, S. David Wu and Zuo-Jun (Max) Shen, Kluwer (2004)
- (**N&S**) *Game-Theoretic Analysis of Cooperation Among Supply Chain Agents: Review and Extensions* by Mahesh Nagarajan and Greys Sošić, to appear in *European Journal of Operational Research* (2006)

Papers assigned to particular topics are listed in the detailed course outline. All papers can be downloaded from the Blackboard.

COURSE ORGANIZATION

The course will consist of lectures, presentations, class discussions, and guest speakers. Lectures will focus on the various concepts from game theory. Several papers, describing game-theoretical applications in supply chain analysis, will be presented and discussed in the class. Active participation in class is important throughout the course.

You will analyze and present various papers. Your work will be marked and will contribute to your course grade.

At the end of the semester, you will submit a research proposal that describes a supply chain problem, along with the game theoretical approach that should lead to its solution. Your submission should be 8-10 pages long, 11-12 pt font, 1.5-2 line spacing. Before you start working on your project, you should discuss the topic of your submission with me.

EXAMS

There will be no final exam for this course.

YOUR COURSE GRADE:

Final project	30%
Paper presentation	60%
Class participation/ Instructor assessment	10%

NOTICE ON ACADEMIC INTEGRITY

The use of unauthorized material, communication with fellow students during an examination, attempting to benefit from the work of another student, and similar behavior that defeats the intent of an examination or other class work is unacceptable to the University. It is often difficult to distinguish between a culpable act and inadvertent behavior resulting from the nervous tensions accompanying examinations. Where a clear violation has occurred, however, the instructor may disqualify the student's work as unacceptable and assign a failing mark on the paper.

FOR STUDENTS WITH DISABILILITIES

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Tentative course outline

Week 1 (8/31) Non-cooperative games

Lecture:

- Course overview. Game representation. Noncooperative games. Nash equilibrium (existence, uniqueness). Equilibrium concepts (Cournot, Bertrand, Stackelberg)

Readings:

- C&N
- McGuire, T.W. and R. Staelin. 1983. An Industry Equilibrium Analysis of Downstream Vertical Integration. Marketing Science, Vol. 2, 161-191.

Week 2 (9/7) Non-cooperative games

Presentations:

- Cachon, G. and P. T. Harker. 2002. Competition and outsourcing with scale economies. Management Science, Vol.48, 1314-1333.
- Netessine, S. and N. Rudi. 2003. Centralized and competitive inventory models with demand substitution. Operations Research, Vol.53, 329-335.

Week 3 (9/14) Non-cooperative games

Presentations:

- Lippman, S.A. and K.F. McCardle. 1997. The competitive newsboy. Operations Research, Vol.45, 54-65.
- Choi, S.C. 1991. Price Competition in a Channel Structure with a Common Retailer. Marketing Science, Vol. 10, 271-296.

Week 4 (9/21) Non-cooperative games

Presentations:

- Bernstein, F. and A. Federgruen. 2003. Pricing and Replenishment Strategies in a Distribution System with Competing Retailers. Operations Research, Vol.51, 409-426.

Lecture:

- Repeated games (subgame perfect equilibria, folk theorem)

Readings:

- C&N, N&S

Week 5 (9/28) Non-cooperative games; Cooperative games; Two-stage games

Presentations:

- Taylor, T. A. and E. L. Plambeck. 2007. Supply Chain Relationships and Contracts: The Impact of Repeated Interaction on Capacity Investment and Procurement. Forthcoming in Management Science.

Lecture:

- Cooperative games (allocations; core, Shapley value). Two-stage games.

Readings:

- C&N, N&S

Week 6 (10/5) Cooperative games
Presentations:

- Hartman, B.C., M. Dror and M. Shaked. 2000. Cores of inventory centralization games. Games and Economic Behavior 31, 26-49.
- Chen, X. and J. Zhang. 2007. A Stochastic Programming Duality Approach to Inventory Centralization Games. Minor revision, Operations Research.

Week 7 (10/12) Two-stage games
Presentations:

- Anupindi, R., Y. Bassok and E. Zemel. 2001. A general framework for the study of decentralized distribution systems. Manufacturing & Service Operations Management, Vol.3, 349-368.
- Granot, D. and G. Sošić. 2003. A three-stage model for a decentralized distribution system of retailers. Operations Research, Vol. 51, 771-784.

Week 8 (10/19) Bargaining and negotiation
Lecture:

- Bargaining and negotiation (guest speaker – Mahesh Nagarajan)

Week 9 (10/26) Bargaining and negotiation; Dynamic stability
Presentations:

- Plambeck, E.L. and T.A. Taylor. 2007. Implications of Breach Remedy and Renegotiation Design for Innovation and Capacity. Forthcoming in Management Science.

Lecture:

- Dynamic stability concepts

Readings:

- C&N, N&S

Week 10 (11/2) Dynamic stability
Presentations:

- Chwe, M. S.-Y. 1994. Farsighted Coalitional Stability, Journal of Economic Theory, 63, 299-325.
- Konishi, H., D. Ray. 2003. Coalition Formation as a Dynamic Process, Journal of Economic Theory 110, 1-41.

Submission of proposals for final project

Week 11 (11/9) Bargaining; Dynamic stability
Presentations:

- Nagarajan, M. and Y. Bassok. 2007. A Bargaining Framework In Supply Chains (The Assembly Problem), Working paper.
- G. Sošić. 2006. Transshipment of Inventories Among Retailers: Myopic vs. Farsighted Stability. Management Science, Vol. 52, 1493-1508.

Week 12 (11/16) Principal-agent model
Lecture:

- Principal-agent model (guest speaker – Hao Zhang)

Week 13 (11/30) Principal-agent model
Presentations:

- Zhang, H. and S. Zenios. 2007. A Dynamic Principal-Agent Model with Hidden Information: Sequential Optimality through Truthful State Revelation. Forthcoming in Operations Research.

Week 14 (12/7)
Final presentations