RSM3046 Advanced Topics in Management Science: Modeling Interactions on Networks

Tentative Syllabus

Time and Place: Wednesdays 11-1, Rotman 570.
Start Date: January 7th 2015.
Instructor: Azarakhsh Malekian, azarakhsh.malekian@rotman.utoronto.ca
Course Requirements

- Homeworks, 50%.
- Final Projects, 50 %.

Homeworks

- There will be biweekly homeworks.

Final Projects: Final projects will be on a topic of your choice that overlaps with the course. More details will be circulated during the semester.
Textbooks:

- David Easley and Jon Klein- berg (EK), "Networks, Crowds, and Markets: Reasoning about a Highly Connected World", Cambridge University Press.
- Matthew Jackson, "Social and Economic Networks", Princeton University Press.

The analysis of economic and social networks heavily relies on game theory. Of course, the course does not presume any game theoretic background, though some of the students will have taken Game Theory course last year. We will cover all of the game theory that you need as we go along.

- **Lecture 1:** Introduction to economic, social and communication networks.Reading: EK, Chapter, 1 (also skim Chapters 3-5); Jackson, Chapter 1. Graph theory and social networks.Reading: EK, Chapters 2 and 13; Jackson, Chapters 2 and 3.

- **Lecture 2:** Branching processes and random graph models.Reading: Jackson, Sections 4.1.1, 4.2.1-4.2.5, and 4.3.

- **Lecture 3:** Rich get richer phenomena, power laws, small worlds. Preferential attachment, degree distributions, clustering. Applications: firm size distributions, link analysis and web search, PageRank, decentralized search and navigation. Reading: EK, Chapters 18, 20, and 14; Jackson, Chapter 5 and Section 7.3.

- **Lecture 4:** Epidemics: SIR and SIS models of diffusion. Applications: spread of information and disease, genetic inheritance. Reading: EK, Chapter 21; Jackson, Section 7.2.

- **Lecture 5:** Game Theory review: Games, strategies, payoffs, extensive and normal forms, Nash Equilibrium. Applications: tragedy of the commons, coordination games.

- **Lecture 6:**Modeling network traffic and strategic network formation, Negative externalities, congestion, Braess' paradox, potential games. Application: congestion tax in London. Reading: EK, Chapter 8; Jackson Chapter 6.

- **Lecture 7:** Network effects, innovation, tipping, and contagion Positive externalities, strategic complements, path dependence, diffusion of innovation, tipping in technology, financial, and product markets. Application: the rise of Microsoft and contagion phenomena. Reading: EK, Chapters 17 and 19, Jackson, Section 9.6-9.7.

- **Lecture 8:** Wisdom of the crowds, information aggregation over networks. Review of Markov Chains, law of large numbers, Condorcet jury theorem, imitation and social influence, consensus and gossip algorithms. Application: prediction markets. Reading: Jackson, Section 8.3.

- **Lecture 9:**Herding and informational cascades Bayesian learning, benefits of copying, herd behavior, informational cascades. Applications: consumer behavior, financial markets. Reading: EK, Chapter 16, Jackson, Sections 8.1-8.2.

- **Lecture 10-11-12** Student Presentations.