ECON 980O: Measuring and Modeling Social Networks

Basic Information

Course Head	Prof. Benjamin Golub (Department of Economics)
Contact	bgolub@fas.harvard.edu
Office hours	Thursday 1:00pm-2:30, Littauer 308 (youcanbook.me)
TF	Dr. Mauricio Fernandez-Duque (Postdoctoral Fellow, Kennedy School)
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Office hours	TBA
Location	Sever 102
Important Times and Dates	Regular time: Wed 9:00 am - 11:00 am No class: April 26 Final presentations May 1, 9:00 am - noon

Course Description

Social networks consist of relationships that carry information, mediate trade, and facilitate cooperation. Online platforms generate "big data" records of what is going on in such networks at unprecedented levels of detail. How do we make sense of the data, and how can we use it to make decisions—as individuals, within companies, and as a society? This seminar teaches models from the economics and statistics of networks that are essential to the task. Topics include ideas going viral, online markets, and social influence. Students will complete a final project that either develops an original model, applies an existing one to analyze real-world data, or offers a history and critique of an important concept.

Assignments and Evaluation

The grade will be primarily based on students' progress toward and completion of an independent research paper of 10-30 pages on one of the course topics. There are three kinds of papers that you can write:

- Perform a statistical analysis of a real-world data set based on a network concept.
    - We will share a set of potential resources.
- Propose a modification of an existing theoretical model, put this modification in context, explain what it accomplishes, and defend its usefulness.
- Provide an *original* history and critique/commentary on an important idea in networks:

    - How was this idea initially presented/formalized?
    - How is it useful? What is wrong with it?
    - How has it evolved since? What have been the most important theoretical or empirical developments?
    - What are the tensions and inconsistencies, especially across disciplines, in the way this idea is treated?

Students will submit proposals and drafts throughout the class. They will also make presentations on their projects, or give mini-lectures on course topics (more on this below).

The assignments and their contributions to the grade are as follows. All assignments should be submitted by email to the course head (bgolub@fas.harvard.edu) by their due dates/times.

- 30% weekly written work and oral participation:
    - problem sets;
    - written case comments;
    - class discussions.
- 25% final paper;
    - 10-30 pages. Due **May 9, 4:50pm**.
    - Short is okay *if you have a great idea*. (We will tell you if this is the case.)
- 25% outlines and drafts leading up to final paper;
    - 4-page (1500-word) overview/literature review, with bibliography (Harvard citation style) of a topic you are interested in
        - Due **Thursday, March 9, 4:59pm**.
    - 5-page "first key section" of your paper,
        - e.g.:
            - Empirical Strategy
            - Model and Formal Question
            - In the history/commentary style of paper, the "key argument," thesis, or perspective on the literature you want to emphasize. Originality is key!
            - Also permissible: written report and evidence of "background work" (e.g. extensive data cleaning, simulation results).
        - Key desideratum: significant progress toward your final paper.
        - Due **Tues, April 11** (6:59pm)

    - 5-page "secondary sections"

        - E.g.:
            - Data Description; Empirical Results
            - Formal Results; Simulation Results
            - History of the Question
        - Due **Wed, Apr 26** (6:59pm)

- 20% presentations—two options (everyone must choose one):
    - A mini-lecture, 30-45 minutes in duration, on a networks topic (to be assigned next meeting) that you will give during our regular meeting time. Advantages: can use others' teaching material; Mauricio and I will be helping you out during your talk. Disadvantages: must thoroughly prepare to teach a topic (including blackboard notes or slides), perhaps with parts not directly relevant to your research paper.
    - A 10-minute "defense" of your research proposal on May 1. Your classmates and the instructors (Mauricio and I) ask probing questions for an additional 4 minutes. Advantages: your work for your paper automatically prepares you for this. Disadvantages: you will be expected to have a deeper understanding of your material and to answer difficult questions on the fly without much help; you will be graded on the quality of your answers.

Late policy: late written work is penalized one notch (e.g. A to A- or B to B-) for every day it's late. After a five-day delay, it receives no credit. Exceptions to this policy are made only for medical or serious academic/personal reasons, generally requiring an administrator/tutor/dean/etc. to contact the Course Head.

The best way to make up for credit lost due to lateness is to ask me for extra credit work; this will generally be available in moderation.

Readings

The textbook that we will use for basic concepts and techniques of network analysis is:

- David Easley and Jon Kleinberg, *Networks, Crowds and Markets.* Cambridge University Press, 2010. There is a full-text version available online.

An additional (advanced graduate) textbook if you want to get into the details of something is:

- Matthew O. Jackson *Social and Economic Networks*. Princeton University Press, 2008.

In addition, course material will include readings from the primary research literature, business publications, etc.

Basic Course Structure

In-class cases and lectures: most by me, some by you (in 30-minute mini-lectures), covering *central ideas* from the study of networks. These will help you discover the questions that will form the basis for your final project.

Workshops: As needed—expect roughly two. Potential topics:

- software for network analysis;
- basics of statistics and hypothesis testing;
- a sermon on writing.

Topic Outline

The following is an incomplete list of topics covered throughout the class.

1. Viral processes getting traction:
    a. coordination games: Schelling coordination, focal points, higher-order beliefs; Chwe (2013); EK Chapter 6
    b. network centrality: the right early adopters. EK Chapter 14; Langville and Meyer (2011, 2012)
2. The velocity of viral growth:
    a. cascades and branching processes; EK Chapter 19
    b. estimation of the basic reproductive number; Lecture 4 (February 15, 2017) and corresponding problem set
    c. practical measurement of user growth; Hsu notes
    d. tipping points and marketing investments. Lecture 4 (February 15, 2017)
3. Saturation and strategy:
    a. barriers to entry and Porter's five forces; Porter (2008)
    b. scaling a viral process—diminishing returns;
    c. why social networks die.

4. Macroeconomics:
    a. Leontief's intersectoral network; ten Raa (2006)
    b. Why are there recessions? The network origins of aggregate volatility. Gabaix (2016)
    c. Financial contagion, systemic risk. Glasserman and Young (2016)

5. Social policy:

a. homophily, “Schelling” segregation; EK Chapter 4
b. tipping points, “white flight”; Card, Mas, and Rothstein (2008)
c. (if time permits) the basic microeconomics of platforms and their regulation; EK Chapter 17
d. (if time permits) network design: transportation networks and Braess’s paradox. EK Chapter 8

6. How not to be wrong: being smart with data.
    a. selection and its paradoxes; bullet holes and recidivists; applies to everyone – not a research topic, but we will have lots of discussion
    b. power laws; EK Chapter 18, Gabaix (2016)
    c. how to do estimation and hypothesis testing “for real”; again, will learn throughout

Bibliography

Acemoglu, Daron, Asuman Ozdaglar, and Alireza Tahbaz-Salehi. "Microeconomic origins of macroeconomic tail risks." *The American Economic Review* 107, no. 1 (2017): 54-108.

Card, David, Alexandre Mas, and Jesse Rothstein. "Tipping and the Dynamics of Segregation." *The Quarterly Journal of Economics* 123, no. 1 (2008): 177-218.

Chwe, Michael Suk-Young. *Rational Ritual: Culture, Coordination, and Common Knowledge*. Princeton University Press, 2013.

Gabaix, Xavier. "Power Laws in Economics: An Introduction." *The Journal of Economic Perspectives* 30, no. 1 (2016): 185-205.

Glasserman, Paul, and H. Peyton Young. "Contagion in Financial Networks." *Journal of Economic Literature* 54, no. 3 (2016): 779-831.

Langville, Amy N., and Carl D. Meyer. *Google's PageRank and Beyond: The Science of Search Engine Rankings*. Princeton University Press, 2011.

Langville, Amy N., and Carl D. Meyer. *Who's #1?: The Science of Rating and Ranking*. Princeton University Press, 2012.

Porter, Michael E. "The five competitive forces that shape strategy." *Harvard Business Review* 86, no. 1 (2008): 25-40.

ten Raa, Thijs. *The Economics of Input-Output Analysis*. Cambridge University

Press, 2006.