HARVARD UNIVERSITY
Department of Economics

ECON 2034
Spring 2020

Basic Information

Course Head	Prof. Benjamin Golub Department of Economics bgolub@fas.harvard.edu and ben.golub@gmail.com
Office hours	Time TBD (following poll of enrolled students) Littauer (North Yard) 308
TF	Chang Liu Ph.D. Candidate, Department of Economics chang_liu@g.harvard.edu
Office hours	Time TBD (following poll of enrolled students)

Meeting time	Lecture Fri. 3:00-5:45pm, 10 min break No recitation
Location	Littauer M-16

Course description

This course prepares students for pure and applied research in the economic theory of networks. Topics covered include the macroeconomic network of production and trade; games of investment with social spillovers (education, criminal activity); financial contagion and other externalities; diffusion of beliefs and behaviors; segregation and homophily; and networked markets. The course emphasizes portable methods, including the linear algebra behind centrality measures; random graph theory; branching processes; power laws and Pareto tails. Prerequisites: basic microeconomic theory at the level of Econ 2010a,b; probability at the level of an advanced undergraduate course.

Textbooks and readings

- Required
  - [**EK**] David Easley and Jon Kleinberg, *Networks, Crowds and Markets*, Cambridge University Press, 2010.
    There is a full-text version available online.
  - [**J-HN**] Matthew O. Jackson, *The Human Network*, Pantheon, 2019.
  - [**J-SEN**] Matthew O. Jackson *Social and Economic Networks*. Princeton University Press, 2008.
- Useful reference
  - [**BGR**] Yann Bramoullé, Andrea Galeotti, and Brian W. Rogers, eds., *The Oxford Handbook of the Economics of Networks*, Oxford University Press, 2016.

In addition, course material will include readings from the media, primary research literature, and readings from other books.

Assignments and evaluation

The assignments and their contributions to the grade are as follows. All assignments should be submitted on Canvas in electronic form by their due dates and times.

- 35% written assignments (due Thursdays – initially biweekly, then more frequent as we do written responses to papers):
  - quantitative exercises;
  - short essays;
  - comments on a mailing list;
- 35% project:
  - Due May 7. You will review and critically analyze several recent research papers on a topic, related to the course, that interests you. Your review will be about 15 pages long in standard working paper format. The papers you discuss must be major ones reflecting the "state of the art" in networks, written within the past 20 years or so. Both purely theoretical papers and ones with data are permissible, as long as they make serious use of some concepts from the course. The best-case outcome is that you get familiar with an area in which you will later do original research, understanding both the state of knowledge as well as challenges and limitations. More instructions to come later.
- 30% presentations:
  - March 27, in class.

Late policy: You may choose **one** written assignment to turn in with an arbitrary delay (by May 7) but you must nevertheless write up the assignment.

You may choose a **second** assignment to turn in under the same "infinite extension" policy for 88% credit.

Course calendar

1/31	2/7	2/14	2/21	2/28	3/6	3/13	3/20
Lec 2h45m	Lec 2h45m	Lec 2h45m	Lec 2h45m	Lec 2h45m	Lec 2h45m	Lec 2h45m (guest)	Spring Break

3/27	4/3	4/10	4/17	4/24
Presentations 2h45m	Lec 2h45m	Lec 2h45m	Lec 2h45m	Lec 2h45m

Topics

For each topic, a basic reading list is provided. More readings (especially from the primary literature) will be assigned as the course progresses.

1. Introduction to the course and basic graph theory

- Required pleasure reading
  - EK Ch. 1, 2
  - J-HN Ch. 1
- Key substantive reading
  - J-SEN, Ch. 1, 2, 3
- Optional reading
  - [a review of EK]: Shalizi, C. "Connecting the Dots." *American Scientist* 99 (2011).

2. Viral processes and their relatives

- Required pleasure reading
  - J-HN Ch. 3
- Key substantive reading
  - EK Ch. 21
  - J-SEN, Ch 4, Section 7.1, 7.2
- Optional theoretical reading
  - If you know basic martingale theory: Durrett, *Probability: Theory and Examples*, Section 4.3.4
  - Bollobás, B., Borgs, C., Chayes, J., & Riordan, O. (2010). "Percolation on dense graph sequences," The Annals of Probability, 38(1), 150-183.
- Optional further reading
  - Banerjee, A., Chandrasekhar, A. G., Duflo, E., & Jackson, M. O. (2013). "The diffusion of microfinance." *Science*, 341(6144), 1236498.
  - Vosoughi, S., Roy, D., & Aral, S. (2018). "The spread of true and false news online." *Science*, 359(6380), 1146-1151.
  - Kremer, M. (1996). Integrating behavioral choice into epidemiological models of AIDS. The Quarterly Journal of Economics, 111(2), 549-573.

3. Network structure and formation

- Required pleasure reading
  - EK Ch. 3, 4, 20
  - J-HN Ch. 5, 9
- Key substantive reading
  - J-SEN Ch. 5, 6

4. Networked markets and platforms

- Key substantive reading
  - EK Ch. 17
  - Rochet and Tirole (2003), "Platform Competition in Two-sided Markets," *Journal of the European Economic Association*

5. Network games: Discrete actions

- Optional review reading on basic game theory
  - EK Ch. 6
  - J-SEN Section 9.9
- Required pleasure reading
  - EK Ch. 19
  - J-HN Ch. 6, 8
- Key substantive reading
  - J-SEN Sections 9.2-9.8
  - Morris, S. (2000). "Contagion." The Review of Economic Studies, 67(1), 57-78.
  - Chwe, Michael Suk-Young. *Rational Ritual: Culture, Coordination, and Common Knowledge*. Princeton University Press, 2013.
- Optional reading
  - Chwe, M. S. Y. (2000). "Communication and coordination in social networks." *The Review of Economic Studies*, 67(1), 1-16.
  - Montanari, A., & Saberi, A. (2010). The spread of innovations in social networks. Proceedings of the National Academy of Sciences, 107(47), 20196-20201.
  - de Soto, Hernando, "The Real Mohamed Bouazizi," *Foreign Policy*, December 16, 2011
  - Schelling, T., *Strategy of Conflict*.

6. Basic network centrality theory

- Required pleasure reading
  - EK Ch. 13, 14, excluding advanced material
- Key substantive reading
  - Carl D. Meyer, *Matrix Analysis and Applied Linear Algebra*. SIAM: 2010., **Ch. 7 and 8** (skim the parts you know, read the parts you don't)

7. Economic manifestations of centrality: propagating impulses through agents

A. **Network games with continuous actions**

- Required pleasure reading
  - J-HN Ch. 2
- Key substantive reading
  - J-SEN Sec 9.5.2
  - Ballester, Coralio, Antoni Calvó-Armengol, and Yves Zenou. "Who's who in networks. Wanted: The key player." *Econometrica* 74.5 (2006): 1403-1417.
- Optional theoretical reading to be added

B. **DeGroot learning and its relatives**

- Required pleasure reading
  - EK Ch 16
  - J-HN 7
- Key substantive reading
  - J-SEN Ch. 8
  - Ben Golub and Evan Salder, "Learning in Social Networks," *Oxford Handbook of the Economics of Networks*. (2016)
- Optional readings
  - Banerjee, A., Chandrasekhar, A. G., Duflo, E., & Jackson, M. O. (2019). "Using gossips to spread information: Theory and evidence from two randomized controlled trials." *The Review of Economic Studies*, 86(6), 2453-2490.

C. Production networks and macroeconomic applications

- Key substantive reading
  - Introduction to classic Leontief model – to be assigned.
  - Jones, C. I. (2011). "Intermediate goods and weak links in the theory of economic development." *American Economic Journal: Macroeconomics*, 3(2), 1-28.
  - Acemoglu, D., Carvalho, V. M., Ozdaglar, A., & Tahbaz-Salehi, A. (2012). "The network origins of aggregate fluctuations." *Econometrica*, 80(5), 1977-2016.
- Optional theoretical reading
  - Baqaee, D. R., & Farhi, E. (2019). "The macroeconomic impact of microeconomic shocks: beyond Hulten's Theorem." *Econometrica*, 87(4), 1155-1203.
- Optional applied reading [more to be added]
  - Carvalho, V. M., Nirei, M., Saito, Y., & Tahbaz-Salehi, A. (2016). "Supply chain disruptions: Evidence from the great East Japan earthquake. Columbia Business School Research Paper, (17-5).

D. Financial networks

- Optional pleasure reading
    - J-HN Ch. 4
- Key substantive reading
    - Diamond, D. W. (2007). Banks and liquidity creation: a simple exposition of the Diamond-Dybvig model. *FRB Richmond Economic Quarterly*, 93(2), 189-200.
    - Kiyotaki, N., & Moore, J. (1997). "Credit cycles." *Journal of Political Economy*, 105(2), 211-248.
    - Acemoglu, D., Ozdaglar, A., & Tahbaz-Salehi, A. (2015). Systemic risk and stability in financial networks. American Economic Review, 105(2), 564-608.
    - Elliott, M., Golub, B., & Jackson, M. O. (2014). "Financial networks and contagion." *American Economic Review*, 104(10), 3115-53.

8. Networks, markets, and inequality

- Required pleasure reading
    - EK Ch. 10, 11
    - J-HN Ch. 6
- Key substantive reading
    - J-SEN Ch. 10, Ch. 12