Econ 410
Economics of Networks
Winter 2023 Quarter

University of Washington Department of Economics
Instructor: Alan Griffith
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Course Description and Goals:

This course is an advanced undergraduate course in the economics of networks. Primary aims include:

1. Develop mathematical tools to describe and analyze data on networks, broadly defined.
2. Analyze how interaction through networks affects predictions from economic theory.
3. Develop and apply tools from game theory to the study of strategic interaction through networks.
4. Develop an understanding of computational issues in dealing with network data, including linkages to computational complexity and algorithms.

The study of networks within economics is a relatively new (and exciting!) phenomenon. Accordingly, we will be borrowing many concepts and results from adjacent fields that have been studying networks for decades (particularly sociology, statistics, discrete mathematics, and computer science). However, throughout the course you should be asking yourself, "What makes this *economics*? What does *economics* as a field have to add?"

Prerequisites: The listed prerequisite for this course is Econ 300 or 400 (Intermediate Micro). Familiarity with the basics of game theory, constrained optimization, and matrix algebra will also be helpful, but I will provide a refresher where necessary. If you do not have these prerequisites (for example, if you are not an Economics major), I am willing to accept alternative quantitative training as a substitute on a case-by-case basis. See below section on "Add Codes."

Textbook:

Required The main text for this course is *The Human Network* by Matthew O. Jackson (*THN* on the syllabus). This book is written for the general public and, as such, omits many of the technical details that will be filled in during the lectures. It's also pretty cheap (your welcome!).

Optional Course material will also draw heavily on additional texts, which make excellent supplemental reading and references.

1. *Networks, Crowds, and Markets* by Easley and Kleinberg (E&K on the syllabus). This one is written from a multi-disciplinary standpoint and is fairly accessible for undergraduates.
2. *Social and Economic Networks* by Matthew O. Jackson (*SEN* on the syllabus). The level of technical detail is a bit higher than what we will be using in this course, but I will be borrowing heavily from it in the lectures.
3. *Algorithms Illustrated* by Tim Roughgarden (Roughgarden on the syllabus). This is a set of short (and cheap, and accessible) books on algorithms that introduce basic concepts. We will draw on material from Parts 1 and 2.

Class Meetings: This class is scheduled for Tuesdays and Thursdays, 8:30am – 10:20am. It will be held in person, in Loew Hall 201. Note that we will not meet on Thursday, Feb 16, as noted on the schedule below.

Grading: The final grade will be calculated as follows:

Homework Assignments	30%
First Midterm	30%
Second Midterm	30%
Class Participation	10%

Exams: There are two Midterm exams. The First Midterm will be held during a scheduled class meeting on Thursday, Feb 2, as noted below. The Second Midterm will be held during the scheduled final exam time, on Tuesday, March 14, 10:30am – 12:20pm.

Readings: Readings are subject to change, as we may cover some topics more quickly or more slowly than planned. Please read the main readings as indicated. Readings marked with ** are supplementary and optional: these often are more detailed and/or more technical readings that I will discuss during the lectures but do not expect you to have read (but they may be useful if you want to dive deeper into a topic). Some of the material—particularly the theory—is difficult and technical. Try to understand the intuition behind the models, concepts, and results, and come to class prepared with questions.

Math Concepts and Methods: A primary goal of this course is to develop a set of mathematical tools with which to analyze networks. Accordingly, there will be parts of lectures that review linear algebra, game theory, algorithms, and other methods throughout the quarter. These are in *italics* on the syllabus.

A note of caution (and encouragement!): some of these concepts are advanced and may be difficult to grasp at first. This course is meant to *challenge* all students (even the very best ones!), so try to understand the concepts to the best extent possible, and do not be discouraged if you do not pick things up at first.

Homework: There are **six** homework assignments due throughout the quarter. The homework assignments will involve a mixture of solving models and reacting to the readings and lectures from class. Some of them will be difficult, as they are intended to push your understanding. You should not be too worried if you cannot completely solve all parts of all problems. You are allowed (and even encouraged) to work with your classmates, although every student should turn in their own solutions, including showing your work in a reasonable manner. Homework is graded on effort and completion. Detailed solutions will be posted shortly after the due date, and reviewing homework solutions is a good way to study for midterms.

Class Participation: Class participation is highly encouraged. This is an upper-level seminar-style class, so we will be discussing the readings at length during class. Some of the material is difficult, but do not be discouraged if you need to ask for clarification – other people probably have the same questions.

Canvas Site: We will be using a Canvas site. There will be posted all relevant course materials. I will also post lecture slides before class so that you can print them out to take notes, if so inclined. Homework submissions should also be posted to Canvas. I will also post grades on Canvas as assignments are completed. However, **do not** pay attention to class grade that is calculated on Canvas: final grades will be determined according to the formula listed above.

Laptops in Class: I strongly discourage the use of laptops in class. Research has shown that people tend to retain things better if they take notes by hand. Also, I have found that having screens in front of students can make class discussion—which we will have a lot of in this class—more difficult. I will post lectures slides before class, and I recommend printing them out prior to class to take notes on, since we will be filling in a lot of details.

Office Hours: I will be holding office hours from **1:30 to 3:00 on Wednesday**. If you are unable to make these times and would like to meet, please email me to suggest an alternative time, including if you'd like to meet via Zoom. These hours may change when I travel, and I will schedule additional office hours around exam times.

Contact: The easiest way to contact me is via email. Please put "410" in the title to the email so that I will know that it is not spam. It is okay to ask simple questions over email, but if you have more complicated questions, including clarifications about concepts in the readings and lectures, it is usually better to come to office hours.

Add Codes: I am fairly generous with add codes, especially for economics majors, if you can show sufficient preparation for the class. I cannot grant add codes beyond the space constraints imposed by classroom size, however. **Please contact me after the first class if you need an add code.**

Date	Topic / Theme	Readings
Tue, Jan 3	(1) Course Introduction – Why Networks? Why Economics?	Matthew O. Jackson. 2014. "Networks in the Understanding of Economic Behaviors." *Journal of Economic Perspectives* 28(4): 3-22. ** Blume et al. 2015. "Introduction to Computer Science and Economic Theory." *Journal of Economic Theory* 156: 1-13. ** Jackson, *SEN* 1. ** E&K 1.
Thu, Jan 5	(2) Describing Networks – Matrices, Paths, Degree, etc. *Basic Graph Theory* *Linear Algebra Review*	Jackson, *THN*, Chapter 1 ** E&K 2.1-2.3. ** Jackson, *SEN,* 2.2.1 – 2.2.2
Tue, Jan 10	(3) Describing Networks – *Simple Combinatorics* *Eigenvalues and Eigenvectors*	Jackson, *THN*, Chapter 2 Feld, Scott. 1991. "Why Your Friends Have More Friends Than You Do." *American Journal of Sociology* 96(6): 1464-1477. ** Bonacich, Phillip. 1987. "Power and Centrality: A Family of Measures." *American Journal of Sociology* 92(5): 1170-1182. ** Jackson, *SEN* 2.4
Thu, Jan 12	(4) Connectedness and Shortest Paths *Computational Complexity* *Graph Algorithms* **Homework 1 Due**	Blume et al. 2015. "Introduction to Computer Science and Economic Theory." *Journal of Economic Theory* 156: 1-13. ** Roughgarden Part 1, Chapter 1. ** Roughgarden Part 2, Chapters 7-8.

Tue, Jan 17	(5) Describing Networks – Homophily, Clustering	Jackson, *THN*, Chapter 5 ** E&K 4.1-4.2. ** Jackson, *SEN* 3.2.2
Thu, Jan 19	(6) Describing Networks – Strong Ties, Weak Ties, Triadic Closure, Continuous Links	Granovetter, Mark S. 1973. "The Strength of Weak Ties." *American Journal of Sociology* 78(6): 1360-1380. Patacchini, Eleanora, and Yves Zenou. 2008. "The Strength of weak Ties in Crime." *European Economic Review* 52(2): 209-236. ** E&K 3.1 – 3.5 ** Jackson 2.2.
Tue, Jan 24	(7) Why Networks Matter – Social Learning and Diffusion **Homework 2 Due**	Jackson, *THN*, Chapter 3 ** Jackson 8.1-8.3. ** Jackson 2.4.1. ** Chandrasekhar, Arun, Horacio Larreguy, and JuanPablo Xandri. 2018. "Testing Models of Social Learning on Networks: Evidence from a Lab in the Field Experiment."
Thu, Jan 26	(8) Why Networks Matter – Herding Behavior and Cascades	Jackson, *THN*, Chapter 7 Salganik, Matthew J., Peter Sheridan Dodds, and Duncan J. Watts. 2006. "Experimental Study of Inequality and Unpredictability in an Artificial Cultural Market." *Science* 311(5762): 854-856. ** E&K 16, 19 ** Banerjee, Abhijit V. 1992. "A Simple Model of Herd Behavior." *Quarterly Journal of Economics* 107(3): 797-817.
Tue, Jan 31	(9) Why Networks Matter – Peer Effects **Homework 3 Due**	Christakis, Nicholas A., and James H. Fowler. 2007. "The Spread of Obesity in a Large Social Network over 32 Years." *New England Journal of Medicine* 357(4): 370-379. Cohen-Cole, Ethan, and Jason M. Fletcher. 2008. "Is Obesity Contagious? Social Networks vs. Environmental Factors in the Obesity Epidemic." *Journal of Health Economics* 27(5): 1382-1387. ** Carrell, Scott E., Bruce I. Sacerdote, and James E. West. 2013. "From Natural Variation to Optimal Policy? The Importance of Endogenous Network Formation. *Econometrica* 81(3): 855-882.
Thu, Feb 2	**FIRST MIDTERM**	
Tue, Feb 7	(10) Why Networks Matter – Networked Markets	Kranton, Rachel E., and Deborah F. Minehart. 2001. "A Theory of Buyer-Seller Networks." *American Economic Review* 91(3): 485-508. ** E&K 11.1-11.3. ** Jackson, *SEN* 10.

Thu, Feb 9	(11) Introduction to Game Theory, with focus on Networks *Game Theory*	Jackson, Matthew O. "A Brief Introduction to Game Theory." Sections 1.1-1.2. ** E&K 6.1-6.4, 6.9. ** Jackson, *SEN* 9.10.
Tue, Feb 14	(12) Games on Networks I – Games of Strategic Complements **Homework 4 Due**	** E&K 6.5. ** Jackson, Matthew O., and Yves Zenou. 2015. "Games on Networks." *Handbook of Game Theory with Economic Applications* 4: 95-163 (Sections 3-4)
Thu, Feb 16	**NO CLASS**	
Tue, Feb 21	(13) Games on Networks II – Games of Strategic Substitutes *Cliques and Independent Sets*	Bramoulle, Yann, and Rachel Kranton. 2007. "Public Goods in Networks." *Journal of Economic Theory* 135(1): 478-494. ** E&K 6.5.
Thu, Feb 23	(14) Network Measurement *Network Measurement* *Survey Methodology* **Homework 5 Due**	Griffith, Alan. 2021. "Name Your Friends but only Five? The Importance of Censoring in Peer Effects Estimates using Social Networks Data." *Journal of Labor Economics.* Forthcoming. Breza, Emily, Arun Chandrasekhar, Tyler McCormick, and Mengjie Pan. 2020. "Using Aggregated Relational Data to Feasibly Identify Network Structure without Network Data." *American Economic Review* 110(8): 2454-2484. ** Chandrasekhar, Arun, and Randall Lewis. 2011. "Econometrics of Sampled Networks."
Tue, Feb 28	(15) Network Formation I – Random Networks *Poisson and Binomial Distributions*	Newman, Mark E., Duncan J. Watts, and Steven H. Strogatz. 2002. "Random Graph Models of Social Networks." *Proceedings of the National Academy of Sciences* 99(supp.1): 2566-2572. ** Jackson, *SEN* 4.1.
Thu, Mar 2	(16) Network Formation I – Growing Random Networks, "Small Worlds"	Barabasi, Albert-Laszlo, and Reka Albert. 1999. "Emergence of Scaling in Random Networks." *Science* 286(5439): 509-512. Jackson, Matthew O., and Brian W. Rogers. 2005. "The Economics of Small Worlds." *Journal of the European Economic Association* 3(2-3): 617-627. ** Jackson, Matthew O., and Brian W. Rogers. 2007. "Meeting Strangers and Friends of Friends: How Random are Social Networks? *American Economic Review* 97(3): 890-915. ** Jackson, *SEN* 5.1-5.2, 3.2.1 ** E&K 18

Tue, Mar 7	(17) Network Formation II – Matching Markets **Homework 6 Due**	Jackson, *THN*, Chapter 9 Roth, Alvin E., and Elliott Peranson. 1999. "The Redesign of the Matching Market for American Physicians: Some Engineering Aspects of Economic Design." *American Economic Review* 89(4): 748-780. ** E&K 10.1-10.5. ** Jackson, *SEN* 11.1.
Thu, Mar 9	(18) Network Formation II – Strategic Network Formation **Recap and Review**	Bloch, Francis, and Matthew O. Jackson. 2006. "Definitions of Equilibrium in Network Formation Games." *Int. J. Game Theory* 34: 305-318. ** Jackson, Matthew O. and Asher Wolinsky. 1996. "A Strategic Model of Social and Economic Networks." *Journal of Economic Theory* 71: 44-74. ** Bala, Venkatesh, and Sanjeev Goyal. 2000. "A Noncooperative Model of Network Formation. *Econometrica* 68(5): 1181-1229. ** Jackson 11.2-11.3.
Tue, Mar 14	**SECOND MIDTERM**	