Topics in Network Analysis
Spring 2023
Wednesdays 9:30am–12:00pm
Commons 349

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Overview

Political science is flush with examples of networks: countries are linked in a trade network, revolutionaries are linked in an information network, politicians are linked in a committee network, voters are linked in a friendship network, and the list goes on. Few agents of interest to political science— politicians, lobbyists, voters, protesters, rebels, migrants, employees, committees, countries— are truly independent actors, and a complete understanding of their actions requires an understanding of the networks that interconnect them.

The study of network analysis is concerned with detecting, measuring, analyzing, predicting, and learning the consequences of networks like these. Because the study is relatively new and has grown up in fields that range from computer science to neurobiology to sociology, an introduction necessarily spans a wide variety of subject areas. Creativity and a willingness to cross disciplinary boundaries will be rewarding. After all, revolutions are not so dissimilar from bank runs and epidemics. Voting behavior has analogues to criminal behavior. Congressional committees actually resemble broadway musical creative teams.

This course serves as an introduction to the study of networks by way of twelve core topics. No prior training in networks is assumed (though of course will be helpful), and early graduate training in statistics and game theory will suffice. We will begin with the tools to describe networks, move to a set of topics geared toward creating precise theories and testable predictions, and finally will cover topics concerned with empirical research design, including proper elicitation of networks and estimation of their consequences. Each topic could be the subject of an entire course; this course will scratch the surface of each and offer direction for pursuing greater depth.

Along the way we will be covering a variety of substantive topics and discussing the wealth of possibilities for original political science research. Classes will generally consist in guided discussions and short lectures so that we can flesh out best practice for political scientists studying networks. The more we can harness the variety of backgrounds and interests of everyone in the class, the more we will all take away.

Requirements

Participation: 10%

Readings are to be completed in time for class and thoughtful participation in discussions is expected. Some readings are quite technical and we will use class to distill them to their main points– constructive questions count as thoughtful participation.

Presentation: 10%

Everyone will be asked to sign up for one presentation slot throughout the semester to teach the class something relevant but not covered on the syllabus. The topic can be a model or research design from an article not on the syllabus, a resource for data, a demo of software, or something else that we would benefit from learning.

Problem Sets: 30%

There will be three problem sets throughout the semester to offer practice with some of the more technical material. I encourage you to work together, but be sure to write up your own answers.

Prospectus for Final Project: 5%

A 3-4 page memo will be due by email to the class **11:59pm, Friday April 14**. The prospectus should propose the topic for the final project in as much detail as possible while adhering to the page limit. Class on April 19th will be devoted to very short presentations and collective feedback on project plans.

Final Project: 45%

A 15-20 page research paper submitted by email as a PDF due **11:59pm, Monday May 1**.

Schedule of Readings (subject to additions and substitutions)

Week 1: Introduction

1/11/23

An overview of using social networks to study the political world. What kinds of topics can be studied with a networks approach? What are the right questions to ask? What kinds of research designs are available?

J.M. Larson. Chapter 1: Introduction to social networks research. In *Designing Empirical Social Networks Research*, pages 1–10. Draft Manuscript, 2023.

Optional background reading:

N.A. Christakis and J.H. Fowler. In the thick of it. In *Connected: The surprising power of our social networks and how they shape our lives*, pages 3–32. Little, Brown, 2009.

D.A. Siegel. Social networks in comparative perspective. *PS: Political Science and Politics*, 44(1):51, 2011.

Week 2: Technical Details

1/18/23

What exactly is a network? What are the different features of networks that we might want to describe or relate to some political outcome of interest? What exactly is "density," "centrality," "clustering," etc.? How might these features of positions within networks or of networks as a whole matter for political science outcomes?

J.M. Larson. Chapter 2: Describing and interpreting social network features. In *Designing Empirical Social Networks Research*, pages 13–39. Draft Manuscript, 2023.

M. Newman. Who is the best connected scientist? a study of scientific coauthorship networks. *Complex networks*, pages 337–370, 2004.

Optional additional resource:

M.O. Jackson. Chapter 2: Representing and measuring networks. In *Social and economic networks*, pages 20–51. Princeton University Press, 2010.

Week 3: Theoretical Relevance of Networks

1/25/23

How should we think about specifying a theory for why networks matter for political science? We'll cover the spectrum ranging from informal (but sufficiently complete) to formal theories. We'll practice applying the framework that requires specifying the nodes, the link type, and the link function.

J.M. Larson. Chapter 4: Crafting a network theory. In *Designing Empirical Social Networks Research*, pages 53–67. Draft Manuscript, 2023.

M.S.Y. Chwe. Communication and coordination in social networks. *The Review of Economic Studies*, 67(1):1–16, 2000.

Y. Bramoullé and R. Kranton. Public goods in networks. *Journal of Economic Theory*, 135(1):478–494, 2007.

J. M. Larson. Networks and interethnic cooperation. *Journal of Politics*, 79(2):546–559, 2017.

Z. Maoz, L. G. Terris, R. D. Kuperman, and I. T. What is the enemy of my enemy? causes and consequences of imbalanced international relations, 1816–2001. *The Journal of Politics*, 69(1):100–115, 2007.

Week 4: Network Agent-Based Models

2/1/23

An alternative to game theory that allows us to test the consequences of assumptions about the role of networks is agent-based models. We'll read examples of this type of research design and focus on the principles that lead to tractable and interesting agent-based models.

T.C. Schelling. Sorting and mixing: Race and sex. In *Micromotives and Macrobehavior*, pages 137–166. WW Norton, 2006.

C. Dorff, M. Gallop, and S. Minhas. Network competition and civilian targeting during civil conflict. *British Journal of Political Science*, 53(2):441–459, 2023.

J. M. Larson and J. I. Lewis. Ethnic networks. *American Journal of Political Science*, 61(2):350–364, 2017.

Z. Maoz and K. A. Joyce. The effects of shocks on international networks: Changes in the attributes of states and the structure of international alliance networks. *Journal of Peace Research*, 53(3):292–309, 2016.

D. A. Siegel. When does repression work? collective action in social networks. *The Journal of Politics*, 73(4):993–1010, 2011.

Week 5: Networks in R Part I

2/8/23

We'll use the igraph package in R to both work with network data and to create agent based models and simulations.

Download R, and install igraph package for R

J.M. Larson. Chapter 8: Working with network data in r. In *Designing Empirical Social Networks Research*, pages 109–137. Draft Manuscript, 2023.

Week 6: Observational Data

2/15/23

The focus of this week is on getting the operationalization of network links right. We'll cover how to use observational data in a study, with a heavy emphasis on the match between network concepts and network measurement.

J.M. Larson. Chapter 5: Moving from theory to empirics. In *Designing Empirical Social Networks Research*, pages 69–83. Draft Manuscript, 2023.

C. Cruz, J. Labonne, and P. Querubín. Politician family networks and electoral outcomes: Evidence from the philippines. *American Economic Review*, 107(10):3006–37, 2017.

J. M. Montgomery and B. Nyhan. The effects of congressional staff networks in the us house of representatives. *The Journal of Politics*, 79(3):745–761, 2017.

C. Dorff, M. Gallop, and S. Minhas. Networks of violence: Predicting conflict in nigeria. *The Journal of Politics*, 82(2):476–493, 2020.

Also skim:

N.A. Christakis and J.H. Fowler. The spread of obesity in a large social network over 32 years. *New England journal of medicine*, 357(4):370–379, 2007.

R. Lyons. The spread of evidence-poor medicine via flawed social-network analysis. *Statistics, Politics, and Policy*, 2(1), 2011.

Week 7: Survey Data

2/22/23

Our focus this week is on the use of survey methods to acquire network data. The goal will be to learn best practices for designing the best possible survey in order to either collect data using a survey or to collect data with other means that most closely mimics the best possible survey.

J.M. Larson. Chapter 6: Acquiring network data. In *Designing Empirical Social Networks Research*, pages 85–93. Draft Manuscript, 2023.

N. Rao, M. Mobius, and T. Rosenblat. Social networks and vaccination decisions. *Working Paper*, 2007.

C. Dorff. Violence, kinship networks, and political resilience: Evidence from mexico. *Journal of Peace Research*, 54(4):558–573, 2017.

J.T. Scholz, R. Berardo, and B. Kile. Do networks solve collective action problems? credibility, search, and collaboration. *Journal of Politics*, 70(2):393–406, 2008.

R. Ferrali, G. Grossman, M. R. Platas, and J. Rodden. It takes a village: Peer effects and externalities in technology adoption. *American Journal of Political Science*, 64(3):536–553, 2020.

Week 8: Experiments

3/1/23

What are the options for designing experiments that are informative about the role of networks? How could we use more of these in political science?

E. Duflo and E. Saez. The role of information and social interactions in retirement plan decisions: Evidence from a randomized experiment. *The Quarterly Journal of Economics*, 118(3):815–842, 2003.

S. Judd, M. Kearns, and Y. Vorobeychik. Behavioral dynamics and influence in networked coloring and consensus. *Proceedings of the National Academy of Sciences*, 107(34):14978–14982, 2010.

J.H. Fowler and N.A. Christakis. Cooperative behavior cascades in human social networks. *Proceedings of the National Academy of Sciences*, 107(12):5334–5338, 2010.

Paul Atwell and Noah L Nathan. Channels for influence or maps of behavior? a field experiment on social networks and cooperation. *American Journal of Political Science*, 66(3):696–713, 2022.

D. Masterson. Refugee networks, cooperation, and resource access. *Working Paper*, 2022.

Week 9: Learning and Diffusion

3/8/23

How do networks facilitate the spread of information? How do people learn from others in their social network? How can we apply these ideas to areas of political science where new information is an important part of the story?

M.H. DeGroot. Reaching a consensus. *Journal of the American Statistical Association*, 69(345):118–121, 1974.

William J. Brady, Julian A. Willis, John J. Jost, Joshua A. Tucker, and Jay J. Van Bavel. Emotion shapes the diffusion of moralized content in social networks. *Proceedings of the National Academy of Sciences*, 114(28):7313–7318, 2017.

Katherine Ognyanova. Contagious politics: Tie strength and the spread of political knowledge. *Communication Research*, 49(1):116–138, 2022.

M. Mobius, T. Phan, and A. Szeidl. Treasure hunt: Social learning in the field. *Working Paper*, NBER, 2015.

J. M. Larson, J. I. Lewis, and P. Rodríguez. From chatter to action: How social networks inform and motivate in rural uganda. *British Journal of Political Science*, 54(4):1769–1789, 2022.

Week 10: Spring Break, No Class

3/15/23

Week 11: Network Formation

3/22/23

How do links get added to networks? We will consider links that are added with some randomness in the process, links that are added based on the strategic behavior, and ways to try to infer the process that led real networks to look the way they do.

Albert-Laszlo Barabasi. Chapters 4-7. In *Linked*, pages 41–92. Plume, 2003.

M.O. Jackson and A. Wolinsky. A strategic model of social and economic networks. *Journal of economic theory*, 71(1):44–74, 1996.

M. Fafchamps and F. Gubert. Risk sharing and network formation. *The American economic review*, 97(2):75–79, 2007.

Peter S Bearman, James Moody, and Katherine Stovel. Chains of affection: The structure of adolescent romantic and sexual networks. *American journal of sociology*, 110(1):44–91, 2004.

S. J. Cranmer, P. Leifeld, S. D. McClurg, and M. Rolfe. Navigating the range of statistical tools for inferential network analysis. *American Journal of Political Science*, 61(1):237–251, 2017.

Week 12: Network Visualization, and Networks in R Part II

3/29/23

We will practice making publication-quality network visualizations in Gephi, and will add to our network toolkit in R.

M. Grandjean. Gephi: Introduction to network analysis and visualization. `martingrandjean.ch/gephi-introduction/`, 2015.

Download Gephi

Week 13: Norms, Communities, and Homophily

4/5/23

How do individual-level decisions affect the ultimate shape of networks and the communities within them? Why do people tend to resemble their social contacts (exhibit "homophily") on a variety of dimensions? What are the implications of homophily for politics?

J.M. Larson. Chapter 3: Accounting for substantive network features. In *Designing Empirical Social Networks Research*, pages 41–52. Draft Manuscript, 2023.

Matthew O Jackson, Stephen Nei, Erik Snowberg, and Leeat Yariv. The dynamics of networks and homophily. *NBER Working Paper*, (w30815), 2022.

Raj Chetty, Matthew O Jackson, Theresa Kuchler, Johannes Stroebel, Nathaniel Hendren, Robert B Fluegge, Sara Gong, Federico Gonzalez, Armelle Grondin, Matthew Jacob, et al. Social capital ii: determinants of economic connectedness. *Nature*, 608(7921):122–134, 2022.

Mohsen Mosleh, Cameron Martel, Dean Eckles, and David G Rand. Shared partisanship dramatically increases social tie formation in a twitter field experiment. *Proceedings of the National Academy of Sciences*, 118(7):e2022761118, 2021.

Zeev Maoz. Preferential attachment, homophily, and the structure of international networks, 1816–2003. *Conflict Management and Peace Science*, 29(3):341–369, 2012.

Week 14: Social Media Data

4/12/23

How can data from online sources be used in networks research projects? How generalizable is research in this domain? What are the special issues that arise?

S. Aral, L. Muchnik, and A. Sundararajan. Distinguishing influence-based contagion from homophily-driven diffusion in dynamic networks. *Proceedings of the National Academy of Sciences*, 106(51):21544–21549, 2009.

S. González-Bailón and N. Wang. Networked discontent: The anatomy of protest campaigns in social media. *Social Networks*, 44:95–104, 2016.

Z. C. Steinert-Threlkeld. Spontaneous collective action: Peripheral mobilization during the arab spring. *American Political Science Review*, 111(2):379–403, 2017.

J. Bisbee and J. M. Larson. Testing social science network theories with online network data: An evaluation of external validity. *American Political Science Review*, 111(3):502–521, 2017.

Friday, 4/14/23: Prospectus due by email to class 11:59pm

Week 15: Your Planned Contributions to the Field

4/19/23

Presentation of Paper Topics

Monday, 5/1/23: PDF of Final Project due by email 11:59pm