

# Political Network Analysis—Methods and Applications

Fall 2022

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## 1 Course Description

Network analysis (sometimes called social network analysis) is truly an interdisciplinary enterprise — the “field” owes much to scholars in mathematics, sociology, psychology, and anthropology. Today applications of network theory can be found everywhere, from the study of the internet, to work on genetics, eco-systems, and markets (among many, many examples - see, e.g., Barabasi’s (2002) *Linked*).

In recent years network analysis has become increasingly popular among political scientists.<sup>1</sup> But network analysis is about more than just the application of a series of statistical techniques — it’s a way of looking at the social and political world that focuses on inter-relationships. Scholars use network concepts and methods to describe the patterns of connectivity between ordinary individuals, political elites, organizations, states, and concepts (to name but a few examples), and to understand how those patterns affect various processes and outcomes.

Because network analysis is incredibly diverse in terms of its development, advancement, and application, our political science approach will be equally broad. Over the course of the semester we will examine all aspects of the method (beginning with data basics and concepts, before moving on to consider essential measures and more advanced techniques). However, throughout we will spend time discussing the foundations of the field and a host of political applications. The ultimate goal of this class is to make you think about the connected nature of the social and political world, and to help you incorporate this perspective into your research.

## 2 Reading Assignments

Required Books — please purchase these from the merchant of your choice:

1. Methodology: Robins, Gary. 2015. *Doing Social Network Research: Network-based Research Design for Social Scientists*. London: Sage Publications.
2. Methodology: Scott, John. 2017. *Social Network Analysis* (4th ed.). London: Sage Publications.

Recommended Books:

1. Methodology: Wasserman, Stanley and Katherine Faust. 1994. *Social Network Analysis: Methods and Applications*. New York: Cambridge.

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<sup>1</sup>Thanks go to Ramiro Berardo, Michael Heaney, David Knoke, and Jim Moody for making their syllabi and various parts of their course materials publicly available.

2. Popular/Application: Barabasi, Albert-Laszlo. 2002. *Linked: The New Science of Networks*. Cambridge: Perseus.
3. Popular/Application: Christakis, Nicholas A. and James H. Fowler. 2009. *Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives*. Little, Brown, and Company. (paperback version: 2011 — Back Bay Books)

A variety of other assigned readings will be available through the CU library system, as well as the course website on *Canvas*. In particular, we will read quite a few chapters from *The Oxford Handbook of Political Networks*, which should be free/accessible from campus. Please note that readings and assignments may be added, dropped, and re-arranged based on the pace and performance of the class.

### 3 Software

Data assignments will make use of R.<sup>2</sup>

Researchers also use *PAJAK* and *NetworkX* for analysis; *SoNIA* and *Cytoscape* are popular for visualization. We may do primers on other packages/environments to the extent that time allows.

### 4 Requirements and Grading

Grading System:

- A: 94 and up
- A-: 90-93
- B+: 87-89
- B: 84-86
- B-: 80-83
- C+: 77-79
- and so on...

Final grades will be assigned as follows, and you must complete all assignments to pass the course:<sup>3</sup>

1. Participation: 10%

I expect serious class-preparation, which means taking notes on/thinking about the readings ahead of time. Discussion of concepts and applications will be an important part of this course, and thus participation counts for a sizable portion of your final grade.

2. Short Assignments: 60%

Over the semester there will be 8 short assignments, each worth 7.5% of your final grade—many will be data exercises, some will be memos on the readings, and a few will focus on the final paper. Detailed instructions and due-dates will be announced at least one week ahead of time. You may discuss assignments with your classmates, but all final work must be your own (unless otherwise noted).

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<sup>2</sup>I'll also discuss *UCINET* ([www.analytictech.com/products.htm](http://www.analytictech.com/products.htm)), though only as a secondary/older resource. A fully-functional version of UCINET may be downloaded from the above site—for free—for 60-days.

<sup>3</sup>I reserve the right to make adjustments to final grades based on effort, improvement, etc.

3. Final Paper/Project: 20%

This class is intended to help you conduct your own research, ultimately resulting in (at least the start of) a publication-quality paper/project. Because students are at various stages of the program, I am happy to discuss project options so that this exercise is most useful to you.

4. Presentation: 10%

Everyone is expected to give the equivalent of a professional conference/panel presentation (about 15 minutes) on their final paper/project. These presentations will occur during the last 2 weeks of class.

## University of Colorado Policies

### Classroom Behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

### Requirements for COVID-19

As a matter of public health and safety, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. CU Boulder currently requires COVID-19 vaccination and boosters for all faculty, staff and students. Students, faculty and staff must upload proof of vaccination and boosters or file for an exemption based on medical, ethical or moral grounds through the MyCUHealth portal.

The CU Boulder campus is currently mask-optional. However, if public health conditions change and masks are again required in classrooms, students who fail to adhere to masking requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the policy on classroom behavior and the Student Code of Conduct. If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the Public Health Office ([contacttracing@colorado.edu](mailto:contacttracing@colorado.edu)). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the Public Health Office ([contacttracing@colorado.edu](mailto:contacttracing@colorado.edu)).

### Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or [dsinfo@colorado.edu](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

## Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

## Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include, but are not limited to: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to Student Conduct Conflict Resolution ([honor@colorado.edu](mailto:honor@colorado.edu)); 303-492-5550). Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct Conflict Resolution as well as be subject to academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the Honor Code website.

## Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, protected-class discrimination and harassment, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these policies, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email [cureport@colorado.edu](mailto:cureport@colorado.edu). Information about university policies, reporting options, and support resources can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of any issues related to these policies regardless of when or where they occurred to ensure that individuals impacted receive information about their rights, support resources, and resolution options. To learn more about reporting and support options for a variety of concerns, visit Don't Ignore It.

## Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance.

## 5 Course in Brief

### 1. Part 1: Foundations

#### Learning Objectives

- Course introduction and overview; get to know your interests and backgrounds.
- Discuss the approach, ideas, and applications of network analysis
- Work through basics of network data collection and measurement; introduce R packages
- Discuss research design in the context of network analysis; (quickly) review helpful math

- (Quickly) start to develop your ideas and applications.

## 2. Part 2: Measures/Descriptives

### Learning Objectives

- Introduce commonly used measures that characterize networks on the whole (e.g., density)
- Introduce measures that characterize the positions of individual actors in networks (i.e., centrality)
- Understand the difference between and utility of different measures of centrality
- Gain a deeper understanding of modes and data formats; practice with R packages for network analysis

## 3. Part 3: Positions and (Sub-)Structures; Visualization

### Learning Objectives

- Think more thoroughly about ways to represent and partition networks
- Work through cliques, cores and components of networks; understand how these (and other) sub-structures are important to (subsequent) inferential techniques; better understand two-mode network analysis
- Discuss considerations in network visualization; practice with R packages

## 4. Part 4: Hypothesis Testing/Network Inference; Additional Considerations/Directions

### Learning Objectives

- Understand the challenges of hypothesis testing/inference in network settings
- Understand basic hypothesis tests—set-up and interpretation
- Introduce (and practice) QAP; introduce the logic and interpretation of ERGM modeling; introduce LS models
- Think through considerations when studying large networks
- practice with R packages

# 6 Detailed Course Outline

Note: In advance of each week's meeting, I will provide guidance on which readings should be examined carefully, which can be skimmed, which are recommended, etc.

- Week 1 (8/25): (Very Broad) Introduction; Syllabus and Course Materials; Your Research Interests
- Week 2 (9/1): Introduction to Network Analysis: Approach, Ideas and Applications
  - Robins, Ch.1,2
  - Scott, Ch. 1,2
  - Borgatti, et al. 2009. "Network Analysis in the Social Sciences." *Science* 323:892-895.
  - Hafner-Burton, E., M. Kahler and A.H. Montgomery. 2009. "Network Analysis for International Relations." *International Relations* 63(3): 559-592.

- Patty, J. and M. Penn. 2016. “Network Theory and Political Science.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
- Sokhey, A. and P. Djupe. “Interpersonal Networks and Democratic Practice.” *PS: Political Science and Politics*. 44(1):55-59.
- *Recommended*: Finifter, Ada. 1974. “The Friendship Group as a Protective Environment for Political Deviants.” *American Political Science Review*. 68(2): 607-625.
- *Recommended*: Granovetter, Mark. 1985. “Economic Action and Social Structure: The Problem of Embeddedness.” *American Journal of Sociology*. 91(3): 481-510.
- *Recommended*: Thurner, Paul W., 2010. “Political Network Analysis.” In *International Encyclopedia of Political Science*. CQ Press.
- Week 3 (9/8): Data Collection and Measurement, Introduction to R packages
  - Scott, Ch. 3
  - Gross, Justin, and J. Jansa. 2016. “Relational Concepts, Measurement, and Data Collection.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
  - Hafner-Burton and Montgomery. 2006. “Power Positions: International Organizations, Social Networks, and Conflict.” *Journal of Conflict Resolution*. 50(1): 3-27.
  - Huckfeldt and Sprague. 1987. “Networks in Context: The Social Flow of Political Information.” *American Political Science Review*. 81(4): 1197-1216.
  - Marsden, Peter. 2005. “Recent Developments in Network Measurement.” In Carrington et al., eds. *Models and Methods in Social Network Analysis*. New York: Cambridge. (handout)
  - *Recommended*: Marsden, Peter. 1990. “Network Data and Measurement.” *Annual Review of Sociology*. 16:435-463.
- Week 4 (9/15): No Class– annual meeting of the APSA
- Week 5 (9/22): Research Design, Essential Math Review, Your Brainstorming
  - Robins, Ch.3
  - Fagiolo, Giorgio. 2016. “The International Trade Network: Empirics and Modeling.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
  - Kinsella, D., and A. Montgomery. 2016. “Arms Supply and Proliferation Networks.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
  - Knoke, D. and T. Kostiuhenko. 2016. “Power Structures in Policy Networks.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
  - McClurg, S., C. Klofstad, and A.E. Sokhey. 2016. “Discussion Networks.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
  - Razo, A. 2016. “Bringing Networks into Comparative Politics.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
  - Ringe, N., J. Victor, and W. Tam Cho. 2016. “Legislative Networks.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
- Week 6 (9/29): Data Collection and Measurement Continued; Points, Lines, and Density
  - Robins, Ch. 4-5
  - Scott, Ch. 4-5

- Fowler, J. 2005. “Turnout in a Small World.” In *The Social Logic of Politics*. Alan Zucker-  
man, ed. 269-288. (To be distributed)
- Kossinets, Gueorgi. 2006. “Effects of Missing Data in Social Networks.” *Social Networks*.  
28(3): 247-268.
- Carpenter, R. Charli. 2007. ”Studying Issue (Non)-Adoption in Transnational Advocacy  
Networks.” *International Organization* 61(03):643-667.
- “lab”: data management
- Week 7 (10/6): Centrality
  - Scott, Ch. 6
  - Bonacich, Phillip. 1987. “Power and Centrality: A Family of Measures.” *American Journal  
of Sociology*. 92(5): 215-239.
  - Friedkin, Noah. 1991. “Theoretical Foundations for Centrality Measures.” *American Journal  
of Sociology*. 96(6): 1478-1504.
  - Hammerli, August, Regula Gattiker and Reto Weyermann. 2006. “Conflict and Cooperation  
in an Actors’ Network of Chechnya Based on Event Data.” *The Journal of Conflict Resolution*.  
50(2):159-175.
  - “lab”: basic descriptives and visualization
- Week 8 (10/13): Cliques, Cores, and Components of Networks
  - Scott, Ch. 7
  - Ansell, Parsons, and Darden. 2002. “Dual Networks in European Regional Development  
Policy.” *Journal of Common Market Studies*. 35(3): 347-375.
  - Burt, Ronald S. 1987. “Social Contagion and Innovation: Cohesion versus Structural Equiv-  
alence.” *American Journal of Sociology*. 81(4): 730-781.
  - Koger, Masket, and Noel. 2009. “Partisan Webs: Information Exchange and Party Net-  
works.” *British Journal of Political Science*. 39: 633-653.
  - Koger, Masket, and Noel. 2010. “Cooperative Party Factions in American Politics.” *Ameri-  
can Politics Research*. 38(1): 33-53.
  - Schneider, et al. 2003. “Building Consensual Institutions: Networks and the National Estuary  
Program.” *American Journal of Political Science*. 47(1): 143-158.
  - “lab”: more on descriptives and visualization
- Week 9 (10/20): Ties, Ties, Ties (and Review)
  - Carpenter, D., K. Esterling, and D. Lazer. 2003. “The Strength of Strong Ties: A Model of  
Contact-Making in Policy Networks with Evidence from U.S. Health Politics.” *Rationality  
and Society*. 15(4): 411-440.
  - Granovetter, M. 1973. “The Strength of Weak Ties.” *American Journal of Sociology*. 78(6):  
1360-1380.
  - Marsden, P. and K. Campbell. 1984. “Measuring Tie Strength.” *Social Forces*. 63(2): 482-501.
  - Roch, C., J. Scholz, and K. McGraw. 2000. “Social Networks and Citizens Response to Legal  
Change.” *American Journal of Political Science*. 44: 777-791.
  - Huckfeldt, Beck, Dalton, and Levine. 1995. “Political Environments, Cohesive Social Groups  
and the Communication of Public Opinion.” *American Journal of Political Science*. 39(4):  
1025-1054.
  - “lab”: other useful packages
- Week 10 (10/27): Positions/Structure
  - Scott, Ch.8

- Burt, R. 1995. *Structural Holes: The Social Structure of Competition*. Excerpt To be distributed.
- Carpenter, Esterling, and Lazer. 2004. “Friends, Brokers, and Transitivity: Who Informs Whom in Washington Politics?” *Journal of Politics*. 66(1): 224-246.
- Fowler, James. 2006. “Connecting the Congress: A Study of Co-sponsorship Networks.” *Political Analysis*. 14(4): 456-487.
- McCubbins, M., P. Ramamohan, and N. Weller. 2009. “Connected Coordination: Network Structure and Group Coordination.” *American Politics Research*. 37(5): 899-920.
- Week 11 (11/3): From Descriptives to Inference—Hypothesis Testing
  - Scott, Ch. 9
  - Robins, Ch.9
  - Cranmer et al. 2016. “Navigating the Range of Statistical Tools for Inferential Network Analysis.” *American Journal of Political Science*. 61(1): 237-51.
  - Cranmer, S. and B. Desmarais. 2010. “Inferential Network Analysis with Exponential Random Graph Models.” *Political Analysis*. 19(1): 66-86.
  - Robins, Pattison, Kalish, and Lusher. 2007. “An Introduction to Exponential Random Graph ( $p^*$ ) Models for Social Networks.” *Social Networks*. 29(2): 173-191.
  - Robins et al. 2007. “Recent Developments in Exponential Random Graph ( $p^*$ ) models for social networks.” *Social Networks*. 29(2): 192-215.
  - Lusher, Dean and Robert Ackland. 2010. “A Relational Hyperlink Analysis of an Online Social Movement.” *Journal of Social Structure* 11(1).
  - Rogowski, J. and B. Sinclair. 2016. “Causal Inference in Political Networks.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
- Week 12 (11/10): Network Inference (cont.); Visualization Options.
  - Robins, Ch. 8
  - Desmarais, B., and S. Cranmer. 2016. “Statistical Inference in Political Networks Research.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
  - Lazer et al. 2009. “The Co-evolution of Networks and Political Attitudes.” *Political Communication*. 27(3): 248-274.
  - Pfeffer, J. 2016. “Visualization of Political Networks.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
  - Suitor, J., B. Wellman, and D. Morgan. 1997. “It’s About Time: How, Why, and When Networks Change.” *Social Networks*. 19:1-7.
  - Snijders, T. 2001. “The Statistical Evaluation of Social Network Dynamics.” *Sociological Methodology*. 31: 361-395.
- Week 13 (11/17): Working with Large (and Complicated) Networks; Discussion of Additional Topics and Issues/Network Analysis in Political Science—New Directions
  - Robins, Ch.6-7
  - Bond et al. 2012. “A 61-Million-Person Experiment in Social Influence and Political Mobilization.” *Nature*. 489: 295-298.
  - Desmarais, B. and S. Cranmer. 2012. Statistical Inference for Valued-Edge Networks: The Generalized Exponential Random Graph Model. *PLoS ONE*. 7(1):1-12.
  - Desmarais, B. J. Harden, and F. Boehmke. 2015. “Persistent Policy Pathways: Inferring Diffusion Networks in the American States.” *American Political Science Review*. 109(2): 392-406.

- Hays, J., A. Kachi, and R. Franzese. 2010. “A Spatial Model Incorporating Dynamic, Endogenous Network Interdependence: A Political Science Application.” *Statistical Methodology*. 7(3): 406-428.
- Yang, S. and S. Gonzalez-Bailon. 2016. “Semantic Networks and Applications in Public Opinion Research.” In *The Oxford Handbook of Political Networks*. Jen Victor and Alex Montgomery, eds. Oxford. (available online)
- Week 14 (11/24): No Meeting – Fall Break
- Week 15 (12/1): Final Project Presentations
- Week 16 (12/8): Final Project Presentations
  - Final Project Due: 12/12/22, by 5:00 p.m.

*New knowledge is the most valuable commodity on earth. The more truth we have to work with, the richer we become.*

—Kurt Vonnegut, *Breakfast of Champions*