POS 6729 - Political Network Analysis

Section: 0001

College of Sciences

School of Politics, Security, and Intl Affairs

Course Information

Term: Spring 2025
Class Meeting Days: W
Class Meeting Time: 06:00PM - 08:50PM
Class Meeting Location: NSC O103
Modality: P
Credit Hours: 3.00

Instructor Information

Jacopo Baggio
Title: Associate Professor
Office Location: Howard Phillpis Hall (HPH) rm 302 (ask the front desk)
Office Hours:
Wednesday from 15 - 16.30 (3pm to 4.30pm)
Email: Jacopo.Baggio@ucf.edu

Course Description

POS 6729 COS-POLS 3(3, 0)Political Network Analysis: PR: Graduate status or consent of instructor Introduces concepts, analytic metrics and methods, and empirical applications in political network analysis. Occasional

The world is becoming increasingly complex and interlinked due to globalization and the advancements of technologies. In the last two decades, network science has gained traction and hasbeen used to describe a wide variety of different phenomena in life and social sciences. In fact, it is well documented that structural properties of networks influence behaviors and outcomes in a wide range of systems: from social networks to food webs, from landscapes to power grids, from the internet to political and policy networks, not to mention epidemics and vaccines interactions, strategies and ideas, coalitions and teams.

Network theory dates its conceptual origins back to the 1730s thanks to Euler (1736); but the startingpoint of modern graph theory is considered to be the work of two Hungarian mathematicians onrandom graphs: Erdos and Reny in 1959 and 1960.

This course is an introduction to network theory. The course will focus on introducing concepts, metrics and applications in network analysis with a focus on policy networks, collaborations andinterdependent systems. The course will also provide students with the ability to devise their ownnetwork survey, collect data, and to do their own network analysis in Python, via the NetworkX package. The course is thus divided into a general lecture in which concepts and metrics are explained to students via standard lecture format, and a technical lecture in which students will familiarize themselves with the analysis of Networks via NetworkX. The course will also include introductory lectures on how to write a script. This latter is an important transferable skill as scripts are used in many programs used in today world and academic environments: from SPSS, to STATA, from Matlab to R. The topics covered will be the following:

- **General concepts**: Networks, classes of networks, network metrics, exponential random graph models, multiplex networks, diffusion on networks. Applying network theoretical tools for the analysis of policyand political networks aswell as integrated social-ecological networks.
- **Technical skills**: Survey instrument for devising networks; Python Network X package
- **Optional skills (to be discussed with the instructor)**: Integrating Networks and computational modelling, using R (sna, igraph, and ergm packages are great).

To facilitate learning, the course is divided into four main blocks:

1. The first block of the course will introduce what are networks, different network classes and the most common network metrics used to analyze networks.
2. The second block of the course will focus on (best) practices to collect data for network analysis,and application of network analysis to real world problems.
3. The third block will focus on advanced network topics (exponential random graph models and multiplex networks).
4. The final block of the course will be centered on group and individual final projects. We will work inclass on defining meaningful research questions related to network analysis, how to gather relevant network data, analyze networks and interpret the results. Optional topics can be discussed with the instructor and addressed in this third block.

Student Learning Outcomes

After successful completion of this course, students will be able to:

- Define and understand key concepts in network science:
  - What are networks, what are nodes and edges
  - Assess and understand the contextual meaning of key network metrics such as degree centrality, clustering, betweenness centrality, closeness, eigenvector centrality, average shortest path length etc..
  - Network Classes: what characterizes scale free, small world and random networks.
- Use of Python to analyze networks
  - Basic python usage
  - NetworkX package
- Writing a research paper focused on networks, and thus how to apply theory and methods learned to interpret and analyze problems in their are a of interest

Course Materials and Resources

The Atlas for the Aspiring Network Scientist
Authors: Michele Coscia
Notes: This is one of the papers, books and book chapter that do not refer to a specific weekly topic but are useful summary reports on network science.
Online Access: https://www.networkatlas.eu/files/sna_book.pdf

Boccaletti, S., Latora, V., Moreno, Y., Chavez, M., & Hwang, D.-H. (2006). Complex networks: Structure and dynamics. Physics Reports, 424(4-5), 175-308.
Notes: This is one of the papers, books and book chapter that do not refer to a specific weekly topic but are useful summary reports on network science.

da Fontoura Costa, L., Rodrigues, F. A., Travieso, G., & Villas Boas, P. R. (2007). Characterization of complex networks : A survey of measurements. Advances in Physics, 56(1-2), 167-242
Notes: This is one of the papers, books and book chapter that do not refer to a specific weekly topic but are useful summary reports on network science.

Newman, M. E. J. (2003). The structure and function of complex networks. SIAM review, 45(2), 167-256.
Notes: This is one of the papers, books and book chapter that do not refer to a specific weekly topic but are useful summary reports on network science.

Network Science
Authors: Albert-Lazlo Barabasi
Notes: This is one of the papers, books and book chapter that do not refer to a specific weekly topic but are useful summary reports on network science.
Online Access: https://networksciencebook.com

Albert, R., & Barabási, A.-L. (2002). Statistical mechanics of complex networks. Reviews of Modern Physics, 74(1), 47-97
Notes: This is one of the papers, books and book chapter that do not refer to a specific weekly topic but are useful summary reports on network science.

Course Assessment and Grading Procedure

Requirements

To successfully complete this class you need access to a pc or laptop and the following software:

- Microsoft Office Excel or equivalent Microsoft Office Word or equivalent
- Microsoft Office Power Point or equivalent PDF Reader
- Python 3 (Anaconda distribution makes it easier to install packages and it comes with the main Python packages already installed. You can find Conda(Anaconda) here: https://conda.io/docs/index.html (https://conda.io/docs/index.html)) or Google Colaboratory or Jupyter Notebooks.

For Students interested in optional topics, software targeted to student interest is recommended (i.e.computational modelling software such as NetLogo).

Own research topics are welcome, but not required. If you have a specific research topic you want towork on, final and mid-term projects will be centered on your own research topic.

- # Expectations

  It is expected that students come prepared to lectures. This means that students are expected to have **read** the material provided ***prior*** the class. The papers and book chapter in **BOLD are mandatory**, but it is **expected**that students will engage with **all the material provided**. The course isdesigned as follows (but subject to modification depending on class educational needs), each class isdivided into a general and a technical lecture/exercises.

  - *General lecture*: will be based on basic concepts for the week topic and discussion of the readings assigned

  - *Technical lecture*: will be centered upon increasing skills and ability in collecting and analyzing network data.

  Typical Class Format

Although class may follow the format described below, the format is not fixed and will depend on the educational needs of the class and the number of students.

General lecture:

- If there is a discussion paper:
  - Discussion Leads for the assigned reading – 10 minutes Discussion on the assigned reading – 10 minute
  - Discussion of the readings and summary of the discussion – 25 or more minute
  - Point raised that needs clarification, q&a, "traditional lecture" – remaining time

- If the format is a standard lecture:
  - Standard lecture on the weekly topic
  - Q & A (during the lecture and after, please feel free to interrupt at anytime).

Remember: the more you are engaged, the more you will learn and the more fun the class can be!

Technical Lecture:

- Revising and discuss previous exercises and concepts
- Exercises in class (this will be varied)

Assignments

For Essay type assignments you are asked to use word processing that your instructor can access.Therefore, preferably use Word, pdf, or plain text files. If you use software that is different and youmay not sure whether it will be accessible by your instructor, contact Dr. Baggio. Files that cannot be opened will not be graded. The total available is 110%.

Assignments deadline:

DiscussionAssessment: See due-

dates on calendar Technical

Assessment: See due-dates on

calendar

Continuous Evaluation

Discussion Assessment: Discussion Leads (20 points)

During block 2 of this course and relating only to application of network analysis papers (dependingon enrollment) one course participants will need to read and discuss a peer-reviewed article. Each discussion lead will have 3 main tasks – (all have to participate in the discussion as all receive pointsfor participation)

- Critically assess the validity of the paper assigned. You can use a power point or not. You are encouraged to search for critiques/validation of the paper assigned. If you have doubts or do notknow how to proceed you can organize a meeting with me and I will provide guidelines for critiquing the paper assigned.
- If the class does not discuss the paper, randomly someone will be chosen to lead the discussion on limitations strengths of the paper assigned.
- Each participation is evaluated each week. If you do not participate you will get 0 points for a specific week.

Technical Assessment: Exercises take-home assignments (20 points)

Each week all students will be expected to complete the assignments given. Assignments vary. For example, take-home assignments can be related to simple “script language questions” (i.e. build an if-then statement or a for loop statement), network analysis questions, loading network data into python.Other technical assignment can relate to how to gather network data, potential biases in networkdatasets etc…

Final Project

Project Presentation (15 points) – open to faculty and other students.

- The project presentations can be done individually or in groups. Presentation cannot be longer than 15 minutes (and they will be timed, going over time will result in a penalization in points)
- If in groups, all the names of all the group members have to be reported by each individual.
- Each individual will have to present part of the project to receive a grade.
- If an individual part of a group does not actually present, s/he will receive 0 points for this assignment.
- A group can be of no more than 4

Final Project Paper (45 points)

The final project is due the lastweek of class

- The final project can be discussed with me at any time during the course. If you have your own topic, we will work on that, if not, you can choose any topic covered during the course or you will be assigned one.
- The final project will be submitted to turn-it-in to check for plagiarism will be checked for use of AI.
- The final project has to showcase your technical skills. It has to involve an in-depth analysis of a topic of yourchoices centered upon network analysis.
- The final project can be done individually or in groups. If in groups, all the names of all the groupmember have to be reported by each individual.
- Contribution of each member should be stated, if not all members will be assumed to have participated equally.
- Groups can be of no more than 4

- **You are not allowed to quote other papers, you must paraphrase and summarize the literature.**
- Your final project must consist of a thoughtful analysis on a topic of your choice
- You can choose to analyze and critique an existing paper that uses network analysis and try to replicate their results.
- The final essay should contain a brief literature review on the topic you are working on, description of the analysis and why you are using specific network metrics), results, limitations, discussion and conclusion.
- You need to cite at least 5peer review articles that deal with the topic of your choice.
- APA style is required as well as proper citation.
- **The essay must be at least 2000 words, not to exceed 3500 words.**

Summary of impact of the different assignment on your final grade:

- Continuous Learning
  - Discussion 20 points
  - Take-Home Assignments 20 points
- Final Evaluation
  - Project Presentation 15 points
  - Final Project Paper 45 points

Assignment Schedule

Due Date	Assignment Name	Assignment Type	Points
1/10/25	1st Week Engagement Quiz	Quiz	1
1/14/25	Technical 0	Assignment	4

Due Date	Assignment Name	Assignment Type	Points
1/21/25	Technical Exercises 1	Assignment	4
2/4/25	Technical Exercise 2	Assignment	4
2/18/25	Technical 3	Assignment	4
2/19/25	Discussion 1	Assignment	5
2/26/25	Discussion 2	Assignment	5
3/5/25	Discussion 3	Assignment	5
3/12/25	Discussion 4	Assignment	5
4/6/25	Technical 4	Assignment	4
4/16/25	Final Presentation	Assignment	15
4/20/25	Final Project	Assignment	45

Grading Scale

Letter Grade	Percentage
A	90-100
B	80-90
C	70-80
D	60-70
F	< 60

Policies for Course Grade

Makeup Work Policy

Work not submitted will be given 0 points. For the discussion if you are not present but you contributed to your group (and your group agrees with your contributions) you will

receive the same points as your group-mates. If you do not contribute you will be assigned 0 points. Generally no make up work will be allowed.

Missed/Late Assignments

- **Continuous Evaluation:**
  - Technical assignments:
    - Late assignments are penalized 1 point each 3 hours late. (after 9hrs, 0 points are awarded).
  - Discussion:
    - If you do not participate in the weekly discussion you will be assigned 0 points.
- **Final Project**: Late assignment will be evaluated with 0 points.

Attendance

Attendance is required in order to receive grades for the discussions (continuous evaluation) and the final presentation.

Note that only medical (WITH doctor's note) late assignments can be accepted, unless otherwise stated by the university policies.

Course Accessibility

The University of Central Florida is committed to providing access and inclusion for all persons with disabilities. Students with disabilities who need access to course content due to course design limitations should contact the professor as soon as possible. Students should also connect with Student Accessibility Services (SAS) (Ferrell Commons 185, sas@ucf.edu, phone 407-823-2371). For students connected with SAS, a Course Accessibility Letter may be created and sent to professors, which informs faculty of potential course access and accommodations that might be necessary and reasonable. Determining reasonable access and accommodations requires consideration of the course design, course learning objectives and the individual academic and course barriers experienced by the student. Further conversation with SAS, faculty and the student may be warranted to ensure an accessible course experience.

Academic Integrity

Students should familiarize themselves with UCF's Code of Conduct at Student Conduct and Integrity Office. According to Section 1, "Academic Misconduct," students are prohibited from engaging in:

a. Academic misconduct is defined as any submitted work or behavior that obstructs the instructor of record's ability to accurately assess the student's understanding or completion of the course materials or degree requirements (e.g., assignment, quiz, and/or exam). Examples of academic misconduct include but are not limited to: plagiarism, unauthorized assistance to complete an academic exercise; unauthorized communication with others during an examination, course assignment, or project; falsifying or misrepresenting academic work; providing misleading information to create a personal advantage to complete course/degree requirements; or multiple submission(s) of academic work without permission of the instructor of record.
b. Any student who knowingly helps another violate academic behavior standards is also in violation of the standards.
c. Commercial Use of Academic Material. Selling of course material to another person and/or uploading course material to a third-party vendor without authorization or without the express written permission of the University and the instructor of record. Course materials include but are not limited to class notes, the instructor of record's slide deck, tests, quizzes, labs, instruction sheets, homework, study guides, and handouts.
d. Soliciting assistance with academic coursework and/or degree requirements. The solicitation of assistance with an assignment, lab, quiz, test, paper, etc., without authorization of the instructor of record or designee is prohibited. This includes but is not limited to asking for answers to a quiz, trading answers, or offering to pay another to complete an assignment. It is considered Academic Misconduct to solicit assistance with academic coursework and/or degree requirements, even if the solicitation did not yield actual assistance (for example, if there was no response to the solicitation).

Responses to Academic Dishonesty, Plagiarism, or Cheating

Students should also familiarize themselves with the procedures for academic misconduct in UCF's student handbook, *The Golden Rule*. UCF faculty members have a responsibility for students' education and the value of a UCF degree, and so seek to

prevent unethical behavior and respond to academic misconduct when necessary. Penalties for violating rules, policies, and instructions within this course can range from a zero on the exercise to an “F” letter grade in the course. In addition, an Academic Misconduct report could be filed with the Office of Student Conduct and Academic Integrity, which could lead to disciplinary warning, disciplinary probation, or deferred suspension or separation from the University through suspension, dismissal, or expulsion with the addition of a “Z” designation on one’s transcript.

Being found in violation of academic conduct standards could result in a student having to disclose such behavior on a graduate school application, being removed from a leadership position within a student organization, the recipient of scholarships, participation in University activities such as study abroad, internships, etc.

Let’s avoid all of this by demonstrating values of honesty, trust, and integrity. No grade is worth compromising your integrity and moving your moral compass. Stay true to doing the right thing: take the zero, not a shortcut.

Title IX

Title IX prohibits sex discrimination, including sexual misconduct, sexual violence, sexual harassment, and retaliation. If you or someone you know has been harassed or assaulted, you can find resources available to support the victim, including confidential resources and information concerning reporting options at Let's Be Clear and UCF Cares.

For more information on diversity and inclusion, Title IX, accessibility, or UCF’s complaint processes contact:

- Title IX – OIE – Office of Institutional Equity & askanadvocate@ucf.edu
- Disability Accommodation – Student Accessibility Services – Student Accessibility Services & sas@ucf.edu
- Access and Community Engagement (including the Ginsberg Center for Inclusion and Community Engagement, Military and Veteran Student Success, and HSI Initiatives)
- UCF Compliance and Ethics Office – Compliance, Ethics, and Risk Office & complianceandethics@ucf.edu

- The Ombuds Office is a safe place to discuss concerns.

Reporting an Incident or Issue

If you believe you have experienced abusive or discriminatory behavior by any faculty or staff member, contact the Office of Institutional Equity online or at 407-823-1336. You can also choose to report using the UCF Integrity Line and can report anonymously or as yourself at 1-855-877-6049 or using the online form. UCF cares about you and takes every report seriously. For more information see the Reporting an Incident or Issue Webpage.

Deployed Active-Duty Military Students

Students who are deployed active duty military and/or National Guard personnel and require accommodation should contact their instructors as soon as possible after the semester begins and/or after they receive notification of deployment to make related arrangements.

Campus Safety

At UCF Public Safety and Police, safety is the top priority. Emergencies on campus are rare, but if one should arise, it's important to be familiar with some basic safety and security concepts.

- In an emergency, always dial 911.
- Every UCF classroom has an **Emergency Procedure Guide** posted on a wall near the door, which will show you how to respond to a variety of situations. This guide can also be found online here.
- In the event of an active threat, remember **AVOID, DENY, DEFEND**. Choose the best course of action and act immediately. Watch the video here to learn more.
    - **AVOID**. Pay attention to your surroundings and have an exit plan. Get as much distance and as many barriers between you and the threat as quickly as possible.

    - **DENY.** When avoiding is difficult or impossible, deny the threat access to you and your space. Lockdown by creating barriers, turning the lights off and remaining quiet and out of sight. Make sure your cell phone is silenced, but do not turn it off.
    - **DEFEND.** When you are unable to put distance between yourself and the threat, be prepared to protect yourself. Commit to your actions, be aggressive and do not fight fairly. Do whatever it takes to survive.
- For emergencies on campus, UCF will utilize the UCF Alert system. All UCF students, faculty and staff are automatically enrolled to receive these email and text alerts, however, it's a good idea to frequently ensure your contact information is up to date.

Financial Aid Accountability

All instructors/faculty are required to document students' academic activity at the beginning of each course. In order to document that you began this course, please complete this activity by the end of the first week of classes or as soon as possible after adding the course. Failure to do so may result in a delay in the disbursement of your financial aid.

Class Schedule

This course schedule as well as the syllabus can change depending on class educational needs. Some topics / skills may require more time than envisioned and in such cases the course schedule will be adjusted. All assignments will be uploaded into Canvas. The course is divided in three main blocks

BLOCK1: Introducing Networks, Network Classes and Network Metrics

Week 1:

Introduction to the course. What we will do, what is expected, what are the aims and objectives and the philosophy behind the teaching of this course. Introduction to Networks and the story behind them.

Technical: Introducing Python: how to install python and python packages, what is python, what are the basics concept of scripting in python?

Readings:

- Barabasi Book Ch 1 and 2.1, 2.2, 2.4, 2.5 and 2.6
- Borgatti S., Mehra, A., Brass, D.J., Labianca, G. (2009).Network Analysis in the Social Sciences, Science 323, 892-895.
- Watts, D. J. (2004). The "New" Science of Networks. Annual Review of Sociology, 30, 243-270.
- Amaral, L. A. N., & Ottino, J. M. (2004). Complex networks: Augmenting the framework for the study of complex systems The European Physical Journal B, 34(2), 147-162.
- Granovetter (1973): The Strength of Weak Ties, American Journal of Sociology 78 , pp. 1360- 1380

Week 2:

General: Network Metrics: Centrality, distance and clustering: the most common network metrics used, and how can we interpret them?

Technical: Basics of Python programming: How to write simple statements in python.

Practice: Write simple statements in Python

Readings:

- Barabasi Book Section 2.3, 2.8, 2.9 and 2.10
- Everett M, Borgatti SP (2005) Extending centrality. Models and Methods in Social Network Analysis, eds Carrington P, Scott J, Wasserman S (Cambridge Univ Press, Cambridge, UK), pp 57–76.
- Bonacich, Phillip. (1987). Power and centrality: A family of measures.American Journalof Sociology:1170–82.
- Börner, K., Sanyal, S., & Vespignani, A. (2007). Network Science. In B. Cronin (Ed.), Annual Review of Information Science & Technology (Vol. 41, pp. 537-607). Medford, NJ: Information Today, Inc./American Society for Information Science and Technology.

- da Fontoura Costa, L., Rodrigues, F. A., Travieso, G., & Villas Boas, P. R. (2007). Characterization of complex networks : A survey of measurements. Advances in Physics, 56(1-2), 167-242 -> Read part 1, 2, 3, 4, 5, 6, and 9
- Freeman, L. C. (1978). Centrality in social networks conceptual clarification. Social networks, 1(3), 215-239.

Week 3:

General: Network Metrics II: Communities, page rank, eigenvector: other important network metrics and their interpretation.

Technical: Basics of Python 2: logic of programming: if-then-else statements

Practice: Exercises on if-then else statements

Readings:

- Barabasi Book Ch 7 (up to section 7.7), Ch 9 (up to section 9.7)
- da Fontoura Costa, L., Rodrigues, F. A., Travieso, G., & Villas Boas, P. R. (2007). Characterization of complex networks : A survey of measurements. Advances in Physics, 56(1-2), 167-242 -> Read part7,10,11,12
- Latora, V., & Marchiori, M. (2001). Efficient Behavior of Small-World Networks. Physical Review Letters, 87(19), 198701-198701 198701-198704.
- Newman, M. E. J. (2002). Assortative Mixing in Networks. Physical Review Letters, 89(20), 208701.208701-208701.208704.
- Newman, M. E. (2006). Modularity and community structure in networks. Proceedings of the national academy of sciences, 103(23), 8577-8582.
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Week 4:

General: Network Classes: What are network classes? Why are the important?

Technical: Basics of Python 3: logic of programming: for and while loops

Practice: Exercises on for and while loops

Readings:

- Barabasi Section 3.1, 3.2, 3.3, 3.4, 3.5 and 4.1, 4.2, 4.3, 4.4
- Barabási, A.-L., & Albert, R. (1999). Emergence of Scaling in Random Networks.

- Science, 286(5439), 509-512.
- Barabasi, A.L. and Bonabeau, E. (2003) Scale-free networks. Scientific American, 50- 59.
- Watts, D. J., & Strogatz, S. H. (1998). Collective dynamics of 'small-world' networks. Nature, 393 (6684), 440-442.
- Watts, D. J. (1999). Networks, dynamics, and the small-world phenomenon. American Journal of sociology, 105(2), 493-527.
- Albert, R., Jeong, H., & Barabási, A.-L. (2000). Error and attack tolerance of complex networks. Nature, 406(6794), 378-382.

BLOCK2: Gathering Network Data and Network Applications

Week 5:

General: Collecting Network data: how we gather network data? What are the different techniques that we can use? What are the typical questions you would like to ask if using survey

Discussion: Each “lead” will discuss one paper chosen from the ones below

Technical: NetworkX: Upload your own data in NetworkX

Practice: upload data in specific formats (dataset will be provided) in NetworkX

Readings (on applications)

- Costa, L. D. F., Oliveira Jr, O. N., Travieso, G., Rodrigues, F. A., Villas Boas, P. R., Antiqueira, L., ... & Correa Rocha, L. E. (2011). Analyzing and modeling real-world phenomena with complex networks: a survey of applications.Advances in Physics, 60(3), 329-412.
- Padgett, J. F., Ansell, C.K., (1993). Robust action and the rise of the medici 1400-1434 The
- American Journal of Sociology, 98, 1259-1319.
- Pitts, F.R., (1979). The medieval trade network of Russia revisited. Social Networks, 1, 285- 292.
- Yousefi Nooraie, R., Sale, J. E. M., Marin, A., & Ross, L. E. (2020). Social Network Analysis: An Example of Fusion Between Quantitative and Qualitative

Methods. Journal of Mixed Methods Research, 14(1), 110–124.

- Schiffer, E., & Hauck, J. (2010). Net-map: Collecting social network data and facilitating network learning through participatory influence network mapping. Field Methods, 22(3), 231– 249.

Week 6:

General: Political Science and Networks

Discussion: Each “lead” will discuss one paper chosen from the ones below.

Technical: NetworkX 2: Analyzing networks!

Practice: Analyze the networks uploaded last week and interpret the results.

Readings (on applications)

- Porter, M.A. et al. 2007. Community Structure in the United States House of Representatives. Physica A. 386(1): 414-438.
- Cranmer, S. J., Desmarais, B. A., Kirkland J.H., (2012). Toward a Network Theory of Alliance Formation. International Interactions 38:295-324.
- Saunders, C., (2007). Using Social Network Analysis to Explore Social Movements: A Relational Approach. Social Movement Studies 6:227-243.
- Krackhardt, D. (1990). Assessing the political landscape: Structure, cognition, and power in organizations. Administrative science quarterly, 342-369.
- Berardo, R., Fischer, M., & Hamilton, M. (2020). Collaborative Governance and the Challenges of Network-Based Research. The American review of public administration, 50(8), 898-913.
- Ulibarri, N., & Scott, T. A. (2016). Linking Network Structure to Collaborative Governance. Journal of Public Administration Research and Theory, muw041.

Week 7:

General: Policy networks

Discussion: Each “lead” will discuss one paper chosen from the ones below.

Technical: Using NetworkX to analyze multiple networks.

Readings:

- Ward, Michael D., Katherine Stovel, and Audrey Sacks. 2011. Network Analysis and Political Science. Annual Review of Political Science 14:245-64.
- Mewhirter, J., & Berardo, R. (2019). The impact of forum interdependence and network structure on actor performance in complex governance systems. Policy Studies Journal, 47(1), 159-177.
- Lubell, M., Scholz, J., Berardo, R., & Robins, G. (2012). Testing policy theory with statistical models of networks.Policy Studies Journal, 40(3), 351-374.
- Berardo, R., & Scholz, J. T. (2010). Self-organizing policy networks: risk, partner selection, and cooperation in estuaries.American Journal of Political Science, 54(3), 632-649.
- Sandström, A., & Carlsson, L. (2008). The performance of policy networks: The relation between network structure and network performance. Policy Studies Journal, 36(4), 497–524.
- Schoon, M., York, A., Sullivan, A., Baggio, J., 2017. The emergence of an environmental governance network: the case of the Arizona borderlands. Reg. Environ. Chang. 17, 677–689.

Week 8:

General: Network analysis in natural resource management.
Discussion: Each “lead” will discuss one paper chosen from the ones below.
Technical: Summary: a recap of what we have learned so far.
Readings:

- Janssen, M. A., Bodin, Ö., Anderies, J. M., Elmqvist, T., Ernstson, H., McAllister, R. R. J., Olsson, P.,Ryan, P. (2006). Toward a Network Perspective of the Study of Resilience in Social-Ecological Systems. Ecology and Society, 11(1), 15.
- Bodin, Ö., García, M. M., & Robins, G. (2020). Reconciling Conflict and Cooperation in Environmental Governance: A Social Network Perspective. Annual Review of Environment and Resources, 45(1), 1–25.
- Bodin, Ö., Alexander, S. M., Baggio, J., Barnes, M. L., Berardo, R., Cumming, G. S., ... & Guerrero, A. M. (2019). Improving network approaches to the study of complex social–ecological interdependencies. Nature Sustainability, 2(7), 551-559.

- Prell, C., Hubacek, K., & Reed, M. (2009). Stakeholder analysis and social network analysis in natural resource management.Society and Natural Resources, 22(6), 501-518.
- Bodin, Ö. (2017). Collaborative environmental governance: Achieving collective action in social- ecological systems. Science, 357(6352), eaan1114.
- Sayles, J. S., & Baggio, J. A. (2017a). Who collaborates and why: Assessment and diagnostic of governance network integration for salmon restoration in Puget Sound, USA. Journal of environmental management, 186, 64-78.
- Sayles, J. S., & Baggio, J. A. (2017b). Social–ecological network analysis of scale mismatches in estuary watershed restoration. Proceedings of the National Academy of Sciences, 114(10), E1776-E1785.

Week 9:

General: Spreading on networks: What is the relationship between spreading of phenomena and the underlying network?

Discussion: Each “lead” will discuss one paper chosen from the ones below

Technical: Networks and Diffusion in Python: How to assess the relationship between network properties (metrics) and diffusion (or spreading) of ideas, strategies, epidemics, policies etc...

Readings:

- Barabasi Book Ch 10 (up to 10.7)
- Centola, Damon. (2010). The Spread of Behavior in an Online Social Network Experiment.
- Science329: 1194-1197.
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- Shalizi, Cosma Rohilla and Andrew C. Thomas. 2011. Homophily and Contagion Are Generically Confounded in Observational Social Network Studies. Sociological Methods & Research 40(2): 211–239.
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- Baggio, J. A., & Hillis, V. (2018). Managing ecological disturbances: Learning and the structure of social-ecological networks. Environmental Modelling & Software, 109, 32-40.
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- Stauffer, D., Sousa, A. O., & Schulze, C. (2003). Discretized opinion dynamics of Deffuant on scale-free networks. Journal of Artificial Societies and Social Simulation, 7(3), 21.
- Brummitt, C. D., D'Souza, R. M., & Leicht, E. A. (2012). Suppressing cascades of load in interdependent networks. Proceedings of the National Academy of Sciences of the United States of America, 109(12), E680-9.

BLOCK 3: Advanced Topics in Network Science

Week 10:

General: Exponential Random Graph Models

Technical: ERGM analysis in Python, using user-written ergm package.

Practice: analyze the dataset provided and interpret the results using the ERGM user-written package in Python (need to re-test if it still works correctly with the last version)

Readings:

- Robins, G., Pattison, P., Kalish, Y., & Lusher, D. (2007). An introduction to exponential random graph (p*) models for social networks. Social networks, 29(2), 173-191.
- Robins, G., Lewis, J. M., & Wang, P. (2012). Statistical network analysis for analyzing policy networks. Policy Studies Journal, 40(3), 375-401.
- Gerber, E. R., Henry, A. D., & Lubell, M. (2013). Political homophily and collaboration in regional planning networks.American Journal of Political Science, 57(3), 598-610.

- Barnes, M., Bodin, Ö., Guerrero, A., McAllister, R., Alexander, S., & Robins, G. (2017). The social structural foundations of adaptation and transformation in social–ecological systems. Ecology and Society, 22(4).
- Barnes, M. L., Wang, P., Cinner, J. E., Graham, N. A., Guerrero, A. M., Jasny, L., ... & Zamborain-Mason, J. (2020). Social determinants of adaptive and transformative responses to climate change. Nature Climate Change, 10(9), 823-828.
- Bodin, Ö., & Tengö, M. (2012). Disentangling intangible social–ecological

systems. Global Environmental Change, 22(2), 430-439.

Week 11:

General: Multiplex Networks

Technical: Analysis of multiplex networks in Python: using Pymnet.

Practice: Analyze and interpret the results of the dataset provided using Pymnet**.**

Readings:

- Baggio, J. A., BurnSilver, S. B., Arenas, A., Magdanz, J. S., Kofinas, G. P., & De Domenico,
- M. (2016). Multiplex social ecological network analysis reveals how social changes affect community robustness more than resource depletion. Proceedings of the National Academy of Sciences, 113(48), 13708-13713.
- Buldyrev, S. V., Parshani, R., Paul, G., Stanley, H. E., & Havlin, S. (2010). Catastrophic cascade of failures in interdependent networks. Nature, 464, 1025-1028.
- Mucha, P. J., Richardson, T., Macon, K., Porter, M. A., & Onnela, J. P. (2010). Community structure in time-dependent, multiscale, and multiplex networks. science, 328(5980), 876- 878.
- De Domenico, M., Solé-Ribalta, A., Cozzo, E., Kivelä, M., Moreno, Y., Porter, M. A., ... & Arenas,
- (2013). Mathematical formulation of multilayer networks. Physical Review X, 3(4), 041022. Kivelä, M., Arenas, A.,

- Barthelemy, M., Gleeson, J. P., Moreno, Y., & Porter, M. A. (2014). Multilayer networks. Journal of complex networks, 2(3), 203-271.

BLOCK 4: Individual/Group projects and optional skills to be developed

Week 12:

Group Project, Discussing research questions and assumptions.

Week 13:

Group Project, Discussing data needs and analysis.

Week 14:

Group Project, Discussing preliminary findings

Week 15:

Presenting your Project