GESIS Fall Seminar in Computational Social Science 2021

Syllabus for week 3:
"Social Network Analysis"

Lecturers:	Dr. Silvia Fierăscu	Ianis Rușitoru
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Date: September 27-October 1, 2021
Time:
- 09:00 - 11:15 (2h of live sessions)
- 11:45 - 13:15 (1.5h on demand one-on-one consultations)
- around 1.5h of pre-recorded lectures and software tutorials sent one day in advance of each topic

About the Lecturers:

Dr. Silvia Fierăscu is Lecturer at the Faculty of Political Science, Philosophy and Communication Sciences and Researcher at the Big Data Science Laboratory at West University of Timișoara, Romania. She holds a PhD in Political Science with a specialization in Network Science from Central European University. Her research interests are on applications of network and data science across sectors. Dr. Fierăscu works in various international, intersectoral and interdisciplinary projects, translating complex problems into solutions for institutional development, public communication, good governance, public policy, and civil society mobilization.

Ianis Rușitoru is a Digital Media undergraduate student at Faculty of Political Science, Philosophy and Communication Sciences at West University of Timișoara, Romania. He is enthusiastic about R programming, Social Network Analysis, Chess and Lovecraftian Horror. Ianis wants to pursue a career in applied Computational Social Science, he is passionate about research topics such as Big Data and Organizational Network Analysis.

Course Description:

Social Network Analysis has become an integral part of a Computational Social Scientist training. The methodological toolkit is powerful, because it is strongly rooted in interdisciplinary theory, techniques, measurements, and interpretations. It is thus suitable for either independent explorations of data and research questions (from small to large-N cases), as well as in mixed-methods research designs, complementing both qualitative and quantitative methodologies. In this class, participants learn the fundamentals of social network theory, methods and techniques, and their application to diverse sets of research problems. We cover topics such as: (1) what it means to work with network data and how to do data collection (from various sources), (2) analysis of networks at the macro-level (network structures), meso-level (network groups and communities), and micro-level (network positions of individual nodes), and (3) hypothesis testing and causal analysis. By the end of the class, participants will be autonomous in conducting Social Network Analysis to better understand the emergence, change and dissolution of social networks, mechanisms at work in complex networks, and principles of network design in organizations, social movements, and communication flows. We will work in the software R, and participants are encouraged to bring their own dataset for a comprehensive analysis during the course.

Keywords:

Social Network Analysis, empirical research, mixed methods, applied research methods, interdisciplinary, R

Course Prerequisites:

No prerequisites are necessary for taking this course. Social Network Analysis is compatible with both qualitative and quantitative methodologies, and it can add value to both less as well as more advanced research projects, in academia or practice.

Participants are encouraged to bring and use their own research data into the class. If one does not yet have such a dataset, we will provide exercise datasets, as close as possible to the field of interest of participants.

Target Group:

Participants will find the course useful if:
- They want to apply Social Network Analysis as a comprehensive research methodology in their projects or if they would like to combine SNA with complementary methodologies, such as process tracing, interviews, statistical analysis, etc.
- They need to find an integrative perspective for different levels of analysis
- They are interested in theorizing, analyzing and visualizing complex interaction ecosystems in any social scientific field (people, organizations, countries, regions, tasks, beliefs, actions, events, etc.).

Course and Learning Objectives:

By the end of the course participants will:
- Understand the theoretical, conceptual and methodological foundations of Social Network Analysis and its application across social scientific fields
- Conduct independent exploratory analyses and visualizations of complex network data
- Identify opportunities and limitations in research design and empirical analyses of networked phenomena

Organisational Structure of the Course:

- around 1.5h of pre-recorded lectures and software tutorials prior to each day of the course
- 2h of live sessions daily
- 1.5h allocated time from instructors for on demand one-on-one consultations

Software requirements:

During this course, we focus primarily on using RStudio for statistical programming of network analysis. Participants are thus kindly asked to download and install the latest versions of RStudio and R on their local machines prior to the start of the class. We encourage participants to also install the latest version of Gephi, a point-and-click social network analysis software, for large graph visualizations.

If using a university laptop/computer, please consult with your local IT team for possible permissions to install new software.

Long Course Description:

Social Network Analysis is a comprehensive research tool kit, with strong interdisciplinary theoretical background, cutting edge analytic methods and techniques, intuitive interpretation of results, and actionable insights. It is thus suited for analyses of complex interdependent systems, to bridge between otherwise disparate streams of knowledge, and in addressing complex research problems in any sector - government, business, academia or civil society.

SNA can help answer questions such as: what kinds of interactions matter for my research problem? How does the ecosystem look like for the phenomenon of my interest? Is it hierarchical or decentralized, fragmented or cohesive, multilayered and nested? How does the infrastructure of interactions affect the behavior of individuals or how do individuals shape the networks around them? Who are the key actors and what are the key interactions in my networks? How can we optimize contact flows to improve behavioral outcomes, institutional performance or (perceived) actions and identities?

The strength of Social Network Analysis lies in (1) the theories that explain complex individual, organizational or group behaviors, (2) in the methodological and analytical techniques that tame this complexity into easily digestible and intuitive results, and (3) in the visualizations of data and results that communicate essential, previously hidden, details about the tensions and opportunities between structures and actors.

To equip participants with the necessary skills and competences to conduct autonomous and independent research using Social Network Analysis, we propose the following topic sequencing:
- Day 1 - We start with an introduction to the methodology and its unique status between theory, methods and practice. We will discuss applications of SNA in participants' relevant fields, and we introduce the main vocabularies, and data-related peculiarities.
- Day 2 - We start an exploratory analysis at the macro level of the system, characterizing network structures using empirical data: identifying different network structures, measuring them, understanding the mechanisms at work that can generate certain network structures, generating network-level hypotheses and testing the basic ones.
- Day 3 - We continue with the meso-level of analysis, the group level. We explore theories of group formation, test different community-detection algorithms, and hypothesize their intermediation effects between the individual level and the network level.
- Day 4 - We delve into micro-level explanations and analyses. We define network centrality and the importance of actors' positions in networks. We identify different types of key actors and discuss the implications of their positions for influence, isolation, mobilization or knowhow.
- Day 5 - In the last day, we bring all these techniques and insights together into a comprehensive Social Network Analysis, and delve into the basics of inferential network analysis (Exponential Random Graph Models (ERGMs) and Stochastic Actor Oriented Models (SAOMs)).

Our aim throughout this course is to support participants in doing a hands-on analysis of their preferred data, with on point theories and applications related to their individual research problems. Thus, participants are encouraged to bring their own data to the course (in whatever format), so that we can help them apply all the new concepts and techniques on these data. For those who do not find a specific research problem or dataset, we will provide example datasets, close to the disciplinary needs of the participants.

Participants are encouraged to work individually on their research problems and homeworks, but share in group their research interests, questions, challenges, and ideas.

We will use RStudio for the analyses of networks, but we encourage participants to also install Gephi if they have large data (above 200 nodes) that need to be visualized. Both RStudio and Gephi are open source and very well documented. Gephi might have installation problems due to Java requirements on each local machine. If any problem is encountered, please contact us and we will help.

Recommended Literature to look at in advance:
- Barabási, A.L. (2016). Network Science. Cambridge University Press. **Chapter 1**
- Lazer, D. (2011). "Networks in political science: Back to the future." PS: Political Science & Politics, 44(1): 61-68.
- Fowler, J.H., Heaney, M.T., Nickerson, D.W., Padgett, J.F. & Sinclair, B. (2011). "Causality in political networks." American Politics Research, 39(2): 437-480.
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Day-to-day schedule and literature:

Day 1: Introduction to Social Network Analysis
- Network Science and Social Network Analysis
- Working with network data and graph visualizations

Literature:
- Hanneman & Riddle (2005) - Social Network Data
- Kunegis (2018) - Social Network Data Vocabulary
- Barabasi (2016) - Graph Theory - Chapter 2
- Borgatti & Everett (1997) - Working with Two-Mode Data
- Smith et al. (2017) - Non-random missing data

Day 2: Macro-level Analysis
- Characterizing network structures
- Network mechanisms
- Network models

Literature:
- Barabasi (2016) - Random Networks - Chapter 4
- Barabasi (2016) - Scale Free Networks - Chapter 4
- Barabasi (2016) - Preferential Attachment - Chapter 5
- de Vaan & Wang (2020) - Micro-structural foundations of network inequality

Day 3: Meso-level Analysis
- Theories of group formation
- Community detection algorithms

Literature:
- Barabasi (2016) - Network Communities - Chapter 9
- Stoltenberg et al (2019) - Community detection in civil society online networks
- Stadtfeld et al. (2020) - Emergence and Stability of Groups in Social Networks

Day 4: Micro-level Analysis
- Importance and centrality
- Actors' positions in networks

Literature:
- Burt (2001) - The social capital of structural holes - Chapter 7
- Padgett & Ansell (1993) - The rise of De Medici family in medieval Florence
- Borgatti & Everett (1992) - Notions of Positions in social networks
- Marineau et al. (2018) - Individuals' power and their social network accuracy
- 05_S - Brands (2013) - Systematic biases in individuals' perception of social networks

Day 5: Wrap Up
- Bringing it all together - a comprehensive exploratory analysis
- Working with two-mode data
- Causality in networks

Literature:
- Fowler et al. (2011) - Causality in political networks
- Cranmer & Desmarais (2015) - A critique of the dyadic approach
- Cranmer et al. (2017) - Statistical Tools for Inferential Network Analysis
- Steglich et al. (2010) - Separating selection from influence

Additional Recommended Literature:

The following recommendations are intended as extensions of different discussion threads we touch upon in class. They mostly cover basic and advanced topics in exploratory network analysis in social sciences – vocabulary, notation, methods, measures, validation, research design; and applications of network analysis to different socio-political problems – international relations, economics, voting behavior, governance, social movements, etc.

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