האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Hebrew University of Jerusalem

Syllabus

Network Theory and Analysis - 56952

Last update 10-09-2024

HU Credits: *2*

Degree/Cycle: *2nd degree (Master)*

Responsible Department: *Political Science*

Academic year: *0*

Semester: *1st Semester*

Teaching Languages: *English*

Campus: *Mt. Scopus*

Course/Module Coordinator: *Dr. Matthew Simonson*

Coordinator Email: *matthew.simonson@mail.huji.ac.il*

Coordinator Office Hours: *By appointment*

Teaching Staff:

Dr. Matthew Simonson

Course/Module description:

Humans live in a web of relationships. Our ideas and attitudes are influenced by those of people we come in contact with, both online and face-to-face. We join social movements, rebel armies, sports clubs, and religious communities, in part, because of whom we know. Political parties, states, tribes, and terrorist groups, and street gangs form rivalries and alliances not in isolation, but in response to a broader web of rivalries and alliances with other actors. Understanding networks, therefore, is crucial to understanding our social and political world. While the emphasis of this course is on the role of networks in political science——and to some extent, communications and sociology——the techniques we use also have applications to networks in ecology, genetics, physics, anthropology, and economics. We will learn network theory and then practice analyzing network data in R. To do so, students will read a textbook chapter and an academic article each week, as well as completing practice exercises begun in class.

Course/Module aims:

This course aims to give a students a broad introduction to network analysis.

Learning outcomes - On successful completion of this module, students should be able to:

Students will come away from this course able to apply network methods to their theses, dissertations, and other research projects. They will be able to program in R at an intermediate level. They will also develop a new mode of thinking about the world.

Attendance requirements(%):

100

Teaching arrangement and method of instruction: In person, half discussion and half lab (practice in R)

Course/Module Content:

A detailed syllabus will be distributed in October. These are the tentative topics:

1. Theory

1. Basic Concepts

- graph v. network terms

- adjacency matrix

- whole v. ego network approaches
- node attributes and bipartite networks
- tie attributes (weight, directionality) and multilevel networks
- temporal dynamics
- microstructures: reciprocity and transitivity
- applications
- inferential challenges
2. Centrality, roles, and motifs
1. structural equilavence
3. Clustering, Centralization, and Community Structure
1. Density, embeddedness, bridges
2. Social capital
3. Stochastic Blockmodeling
4. Contagion and Spillover
5. Homophily/Assortativity
6. Social capital
2. Methods 1: Egonets
1. survey network generators
2. multilevel modeling
3. Methods 2: Network Formation and Change
1. Exponential Random Graph Models (ERGMs)
2. Social Relations Model (SRM) and its offshoots
1. Additive and Multiplicative Effects (AMEN) framework (Peter Hoff)
2. Latent Space Models (LSM) including LDM (latent distance model)
3. Latent Factor Models (LFM) - Shahryar, Cassy, and Peter's stuff
4. Blockmodels and Stochastic Equivalence Modeling
3. Quadratic Assignment Procedure (QAP)
4. Stochastic Actor-Oriented Models (SAOM)
4. Methods 3: Spillover of Treatments and Attributes
1. Fisher Randomization Inference
2. Exposure Mapping
3. Experimental Design
4. Contagion Models

<u>Required Reading:</u>
Network Analysis: Integrating Social Network Theory, Method, and Application with R

Various articles will be assigned on a weekly basis. Students will take turns presenting articles and will be expected to participate in the discussing them.

<u>Additional Reading Material:</u>
Suggested readings are provided in each chapter of the textbook.

Grading Scheme:

Essay / Project / Final Assignment / Home Exam / Referat 30 %

Active Participation / Team Assignment 10 %

Submission assignments during the semester: Exercises / Essays / Audits / Reports / Forum / Simulation / others 60 %

Additional information:

Students are expected to have taken an introductory statistics course. Familiarity with R is highly recommended, though those who have not used this programming language can catch up with extra work in the initial weeks. Social Science Methods Bootcamp (Course 56988), a 5-day pre-semester workshop, offers an excellent way to get introduced to R and review basic statistics.