Course Description
Interest in network analysis has EXPLODED in the past few years, partly due to the latest advancements in statistical modeling and the rapid availability of network data and partly due to the recognition that many analytical problems can be re-cast as a network problem. Aiming to examine social connections and interactions quantitatively, network analysis has become an essential method and tool for studying a variety of issues in social and natural sciences. This course covers the major methods to collect, represent, and analyze network data. Selected topics include centrality analysis, positional analysis, clustering analysis, the exponential random graph model for modeling network formations, the stochastic actor-oriented model for dynamic network analysis, meta network analysis, weighted network analysis, text network analysis, causal analysis of network effects, and social network-based predictions and interventions. Examples are drawn from a wide range of disciplines including business, economics, education, political science, public health, and sociology. Students will learn hands-on skills to conduct their own research by using mainstream network packages in R such as “statnet” and “RSiena”. This course requires a basic knowledge of logistic regression and basic programming skills in R.

Requirements
1. Class discussion (20%). Each group of no more than three students will lead one class discussion. For each required reading, the group will prepare two slides to summarize the content and present two to three questions for discussion. The recommended readings are optional. But each group is encouraged (with up to 5% bonus points) to prepare one slide per reading to summarize the content and present one to two questions for discussion. All students are expected to read the required readings and to speak up at least once per class.

2. Five assignments (30%). A typical assignment includes a memo and a computation task. The memo is a 300 word commentary on one of the required or recommended readings from a particular class. [Graduate students usually write two memos on two readings.] Students are allowed to discuss the computation task among themselves, but no copy-paste and the code and the write-up must be the student’s independent work.

3. Midterm (20%). Midterm is open book. No collaboration is allowed.

4. Project presentation (10%). Each group of no more than three students will work on a final project and give a presentation of no more than five slides. Undergraduates can choose to conduct replication analyses that replicate a previous study or analyze previous data in novel ways. Graduate students are expected to conduct a new study that addresses new research questions or using new data. Only when data access is a problem, are graduate students allowed to conduct a replication project or to submit a research proposal only. Undergraduate and graduate projects are expected to be about 3000 and 5000 words in length, respectively. Each project should include an introduction to the research question(s), data and methods, results, and conclusion.

5. Research project (20%)
Grading Scale

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<thead>
<tr>
<th>Grade Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>94-100</td>
<td>A</td>
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<tr>
<td>90-93</td>
<td>A-</td>
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<td>87-89</td>
<td>B+</td>
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<td>83-86</td>
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<td>80-82</td>
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<td>70-79</td>
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<td>60-69</td>
<td>D</td>
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<td>0-59</td>
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Textbooks


Course Schedule

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<th>Topic</th>
<th>Lab</th>
<th>Assignment</th>
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<td>Introduction</td>
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<tr>
<td>9/11</td>
<td>Network Data</td>
<td>Lab 1: Basic Analysis</td>
<td>Assignment I</td>
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<tr>
<td>9/18</td>
<td>Network Formation</td>
<td>Lab 2: ERGM</td>
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<tr>
<td>9/25</td>
<td>Random Network Models</td>
<td>Lab 3: ERGM</td>
<td>Assignment II</td>
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<tr>
<td>10/2</td>
<td>Network Effects I</td>
<td>Lab 4: Positional Analysis</td>
<td>Assignment III</td>
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<tr>
<td>10/16</td>
<td>Network Effects II</td>
<td>Lab 5: SAOM</td>
<td>Midterm</td>
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<tr>
<td>10/23</td>
<td>No Class</td>
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<tr>
<td>10/30</td>
<td>Dynamic Network Analysis</td>
<td>Lab 6: Meta Network Analysis</td>
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<tr>
<td>11/6</td>
<td>Meta Network Analysis</td>
<td>Lab 7: Special Networks</td>
<td>Assignment IV</td>
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<tr>
<td>11/13</td>
<td>Special Networks</td>
<td>Lab 8: Network Interventions</td>
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<tr>
<td>11/20</td>
<td>Interventions</td>
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<tr>
<td>11/27</td>
<td>Predictions</td>
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<td>Assignment V</td>
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<tr>
<td>12/4</td>
<td>Research</td>
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<tr>
<td>12/11</td>
<td>Presentations</td>
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<tr>
<td>12/18</td>
<td>Final Paper</td>
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Course Outline

1. Introduction
An overview of network analysis in the social sciences and some challenges and opportunities.

Readings:

Recommended:

2. Network Data
Measuring what and how to measure are two fundamental problems in network data collection.

Readings:

Recommended:

3. Network Formation
How social networks are formed? What role does social context, social status, cultural taste, perception, and local social processes each play in the formation of social networks?

Readings:


Recommended:

4. **Random Network Models**
Exponential random graphic models (ERGMs) are the state-of-the-art for modeling networks.

Readings:

Recommended:

5. **Network Effects I: Relational effects**
The literature on relational effects can be divided into two groups. The social capital literature shows how a person’s social networks provide access to social resources or emotional support. The social contagion model shows social norms and behaviors can transmit through networks.

Readings:


Recommended:


6. Network Effects II: Positional and structural effects

Both network positions and network structures can affect individuals' outcomes. Understand the concepts of structural holes and structural equivalence.

Readings:


Recommended:


7. **Dynamic Network Analysis**
Longitudinal network data help estimate causal peer effects. Compare the advantages and disadvantages of the dynamic logit model and the stochastic actor-oriented model.

Readings:

Recommended:

8. **Meta Network Analysis**
Introduce meta network analysis for combing multiple network models and big network analysis.

Readings:

Recommended:

9. **Special Networks**
Introduce methods for analyzing weighted networks, two-mode networks, and text networks.

Readings:

Recommended:
10. Network Interventions
Network interventions may be conducted at three levels. (1) At the contextual level, they aim to change the environment of a social network and examine the adaption of the social network. (2) At the structure level, they attempt to shape the structure of a social network in order to facilitate information diffusion or behavior changes. (3) At the individual level, they aim to utilize social network information to more strategically select seed subjects to facilitate social contagion.

Readings:

Recommended:

11. Social Networks and Predictions
There are two kinds of predictions related to networks. One is to infer network ties based on attributes or alter reports. The other is to use networks to predict or monitor social behaviors.

Readings:

Recommended: