What is Network Analysis?

“Social Life is relational ...”

PAD 637, Lecture 2
Spring 2013
Network phenomena around us

• Very evident all over the world... What does this proverb suggest...?
• Birds of a feather flock together. Or, A man is known by the company he keeps
• 끼리끼리 모인다, 친구를 보면 그 사람을 알 수 있다 (Korean)
• 观其友，知其人 (Chinese)
• 類類相從 (Chinese)
• 類(るい)は友(とも)を呼(よ)ぶ (Japanese)
• Dime con quien andas y te diré quien eres. (Spanish)
Network analysis around us

- **The Oracle of Bacon**
  : Find the link from Actor A to Actor

- **Capture of Saddam Hussein**
  : As U.S. forced hunted for associates they hoped might lead to Saddam, the ultimate question was “which relationships actually matter?”
  : Overall, Saddam’s core network—people with whom he had close connections—was small and tightknit, dominated by family and tribal associations.
Network analysis

- SARS Epidemic Evolution in 2003
Network analysis

Impact of Air Travel on Global Spread of Infectious Diseases

14th Century: Black Death

Epidemic spreading pattern changed dramatically after the development of modern transportation systems.

Epidemic propagation as a slow diffusion wave

World-wide outbreak characterized by a first-pitched and heterogeneous spatio-temporal pattern

17 March 2003

1 April 2003
Network analysis around us

- Cosponsorship Network Data
  - developed by Dr. James Fowler
  - Using data on Cosponsorships in the U.S. Senate and U.S. House of Representatives for the 93rd to 108th Congresses
  - Examining “which bills individuals and groups of legislators will support?”
  - Power of social network
Network analysis around us

- Let’s watch his short talk
- Think about what social network related concepts/questions he mentioned!
  (http://jhfowler.ucsd.edu/ )
Network analysis around us

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Facebook, twitter, and my space:
Decline of social relationship on my space?

A friend of friend of friend ...
My son’s friend’s mother:
Weak tie argument by Granovetter
Network analysis around us

- Gaining/losing weights example
  - Influence processes:
  - You influence them as well
  - You are strongly influenced by others
  - Everybody else is turning to the left.
    - Mimic processes
- Individual centered/independent decisions?
  - You can’t do it alone
    - Under the structural pressures
    - Oversocialization
- Similar music tastes
  - Homophily processes
- Difference between facebook friends and photo tagged friends:
  - different relations exist
A brief history

• Sociology and psychology: Moreno developed sociometry – the sociogram (1930s) – graphical presentations of networks

"If we ever get to the point of charting a whole city or a whole nation, we would have … a picture of a vast solar system of intangible structures, powerfully influencing conduct, as gravitation does in space. Such an invisible structure underlies society and has its influence in determining the conduct of society as a whole."

J.L. Moreno, *New York Times*, April 13, 1933
A brief history

- Social psychology: Harary, Norman & Cartwright – the sociomatrix (1940s to 50s) – matrices & algorithms

- Anthropology: Barnes & Mitchell – structuralism and complex societies (1950s to 70s) – measures
  - Mathematical graph theory provided key – but deterministic – ideas and measures; problems with random graphs

- Mathematical sociology: Holland, Leinhardt, Wasserman, etc. (1980s to ???) – statistical models
  Tom Snijders, Gary Robins (around 2002?? – still) – P* model

Focus on empiricism and measurement
Fundamental assumptions

- Social life is about interdependence, not independence
  - Social entities make non-random, non-trivial connections
  - Relations are at least as important as attributes and norms – in fact, attributes & norms may flow from relations
  - Patterns of interconnection matter because they support flows of resources – material & non-material
  - Direct & indirect relations matter – collusion, for instance
  - The broader structure matters and may be constitutive substructure

- Persistent connections are what matter – social structure

- Social structure enables and constrains action

- Access is related to resources, power, & influence: brokerage

- Networks are dualistic
  - They help to shape action
  - They are reproduced through action
  - They change through purposive action & random events
Fundamental uses of network analysis

• **Formal description**
  ▫ Creation of formal, mathematical ways to describe relational concepts
  ▫ May be an end in itself ("social X-ray"), may contribute to "traditional methods," or be an adjunct to...

• **Model and theory evaluation & testing**
  ▫ Provides the basic toolkit for measuring relational concepts
  ▫ Provides deterministic and probabilistic means of testing models and theory
Fundamental concepts

- **Actor/node**
  - Any independent social entity – persons, groups, organizations

- **Ties/edges**
  - Any persistent communication or exchange relationship between two nodes; may be directional & varying in strength

- **Relations**
  - A collection of ties of a specific kind among members of a group

- **Networks**
  - A set of actors are that related by ties across one or more relations
Data collection methods

- **Sampling gives way to complete population studies**
  - Network sampling is extremely difficult
  - Populations specified by research criteria or by consensus among a population

- **Data collection**
  - Archival analysis
  - Interviews
  - Surveys
  - Analysis of passively collected data – e-mail logs, contacts databases, telephone logs, etc.
Fundamental level of analysis

- Actor-level analysis – used to find graph theoretic properties of actors, which are often used as proxies for other concepts
  - Example: centrality and power; structural holes
Fundamental level of analysis

• Dyadic level analysis - Reciprocity
• Triadic level analysis – Transitivity, Balance...
• Group level analysis
  ▫ Subgraph analysis – Identification of subgroups in a single relation
    • Cliques – cohesive social groups
    • Core/periphery structures – policy networks
  ▫ Positional analysis – Identification of “equivalent” subgroups in a network using multiple relations
    • Example: core/periphery patterns in trade data
Different level of analysis

- Think about the similarities and difference between two pictures using different level of analysis

Borgatti et al. (2009) Science
Different levels of analysis:

- Ego centric approach
  - actor level
  - dyadic level

- Entire network approach
  - actor level
  - dyadic level
  - triadic level
  - group level

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Business field, this is popular because ...

What? Any guess??

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Business field, this is popular because, typically, organization is assumed to make relationship decisions based on “self-interest”.

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Micro approach

Open
Closed
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* Public sector organizations consider this approach.

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* Because of “collective action problem (CAP)”

CAP = describing a problematic situation where multiple individuals would benefit a certain joint actions

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**Micro approach**
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  - Dyadic level

**Macro approach**
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  - Actor level
  - Dyadic level
  - Triadic level
  - Group level

*Because of “collective action problem (CAP)”*

CAP = describing a problematic situation where multiple individuals would benefit a certain joint action.
Fundamental types of analysis

- **Visualization** – A social X-ray. Used to visually identify relationships or substructures
  - Often done in conjunction with analytic routines like multidimensional scaling, factor analysis, etc.
  - Can be diagnostic without additional analysis
    - Terror cells; Terror syndicates
    - Policy networks

- **Two-mode analysis** – Measurement of relationship between a group of actors and a group of events
  - Participation of social movement orgs. in protests
Fundamental types of analysis

- **Ego-centric analysis** – Use of network concepts within the context of standard regression models
  - Example: General Social Survey and measures of ego networks
    - Size of core discussion networks

- **Statistical analysis** – Models of network structure that include both network and compositional data
  - Examples: Gender choice and play in elementary school; communication preference in policy networks; friend choice among masters students
Fundamental questions in SNA

- Which actors are most powerful?
- Do actors form cohesive subgroups?
- Do actors form preferential connections with some other actors?
- Do networks display core-periphery structures?
- Are actors in a network divided into subgroups that have similar patterns of connections?
- How do networks change over time?
- How do network characteristics/structures affect outcome variables of interest?
Empirical questions addressed with social network analysis

- Is there a core-periphery structure to world trade?
- Which actors have preferential access to public decisionmakers?
- Does the structure of public service networks in mental health affect patient outcomes?
- If school superintendents spend time cultivating relationships with school boards, does that tend to improve or degrade school performance?
- Are there really only six degrees of separation in the Internet age?
- Do terrorist organizations with more connections kill more people?
Empirical questions addressed with social network analysis

- Is the Internet tending to broaden or contract access to public decisionmakers?
- How much do key innovations in the information age owe to patents gotten through publicly-funded research?
- Are job seekers more likely to find a job using an online service or a friend?
- Why does Chicago have a hard time attracting information-age entrepreneurs?
- How important is having a broad network of professional to development of high-tech industries?
Work that is beginning/continuing here

- Asal (Poli Sci), Rethemeyer, Study of terrorism networks and why terrorist organizations ally
- Lee, Nakashima, and Rethemeyer, Study of coevolution between students’ friendship networks and academic performance
- Lee, Rethemeyer, and Park, Study of the impacts of policy network contexts on network connections in social service networks
- Nakashima, Andersen and Rethemeyer, In CTG, i-choose projects developments and scholars’ networks
- Park, Faerman, and Rethemeyer, “Becoming a Manager: The Coevolution of Managerial Knowledge, Identity, and Social Networks.” (Socialization processes)
Discussion: How does this connect to other traditions used here?

- System dynamics
- Decision analysis
- Economic modeling

- How do you develop your research topic/agenda/questions?