Social Network Analysis

SOCIAL NETWORK DATA – II

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Types of Network

One-Mode Networks

One-mode involves measurements on just a single set of actors

Actors can be of a variety of types

- Subgroups
- Organizations
- Collectives/Aggregates:
- Communities
- Nation-states

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Relations

The relations measured on the single set of actors in a one-mode network

- Individual evaluations: friendship, liking, respect, and so forth
- Transactions or transfer of material resources: lending or borrowing; buying or selling
- Transfer of non-material resources: communications, sending/receiving information
- Interactions
- Movement: physical (migration from place-to-place), social (movement between occupations or statuses)
- Formal roles
- Kinship: marriage, descent

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Actor Attributes

In addition to relational information social network data sets holds actor attributes

People attributes their age, gender, race, socioeconomic status, place of residence, grade in school, and so on

For corporate actors, profitability, revenues, geographical location, purpose of business

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Two Mode Networks

- Two-mode involves measurements on two sets of actors, or on a set of actors and a set of events

- At least one relation must be defined between the two sets of actors

Example:
A collection of corporations, and the non-profit organizations (such as the Red Cross) rely on contributions from the public sector for their operating budgets

- Relation is unidirectional

- Additionally number of relations defined for each mode

Example: for the corporations (such as shared country club memberships among the chief executive officers)

- For non-profits (such as interlocking boards of directors)

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One Set of Actors and One Set of Events

- Referred as affiliation network or membership network
- First mode is a set of actors, and the second is a set of events which affiliates the actors.

Example: A set of women attended a variety of social functions

  - Each social function can be viewed as a affiliation variable, binary measurement made as to whether a specific actor attended the specific function

- Affiliations are measured on subsets of actors, such networks are non-dyadic, two-mode networks

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Actors

Actors same as in one-mode and two-mode networks - only requirement is that the actors must be affiliated with one or more events

Events

Actors (the first mode) are related to each other through their joint affiliation with events

Example:

The events are often defined on the basis of:

- membership in clubs or voluntary organizations
- attendance at social events
- sitting on a board of directors
- socializing in a small group etc…….

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Attributes:

Actor attribute variables the same as one-mode and two-mode networks

Two sets of attribute variables in an affiliation network data set: Actor attributes and Event attributes

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Special Dyadic Networks and Ego-centered

Special Dyadic Networks

In two-mode networks with two sets of actors, all actors in the first mode can relate to all in the second

some data collection designs gather structural information on some pairs but not others

An example of such data arises in studies of couples

Each partner in the couple can interact with the each other but with no other person during counseling sessions

When interest centers on a collection of pairs (husband-wife, father-son, and so forth), these **non-network relational data referred as special dyadic designs**

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- An actor may also relate to a limited number of "special" other actors
- Example, mothers interacting with their own children and children only interact with their own mother
- Partners for one person (either mother or child) are different from the partners for another
- It constrains the interactions among the set of people so that all people cannot interact with all others

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Ego centered network

- It is also called as personal network data
- It consists of a focal actor, termed ego, as set of alters who have ties to ego
- Measurements on the ties among these alters
- Example:
- Here one samples respondents, and each respondent reports on a set of alters to whom they are tied

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Ego Networks

These data are relational, but limited, since ties from each actor are measured only to some (usually only a few) alters

Ego-centered networks are used in the study of social support

"social support" has been used to refer to social relationships that aid the health or well-being of an individual

It helps to study relationships in clinical and community psychology and sociology

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Network Data, Measurement and Collection

Measurement

- Social network data consist of one (or more) relations measured among a set of actors
- Presence of relations has implications for a number of measurement issues
- Unit of observation (actor, pair of actors, relational tie, or event)
- Modeling unit (the actor, dyad, triad, subset of actors, or network)
- Quantification of the relations (directional vs nondirectional; dichotomous vs. valued)

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Unit of Observation

- The unit of observation is an actor, from whom we get information about ties.
- The dyad is the unit of observation when one measures ties among pairs of actors directly
- Example, one could record instances of aggression among pairs of children on a playground
- For affiliation network data the unit of observation is often the event

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Modeling Unit

There are several levels at which network data can be modeled or summarized

- Actor
- Dyad
- Triad
- Subgroup
- Set of actors or network

Relational Quantification

There are two properties of relations for measurement and for categorizing the methods:

- Directional or non-directional
- Dichotomous or valued

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Directional Relations

In a directional relation, the relational tie between a pair of actors has an origin and a destination

Example: one country exports manufactured goods to a second country

non-directional relation the tie between a pair of actors does not have a direction

Example: tie between two countries if they share a border

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Second important property of a relation is whether it is **dichotomous or valued**

Dichotomous relations are coded as either present or absent, for each pair of actors

Example: an ambassador send to a country or not taking two values "send" or "not send."

Valued relations can take on a range of values, indicating the strength, intensity, or frequency of the tie between each pair of actors

Example: Record the dollar value of manufactured goods exported from one country to other country

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Collection

Variety of ways in which social network data can be gathered

These techniques are:

- Questionnaires
- Interviews
- Observations
- Archival records
- Experiments
- Other techniques : ego-centered, small world, and diaries

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Questionnaire

- This data collection most commonly used
- The questionnaire usually contains questions about the respondent's ties to the other actors.
- Questionnaires are used when relation(s) that are being studied are ones that the respondent can report on.
- There are three different question formats that can be used in a questionnaire :
  - Roster vs. free recall
  - Free vs. fixed choice
  - Ratings VB. complete rankings

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Roster

- when questionnaire gather network data each actor should be presented with a complete list, or roster
- Rosters can be constructed only when the members known in the set prior to data gathering
- Example: Each person rate their friendship with every member of the class on a five point scale, Corresponding questionnaire is
- "Please place a check in the space that best describes your relationship with each person on the list."
- Five categories one could choose: "trust as a friend", "know welt", "acquaintance", "associate name with face", and "do not know"

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Free Call

In Free Call, the researcher does not present a complete list of the actors to the respondent on the questionnaire

Example:

"name those people with whom you (fill in specific tie)“

Each pupil in both schools was asked to write his name, age, grade, and home room number on a card and to fill in the blanks in the statements:

"My best friend in (name of school) Junior High School is . . ."
"My second best friend is . . ."
"My eighth best friend is. . . ."

Here though the network membership is known beforehand but students listed their friends using free recall

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Free Call

If not even have a list advance sampling or enumeration techniques are used

Example:

In studies of community elites - selected actors are asked to name other actors they believe to be influential in the community

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Free vs, Fixed Choice

Fixed Choice

In a fixed choice design each actor has a fixed maximum number of ties to the other actors in the set of actors.

Example:
Each doctor interviewed was asked three sociometric questions:
(i) "To whom did he most often turn for advice and information?"
(ii) "With whom did he most often discuss his cases in the course of an ordinary week?"
(iii) "Who were the friends, among his colleagues, whom he saw most often socially?"

In response to each of these questions, **the names of three doctors** were requested

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Free Choice

If actors are not given any such constraints on how many nominations to make, the data are free choice

Example:

Each individual was asked to denote for each member of the user group whether or not they:

- Had an office next to each other
- Attended the same school at the same time
- Shared an office

Here there is no constraint on the number of people that an individual respondent can choose on these 3 relations

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Ratings VS. Complete Ranking

Ratings

- Actors are asked to rate or rank order all the other actors in the set for each measured relation
- Measurements reflect the intensity of strength of ties.
- Ratings require each respondent to assign a value or rating to each tie
- Complete rankings require each respondent to rank their ties to all other actors

Example:

Each of forty members of a social science research office to report the amount of communication with each other member of the office

Asked to rank the cards from most to least on how often they talked to others in the office during a normal working day

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- Alternatively, ratings can be dichotomous study (ties are either present or absent)
- Valued - the study where ratings were made by choosing one of five possible categories for the strength of each tie
- In either case, when "choices" can be directional or non-directional

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Interviews

Interviews can be of either face-to-face or over the telephone

Used occasionally where questionnaires are not feasible

For example: interviewing the CEOs of the largest corporations , prefer face-to-face interviews than via an impersonal questionnaire

Interviews have been used to gather data from respondents in ego-centered networks

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Observation

Observing interactions among actors is another way to collect network data

Used to study relatively small groups of people who have face to-face interactions

Observing interactions does not require verbal responses from the people

Method is quite useful with people who are not able to respond to questionnaires or interviews

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Observation

Widely used in the study of interactions among non-human primates

It is useful for collecting affiliation network data

The researcher can record who attends each of a number of social events

Used to observe a set of actors for an extended period of time, summarizes the impressions of ties among all pairs of actors in the set

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Archival Records

Measures ties by examining measurements taken from records of interactions

Example:

journal articles, newspapers, court records, minutes of executive meetings

Give rise to longitudinal relations and can be used to reconstruct ties that existed in the past

Affiliation data can be compiled from archival sources

Used in study of sociology of science, specifically, patterns of citations among scholars

One can examine "who cites whom" in order to understand diffusion of a scientific innovation

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Others

Other designs for collecting relational data:

- Cognitive Social Structure
- Experimental
- Ego-centered
- Small-world
- Diary

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Cognitive Social Structure

Ask respondents to give information on their perceptions of other actors' network ties

Example1:

Employees perceptions of friendships among all other employees in the restaurant

Gives info about own friendships and their perceptions of the friendships among all other pairs of employees

Example2:

Report subgroups of people within the larger collection of people

Gives more information than the usual sociometric design

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Experimental

Social network data can be collected using experimental designs in 2 ways:

- Choose a set of actors and observe their interactions in an experimentally controlled situation
- Records interactions or communications between pairs of actors

  - choose actors and specify which pairs of actors are permitted to communicate with each other
  - Records frequency or content of communications between those pairs of actors

Group problem-solving experiments

- Actors assigned to positions defined by the experimenter and allowed to communicate only with specific others
- Experimenter manipulates both group members and their ties

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Ego-centered

An ego-centered, or local, network consists of a focal person or respondent (ego), a set of alters who have ties to ego

Measurements are taken on the ties from ego to alters and on the ties between alters

Collection of respondents are asked about their ties to other people to elicit the set of alters

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Small World

- Special network designs are also used in small world and reverse small world studies
- A small world study is an attempt to determine how many actors a respondent is removed from a target individual based on acquaintanceship
- Focus of interest is how long these "chains" are
- Also the characteristics of the intermediate actors in the chain
- A reverse small world study focuses on the ties from a specific respondent to a variety of hypothetical targets

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Diary

- Each respondent to keep a continuous record of the other people with whom they interact
- Used in the study of personal networks among people
- Data sets frequently include information on the type of relation and characteristics of the alters in each ego-centered network

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Longitudinal Data Collection

Study focused on how ties in a network change over time

One measures one or more relations at fixed intervals of time

Such designs allow one to study how stable ties are and whether ties reach an equilibrium state

It deals with 2 questions

- How the process has changed over time
- Whether the past, or the history of the process, can predict the future

Longitudinal social network data can be collected using any of the methods (questionnaire, interview, observation etc.)

Mostly studied in friendship and communications throughout a network over time

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Measurement Validity, Reliability, Accuracy, Error

Freeman and Romney (1987):

"social structure refers to a relatively prolonged and stable pattern of interpersonal relations“

Holland and Leinhardt found observed structure of measured network data contains error compare to true structure

Bernard et al concluded 50% of people reported on their own interactions is incorrect – people are not very good at reporting on their interactions

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Freeman, Romney, and Freeman (1987)

Argued that verbal reports (recall of interactions) needs memory and cognition

Study of long-range social structure, rather than to particular instances is good

Information on ties is collected from individuals as representatives – so interviewed person should be knowledgable of the information

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Valid

A measure of a concept is valid to the extent that it actually measures what it is intended to measure

Example: Which people in this group 'are your friends ?"

Validity based on answer to the question gives a set of actors who are related to the respondent through friendship ties

Very few construct validity of social network measures was studied

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Reliable

A measure of a variable or concept is reliable if repeated measurements give the same estimates of the variable

It is assessed by comparing measurements taken at two points in time (test-retest reliability), or by comparing measurements based on subsets of test items

Test-retest assessment of reliability to be appropriate, one must ensure that the "true" value of a variable has not changed over time

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Three approaches that have been used to assess the reliability of social network data are:

a) test-retest comparison
b) comparison of alternative question formats
c) reciprocity of sociometric choices

Reliability of sociometric data can also be assessed at different levels.

a) One can study the reliability of the "choices" made by individual actors,

b) One can study the reliability of measures aggregated over a number of individual responses

Example: the popularity of an actor measured as the total number of choices it received

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Sociometric questions using ratings or full rank orders are more reliable (have higher test-restest reliability)

Fixed choice designs in which just a few responses are allowed

sociometric questions about more intense or intimate relations have higher rates of reciprocation than less intense or intimate relations questions

Reliability of aggregate measures (such as popularity) is higher than the reliability of "choices" made by individual actors

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Measurement Error

Measurement error occurs when there is a discrepancy between the "true" score or value of a concept and the observed (measured) value of that concept

Need to understand the implications of measurement error at different levels.

Error arises in fixed choice data collection designs due to restrictions

Example: “List your three best friends." It is quite unlikely that all people have exactly three best friends

The restriction also introduces error into the measurement of network properties, such as of triads and subgroups