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Introduction to social network analysis

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Introduction

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Data Collection Social Network Analysis (SNA) has attracted considerable interest from social and behavioral science community in recent decades.

Much of this interest can be attributed to the focus of social network analysis on *relationship* among units, and on the patterns of these relationships.

Social network analysis is a rapidly expanding and changing field with broad range of approaches, methods, models and substantive applications.



Basic definitions

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Data Collection *Social network* consists of *units* (social actors) with one or more social *relations* (set of ties or relationships) defined over those units. *Properties* on units and on ties can be added.

Units can be individuals, groups, organizations, ...

A relation among workers in an organization can be 'to communicate with'.

The relation can be *symmetric* (e.g., co-authorship) or *non-symmetric* (e.g., friendship).



Some applications of SNA

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- personal communities
- social support
- animal social networks
- networking online
- · corporate elits and intercorporate networks
- policy networks
- · social movements and collective action
- crime
- terrorist networks
- scientific and scholarly networks
- cultural networks
- spacial networks
- intra- and inter-organizational studies
- health and illness, particularly AIDS
- world political and economic system

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Presentation of a social network

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A social network can be **presented** by

- graph
- relational matrix
- set of related pairs of units



Example: Graph



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Relational matrix

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	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
3	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
4	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0
5	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	0
6	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
9	1	1	1	0	0	0	0	0	0	0	0	0	1	1	0	1
10	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
11	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1
14	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
15	0	0	0	1	1	0	0	0	0	0	1	0	1	0	0	0
16	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0

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Set of related pairs of units

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Data Collection

$$R = \{(1:9), (2:6), (2:7), (2:9), (3:5), (3:9), (4:7), (4:11), (4:15), (5:11), (5:15), (7:8), (7:16), (9:13), (9:14), (9:16), (10:14), (11:15), (13:15), (13:16)\}$$

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- When the ties for each pair of units are known, we have a *whole network*.
- If a set of units are given (e.g., a random sample) and only ties from each of these units (*egos*) to some (other) units (*alters*) are measured (usually not ties between these alters) we speak about *egocentered networks* or *personal networks*.





Types of networks

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Data Collection Besides the usual whole networks some extended types of networks are also used:

- 2-mode networks,
- signed networks
- temporal networks or dynamic networks,
- multiple networks or multi-relational networks,
- *specialized networks* (e.g., genealogies).



Two-mode networks

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Data Collection *One-mode social network* is defined by the set of units and the relationships defined only between them, e.g., friendship relation among pupils in a class.

If there are two sets of units and the relationships are defined between units of the first set and units of the second set we referred to the *two-mode social network*.

An example of two-mode network is membership network, e.g., scientists (first set) are members of different scientific associations (second set).



Deep South

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Classical example of two-mode network are the Southern women (Davis 1941).

	CODE NUMBERS AND DATES OF SOCIAL EVENTS REPORTED IN Old City Herald													
NAMES OF PARTICIPANTS OF GROUP I	(1) 6/21	3/2	(3) 4/12	(4) 9/26	(5) 2/25	(6) 5/19	3/15	(8) 9/16	(9) 4/8	(10) 6/10	塭	(12)	(13) 11/21	(14) 8/3
1. Mrs. Evelya Jefferson.	X	×	X	X	X	X		X	×					
2. Miss Laura Mandeville	X	X	X		X	X	X	X						
3. Miss Theresa Anderson.		X	X	X	X	X	X	X	X					
4. Miss Brenda Rogers	X		X	X	X	X	X	X						
5. Miss Charlotte McDowd			X	X	X		X							
6. Miss Frances Anderson.			X		x	X		X						
7. Miss Eleanor Nve.					x	X	X	X						
8. Miss Pearl Oglethorpe						X	L.C.	X	X					
9. Miss Ruth DeSand					x		X	X	x					
10. Miss Verne Sanderson							X	x	x			X		
11. Misa Myra Liddell							· · ·	X	X.	X		12		
12. Miss Katherine Rogers								12	S.	1x		¥	×	X
13. Mrs. Svivis Avondale						1.1	X	1x	12	1 Q		2	Ŷ	1 Q
14. Mrs. Nora Favette						X	12	<u> </u>	X	1 Q	×	2	Ŷ	X
15. Mrs. Helen Lloyd						10	12	X	1	1 Q	S.	2	~	1
16 Mrs. Dorothy Murchison							~	12	X	1	~	~		
17. Mrs. Olivia Carleton						····		1	12		X			
18. Mrs. Flora Price									x		1x			



Signed networks

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Data Collectior Here, the ties can have positive, zero or negative values.

ſ		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
ſ	1	0	-2	3	0	0	0	-3	0	0	-1	0	1	0	2	0	0	0	0
	2	3	0	0	-3	0	0	1	-2	0	0	0	2	-1	0	0	0	0	0
	3	3	-2	0	-3	0	-2	0	0	0	0	0	0	2	0	0	-1	1	2
	4	-2	-3	0	0	3	1	0	0	0	0	2	0	0	-1	0	0	0	0
	5	0	0	0	3	0	0	0	0	1	0	2	0	0	0	0	0	0	0
	6	0	-1	-3	3	1	0	-2	0	2	0	0	0	0	0	0	0	-2	0
	7	0	3	0	-3	0	-2	0	-1	0	0	0	1	0	0	0	2	0	0
	8	0	-3	-2	3	0	2	0	0	1	0	0	0	0	-1	0	0	0	0
	9	0	0	-3	0	1	0	0	3	0	0	0	2	0	0	0	0	-2	-1
	10	0	0	0	3	1	0	0	0	1	0	0	0	2	0	0	0	0	0
	11	-1	-3	-2	0	2	0	0	3	0	0	0	0	0	1	0	0	0	0
	12	3	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	13	0	-3	0	0	2	-2	1	0	0	0	0	-1	0	0	0	0	0	3
	14	3	0	0	-3	0	0	0	-2	0	0	0	1	0	0	2	0	-1	0
	15	0	3	-2	-1	0	0	1	0	0	0	0	2	-3	0	0	0	0	0
	16	0	3	-1	-3	0	0	2	0	0	0	0	0	0	0	1	0	-2	0
	17	0	1	2	-1	0	-3	0	-2	0	0	0	0	0	0	0	0	0	3
l	18	0	1	2	-1	0	0	0	-3	0	-2	0	0	0	0	0	0	3	0



Temporal networks

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Data Collection *Temporal* or *dynamic* networks change over time. Here, units or ties can change through time.





Multiple networks

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Data Collection If several relations are defined over the set of units, such a network is called *multi-relational* network or *multiple* network.

Example

Sampson (1968) reported data about four relations (positive and negative ties) at five time points among a group of 18 trainee monks at a New England Monastery:

- affect,
- esteem,
- $\bullet\,$ influence, and
- sanctioning.

Therefore, it is multiple and temporal signed network.



Unit of the observation

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Data Collection Unit of the observation and analysis can be:

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- a social actor
- a dyad
- a triad
- a subgroup
- a network



Important researchers in SNA

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Data Collection Graph theory: Euler (1736), Hamilton (cycles), Kirchoff (electrical circuits), Kekule (molecule), Kruskal, Dijkstra, Ford and Fulkerson (optimization), Harary, Berge (first books) ...



- Moreno (1934) sociometry
- Small networks: Lewin (1936), Warner and Lunt (1941), Heider (1946), Bavelas (1948)
 – centrality, Homans (1950), Cartwright and Harary (1956), Mitchell (1969)
- Roles and positions: Nadel (1957), H. White (1970)
- Probabilistic models: Wasserman (1977), Leinhardt and Holland (1981), Frank (1986)

Moreno Freeman L.C. (2004) The Development of Social Network Analysis



Institutionalized forum of SNA



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- International Association of Social Network Analysis – INSNA, 1978
- Journal: Social Networks, 1978
- Newsletter: Connections, 1978
- SUNBELT conferences, 1981
- e-Journal: Journal of Social Structure, 2000
- Journal: Social Network Analysis and Mining, 2011
- Journal: Network Science, 2013



Network data collection

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Data Collection

- Archival records
- Observation
- Informant data
- Diary
- Survey
- Network data collection from Internet and data bases
- Other data collection techniques