

Introduction to Social Network Analysis

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Online Workshop for Warwick ESRCdtp Masterclass
September 2026

- ① Intro to SNA
- ② Coding Session: Intro
- ③ Descriptives
- ④ Coding Session: Descriptives
- ⑤ Intro to inferential statistics for SNA
- ⑥ Coding Session: Baseline models

Examples

Definition

Sampling

Sources and
Surveys

Data
Structures

Software

- ① Examples
- ② Definitions
- ③ Boundaries and sampling
- ④ Data sources and survey development
- ⑤ Data structures
- ⑥ Software

What is a network?

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At the most basic, a network consists of:

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- A set of actors/nodes/vertices

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At the most basic, a network consists of:

- A set of actors/nodes/vertices
- And relationships/edges/ties between these actors/nodes/vertices

Examples

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Examples

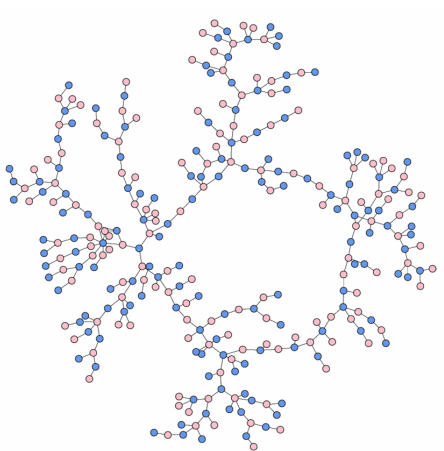
Definition

Sampling

Sources and Surveys

Data Structures

Software



<http://www-personal.umich.edu/mejn/networks/>

Examples

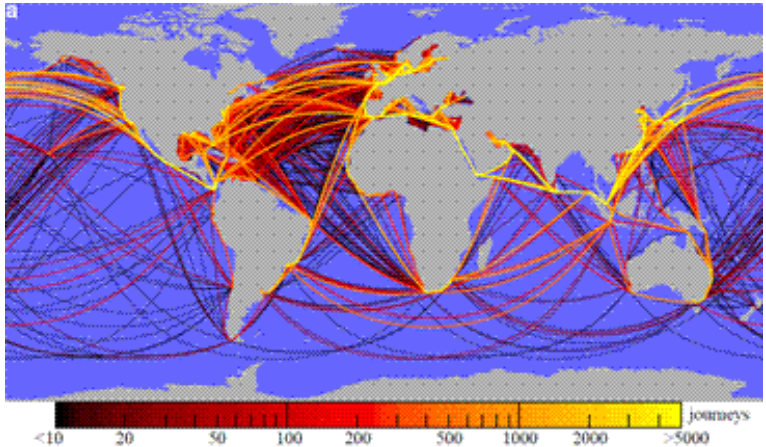
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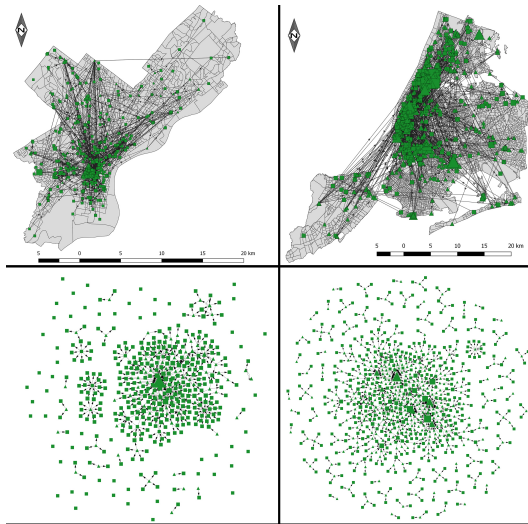
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Software



<https://www.technologyreview.com/2010/01/15/206638/the-global-shipping-network-is-finally-revealed/>



Group Home Offices. Sized by Indegree

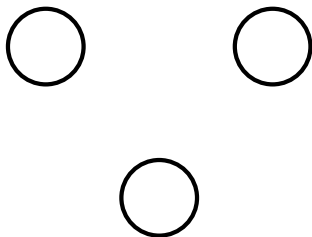
▲ Survey respondent
■ Survey non-respondent
■ Census Block Groups
— Collaborative Ties

Jasny et al 2019

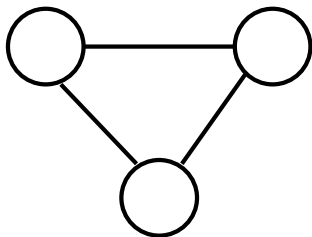
Think Formally

A network is not just a
metaphor: it is a
precise, mathematical
construct

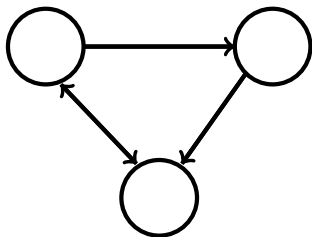
A network is not just a metaphor: it is a precise, mathematical construct of nodes (vertices, actors) N



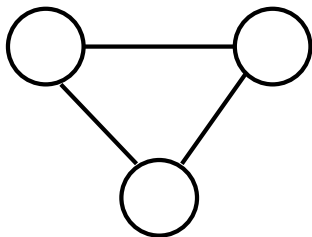
A network is not just a metaphor: it is a precise, mathematical construct of nodes (vertices, actors) N and edges (ties, relations) E



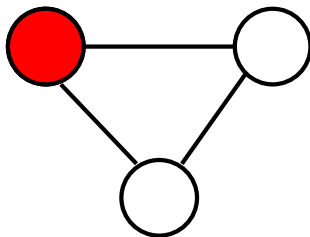
A network is not just a metaphor: it is a precise, mathematical construct of nodes (vertices, actors) N and edges (ties, relations) E that can be directed



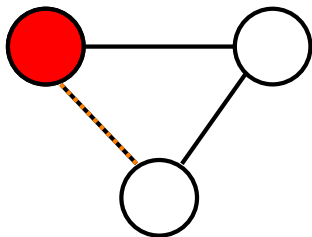
A network is not just a metaphor: it is a precise, mathematical construct of nodes (vertices, actors) N and edges (ties, relations) E that can be directed or undirected.



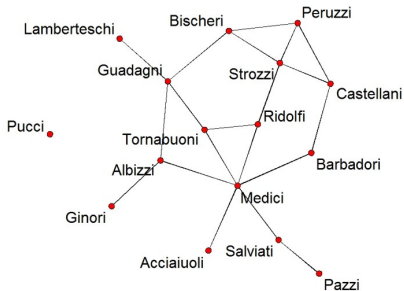
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A network is not just a metaphor: it is a precise, mathematical construct of nodes (vertices, actors) N and edges (ties, relations) E that can be directed or undirected. We can include information (attributes) on the nodes as well as the edges.



Network Intuition



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Why networks?

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- Cannot simply use existing statistical methods

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- Cannot simply use existing statistical methods
- The whole point is that observations are interdependent
- Want to explicitly model these interdependencies

Kinds of Network Relations

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- Interaction (eg communication)

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- Logical implication

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- ...

Types of Actors

- Individuals

Types of Actors

- Individuals
- Collectives or aggregates
 - Households
 - Organizations
 - Countries

Types of Actors

- Individuals
- Collectives or aggregates
 - Households
 - Organizations
 - Countries
- Other units
 - Objects
 - Locations
 - Beliefs

Types of Network Data

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- ‘Whole’ network data

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- Sampled networks

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 - ego networks

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 - respondent-driven sampled data (aka link-trace data, depth or breadth first searches)

Types of Network Data

- ‘Whole’ network data
- Sampled networks
 - ego networks
 - respondent-driven sampled data (aka link-trace data, depth or breadth first searches)
 - somewhere in-between – start with a sample, and ask respondents for additional ‘waves’ of data until no new nodes are found

Boundary Specification

Boundary Specification

- Exogenously defined – based on substantive theory or research question

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 - Members of an organization

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 - People communicating via a specific bulletin board, radio channel, twitter hashtag

All kinds of reasons for sampling

All kinds of reasons for sampling

- used when population is hard to find

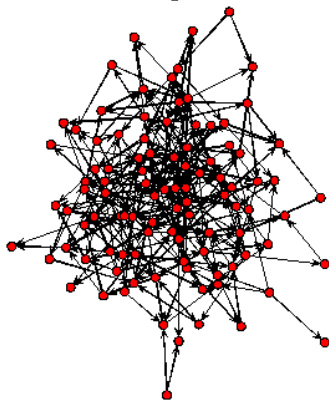
All kinds of reasons for sampling

- used when population is hard to find
- when population is too large

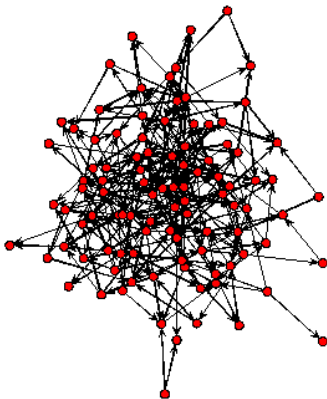
All kinds of reasons for sampling

- used when population is hard to find
- when population is too large
- when all the population just doesn't want to respond

All kinds of samples

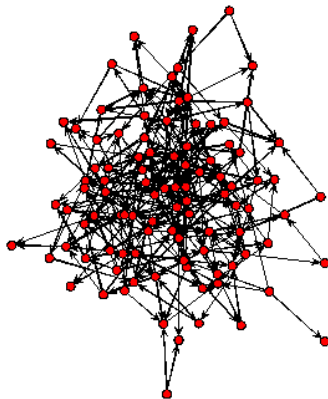


All kinds of samples



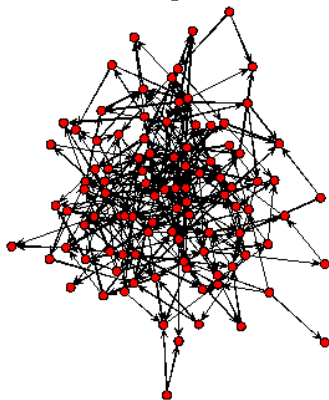
- Ego Networks

All kinds of samples

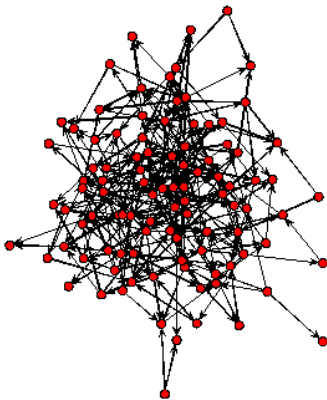


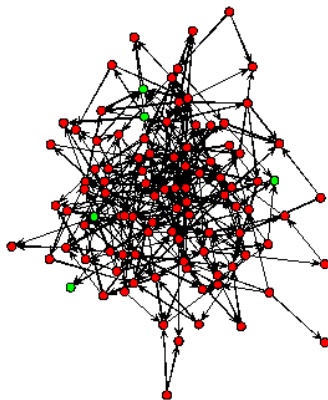
- Ego Networks
- Snowball and Trace sampling

All kinds of samples



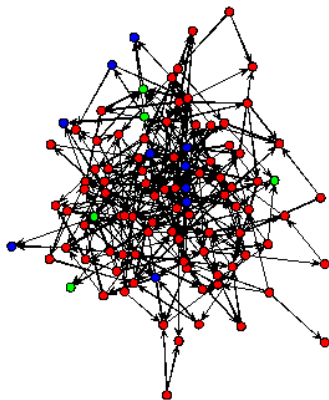
- Ego Networks
- Snowball and Trace sampling
- Boundary setting





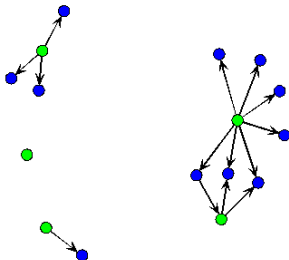
- Randomly select ‘egos’

Ego Networks



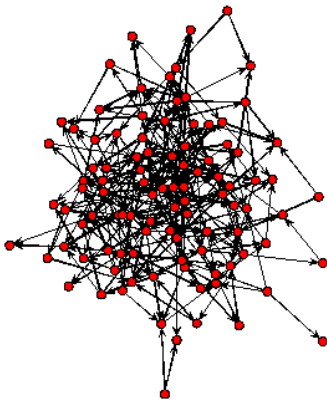
- Randomly select ‘egos’
- Find their alters

Ego Networks

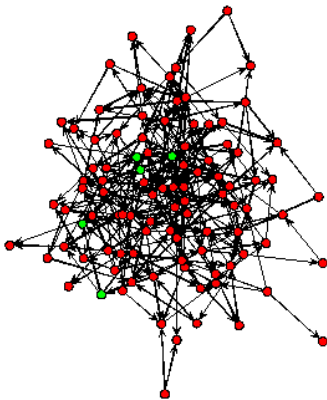


- Randomly select ‘egos’
- Find their alters
- Extract the sample made up of the egos and their alters

Trace Networks

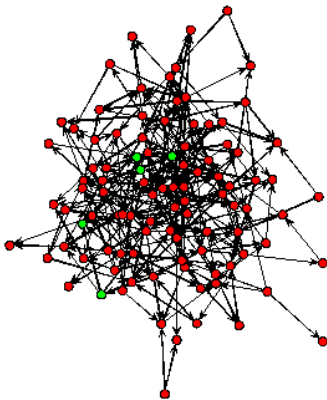


Trace Networks



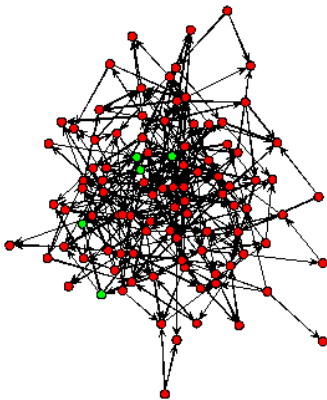
- Randomly select one 'start' node

Trace Networks



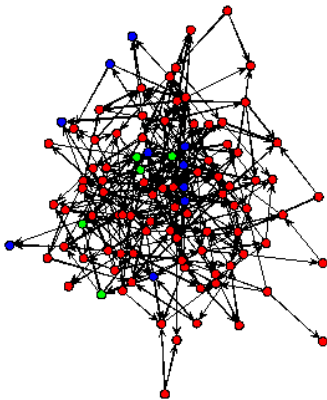
- Randomly select one 'start' node
- Pick one of start's alters

Trace Networks



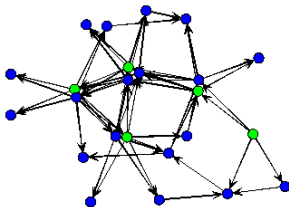
- Randomly select one 'start' node
- Pick one of start's alters
- Pick one of start's alter's alters

Trace Networks



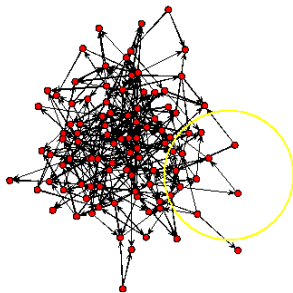
- Randomly select one ‘start’ node
- Pick one of start’s alters
- Pick one of start’s alter’s alters
- Select all of their alters for the sample

Trace Networks

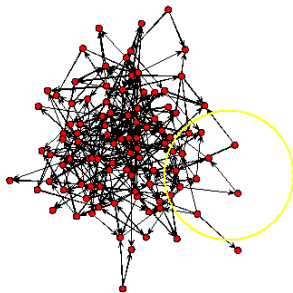


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Boundary Networks

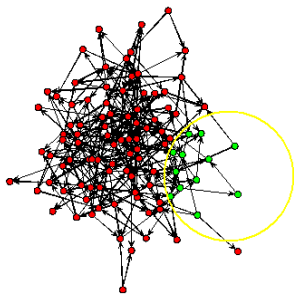


Boundary Networks



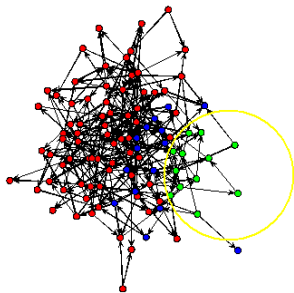
- Set a boundary around some subset of nodes

Boundary Networks



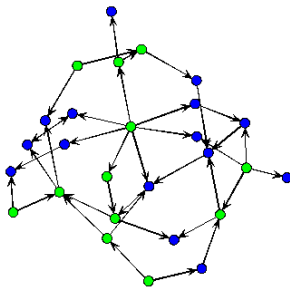
- Set a boundary around some subset of nodes
- Select nodes within the boundary

Boundary Networks



- Set a boundary around some subset of nodes
- Select nodes within the boundary
- Collect their alters

Boundary Networks



- Set a boundary around some subset of nodes
- Select nodes within the boundary
- Collect their alters
- They are your sample

Where do we find Network Data?

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- Survey

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- Historical records

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Where do we find Network Data?

- Survey
- Historical records
- Newspapers/text
- Web scraping
- Plenty of other sources

Data Collection Questions

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 - Do you have a directed relationship, or multiple observations of an undirected relationship?

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 - And if so, should you symmetrize?

Question Example

13. PLEASE LIST THE NAMES OF ALL OF THE ORGANIZATIONS WITH WHICH YOU COLLABORATE REGULARLY WITHIN THE FOLLOWING CATEGORIES.

COMMUNITY GROUPS (CIVIC GROUPS, NON PROFITS, ETC.)

BUSINESSES AND/OR BUSINESS GROUPS (CHAMBERS OF COMMERCE, BUSINESS IMPROVEMENT DISTRICTS, ETC.)

GOVERNMENT AGENCIES/PROGRAMS (LOCAL, STATE, AND/OR FEDERAL)

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- Were responses constrained in some way?
 - List up to 5

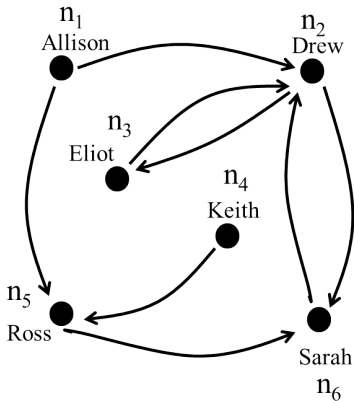
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 - List up to 5
 - Roster-based

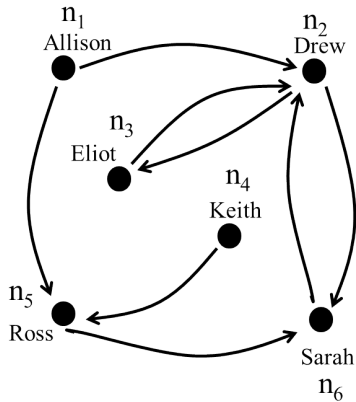
<i>1:</i> <i>Science</i>	<i>2:</i> <i>Collaborators</i>	<i>3:</i> <i>Influential Actors</i>	<i>Comments</i>
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**Government (Bureaus, Departments,
Agencies, Research Institutes):**

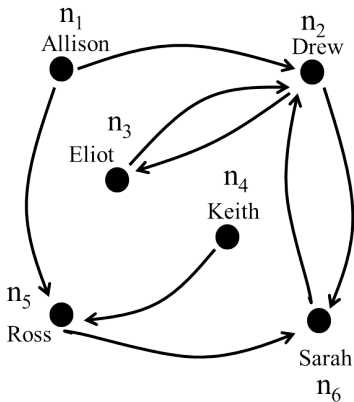
Federal Energy Regulatory Commission				
Government Accountability Office				
NASA				
National Institutes of Health				
NOAA				

- Directed or Undirected?
 - Undirected: marriage, lives next door to, has a conversation with
 - Directed: gives money to, has respect for, asks a question of
 - Do you have a directed relationship, or multiple observations of an undirected relationship?
 - And if so, should you symmetrize?
- Were responses constrained in some way?
 - List up to 5
 - Roster-based
 - Question confusion and difficulty



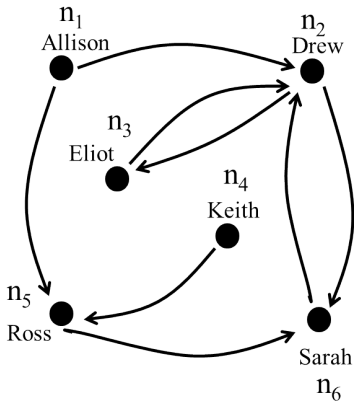


	n_1	n_2	n_3	n_4	n_5	n_6
n_1						
n_2						
n_3						
n_4						
n_5						
n_6						

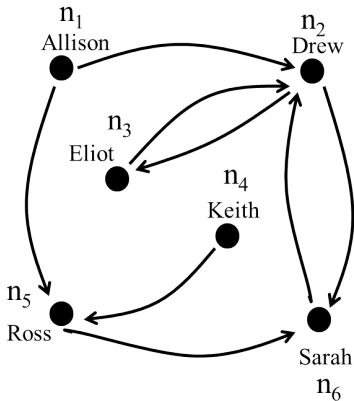


	n_1	n_2	n_3	n_4	n_5	n_6
n_1		1				
n_2						
n_3						
n_4						
n_5						
n_6						

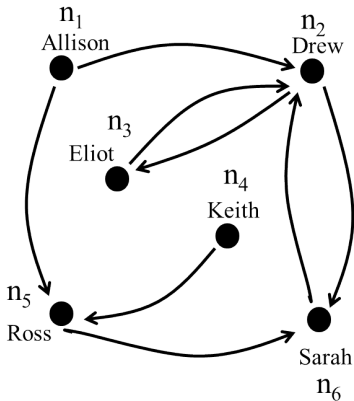
Data Structures



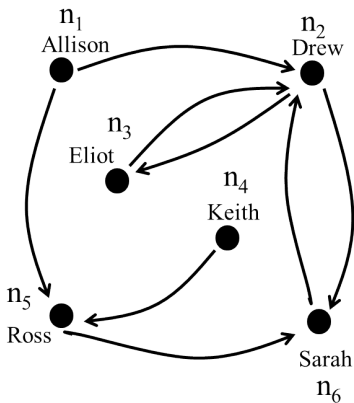
	n_1	n_2	n_3	n_4	n_5	n_6
n_1		1			1	
n_2			1			1
n_3		1				
n_4			1		1	
n_5				1		1
n_6		1			1	



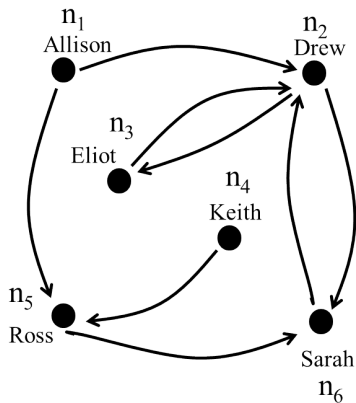
	n_1	n_2	n_3	n_4	n_5	n_6
n_1		1			1	
n_2			1	1		
n_3		1				
n_4					1	
n_5						1
n_6		1				



	n_1	n_2	n_3	n_4	n_5	n_6
n_1	-	1			1	
n_2		-	1	1		
n_3		1	-			
n_4				-	1	
n_5					-	1
n_6		1				-

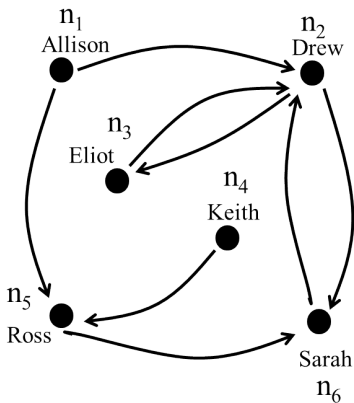


	n_1	n_2	n_3	n_4	n_5	n_6
n_1	-	1	0	0	1	0
n_2	0	-	1	1	0	0
n_3	0	1	-	0	0	0
n_4	0	0	0	-	1	0
n_5	0	0	0	0	-	1
n_6	0	1	0	0	0	-

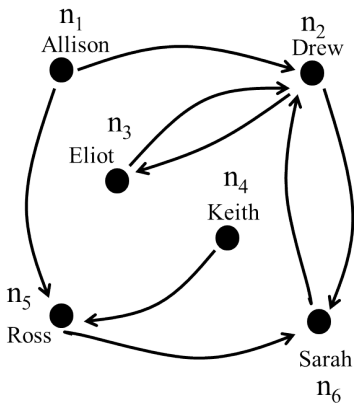


Sender	Receiver	Weight
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Data Structures

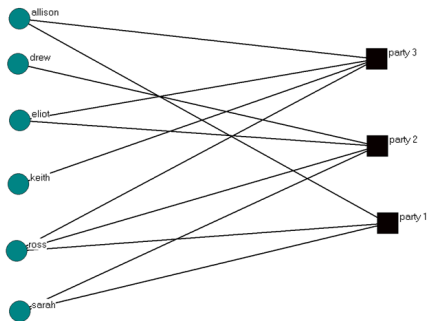


Sender	Receiver	Weight
n_1	n_2	1



Sender	Receiver	Weight
n_1	n_2	1
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n_3	n_2	1
n_4	n_5	1
n_5	n_6	1
n_6	n_2	1

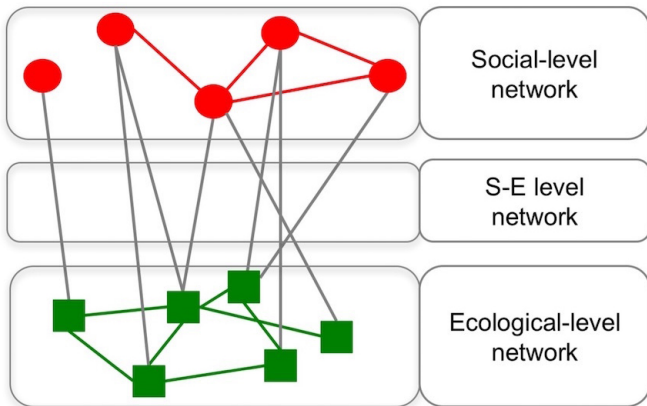
Two-Mode Matrices



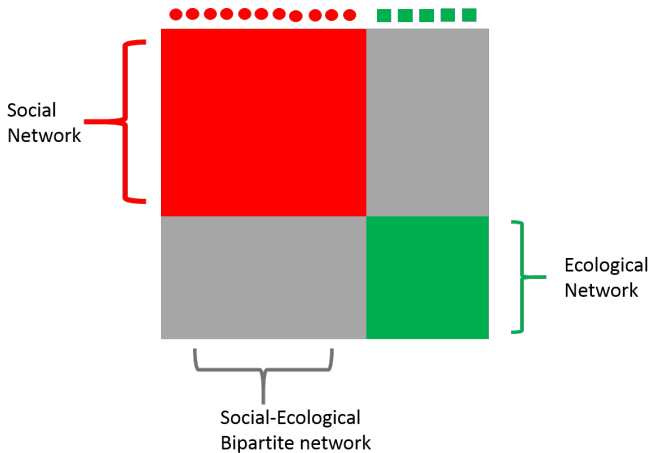
- Two sets of entities or groups
- Usually defined with undirected ties between groups and not within groups

Barnes et al. 2017

A



Socio-Ecological Networks



- UCInet - introductory, point-and-click (<https://sites.google.com/site/ucinetsoftware/home>)
- Pajek - larger data, focus on clusters (<http://mrvar.fdv.uni-lj.si/pajek/>)
- NodeXL - focused on social media (<https://www.smrfoundation.org/nodexl/>)
- Visone - Visualization (visone.info)
- Gephi - Visualization (<https://gephi.org/>)
- Network Canvas - interactive surveys (<https://networkcanvas.com/>)
- **R** programming language - packages Statnet and iGraph
- Python library NetworkX

Examples

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Definition

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- 2 Johnson, Jeffrey C., James S. Boster, and Lawrence A. Palinkas. “Social roles and the evolution of networks in extreme and isolated environments.” *Journal of Mathematical Sociology* 27.2-3 (2003): 89-121.
- 3 Laumann, Edward O., Peter V. Marsden, and David Prensky. “The boundary specification problem in network analysis.” *Research methods in social network analysis* 61 (1989): 87.
- 4 Tromble, Rebekah, Andreas Storz, and Daniela Stockmann. “We Don’t Know What We Don’t Know: When and How the Use of Twitter’s Public APIs Biases Scientific Inference.” Available at SSRN 3079927 (2017).

- ⑤ Crossley, Nick, et al. Social network analysis for ego-nets: Social network analysis for actor-centred networks. Sage, 2015.
- ⑥ Gile, Krista J., Lisa G. Johnston, and Matthew J. Salganik. “Diagnostics for respondent-driven sampling.” Journal of the Royal Statistical Society. Series A,(Statistics in Society) 178.1 (2015): 241.
- ⑦ Abdul-Quader, Abu S., et al. “Implementation and analysis of respondent driven sampling: lessons learned from the field.” Journal of urban health 83.1 (2006): 1-5.

Data Structures

- ① Barnes, Michele L., et al. “The social structural foundations of adaptation and transformation in social–ecological systems.” Ecology and Society 22.4 (2017).