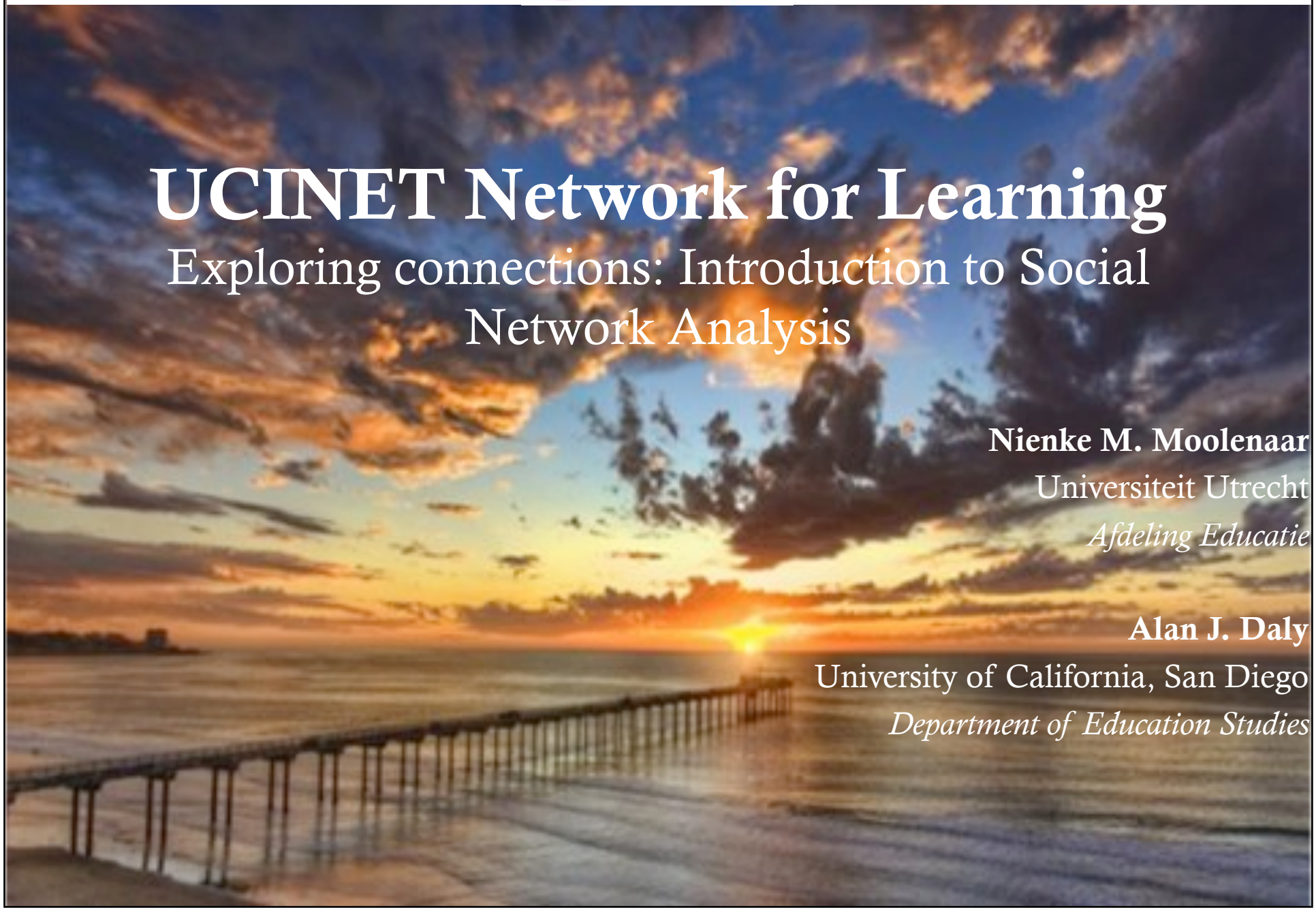

UCINET Network for Learning

Exploring connections: Introduction to Social Network Analysis

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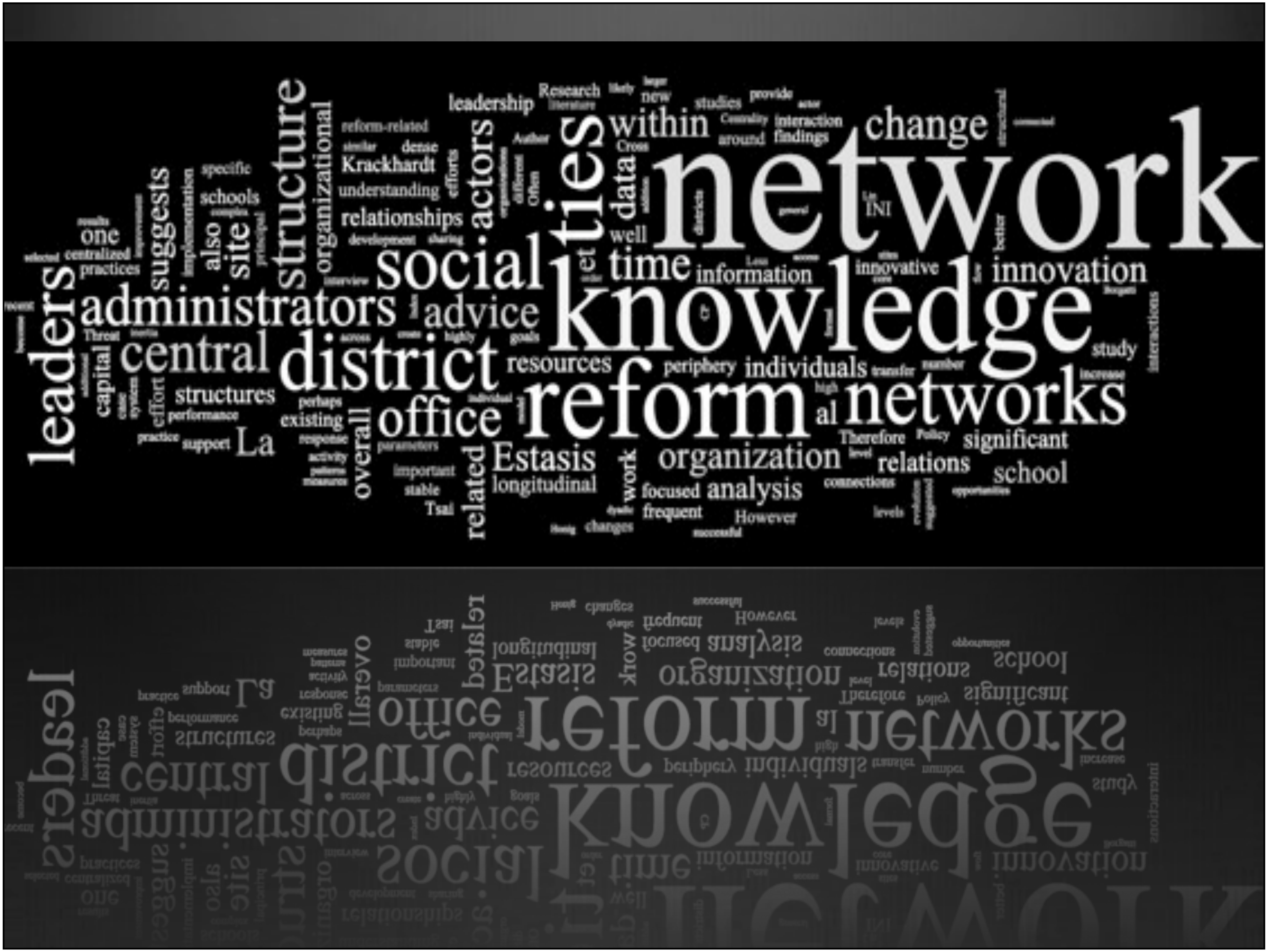
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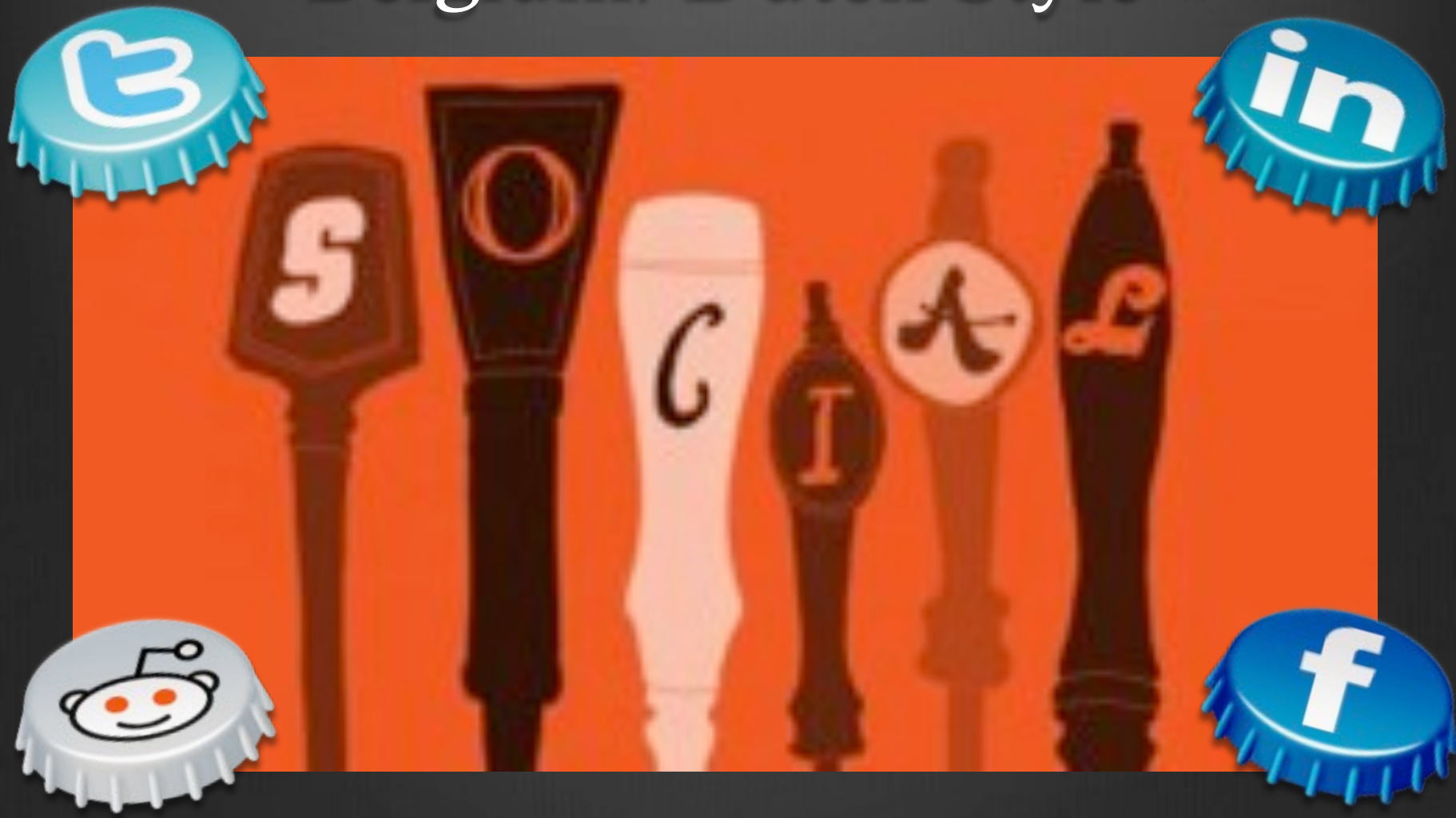
Many Thanks …

- Sara Van Waes Universiteit Antwerpen
- Brian V. Carolan, Montclair State University
- Steve Borgatti, Rich DeJordy, Tom Snijders, and Tom Valente
- SNA courses we have taken and taught these past several years

Social Networks: San Diego Style

Social Networks: Belgium/Dutch Style



Introduction to UCINET for Educational Researchers
Network for Learning Meeting 2014

Today's Objectives

1. Offer an overview of available software to analyze social network data
2. Provide hands-on experience with software (UCINET) to investigate social network structure

Workshop Overview

1. Measures and Analysis
2. Hands-on: UCINET Network Demonstration
3. Getting Started with Network Research
4. Concluding Remarks, Questions, and Next Steps

Network-Level Measures

- Explain outcomes as function of complete network properties
  - Density: the ratio of existing ties divided by all possible ties
  - Reciprocity: the extent to which mutual ties
  - Centralization: the extent to which a network is centralized (star-shaped)
  - Cliques: subgroup of of three or more actors
  - Many more…

Density

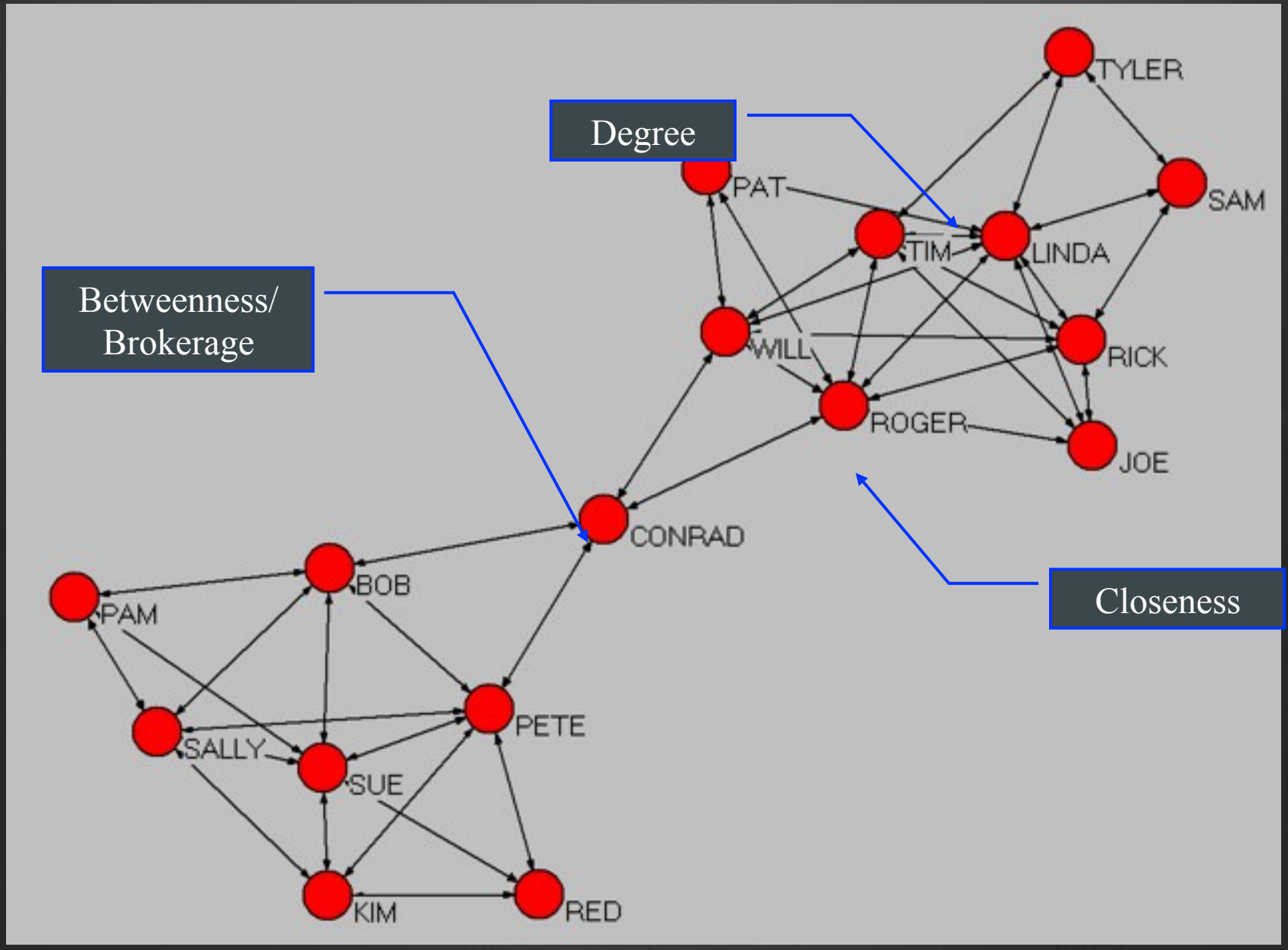
- Measures a network's cohesion
- Density supports the exchange of resources between actors (flows) as it allows for development of shared norms, monitoring, sanctions, and trust
- Dense networks can also move tacit resources more quickly, and provide increased opportunities for meeting collective goals.
- Sparse networks associated with access the new information through non-redundant ties
- Density, may, however, inhibit the exchange of vital ideas and tacit knowledge
- Calculated as number of existing ties/total number of possible ties

Reciprocity

- Defined as the extent to which relationships in a network are mutual / reciprocal
- Important in systems oriented toward learning and work flow relationship
- Have potential to become imbued with trust, value, legitimacy, and can support exchange of complex resources
- Are associated with complex knowledge exchange and higher organizational performance
- May also constrain the exchange of novel resources
- Calculated as number the number of dyads connected by a mutual tie divided by the number of dyads connected by any tie.

Ego-Level (Individual) Measures

- Centrality
  - Degree
    - how well connected; direct influence
  - Closeness
    - How ‘close’ an actor is to the entire network
    - how long information takes to arrive
  - Betweenness
    - Times an actor is positioned ‘in between’ disconnected others and ‘bridges’ a structural hole
    - brokerage, gatekeeping, control of info
- Many more…



Data courtesy of David Krackhardt

Degree Centrality

- Index of exposure
- What is flowing through the network?
  - Gossip network: central actor more likely to hear a given bit of gossip
- Interpreted as opportunity to influence & be influenced directly
- Predicts variety of outcomes: virus resistance, power & leadership, job satisfaction, and knowledge

Degree Centrality (con't)

- Highly central actors increased influence over the network
- Increase an actor's opportunities to access novel information in sparse networks
- Burden of maintaining too many ties
- Calculated (in a directed network) as the number of out-/in-going ties divided by the total number of potential out-/in-going ties. Can be normalized and compared across networks

Closeness Centrality

- Direct and indirect ties are important in enhancing an actor's ability to move resources (Bacon Number)
- Index for how 'long' it will take for resources to arrive
- Key Players/Opinion Leaders and their ability to influence actors/network

Closeness Centrality (con't)

- Calculated as (the inverse of) the sum of lengths of one actor to all others
- Index of expected time until arrival of whatever is flowing through the network
  - E.g., gossip network: central player hears things first

Betweenness Centrality

- How often a node lies along the shortest path between two other nodes

- Index of potential for gatekeeping, brokering, controlling the flow, and also of liaising otherwise separate parts of the network
- Interpreted as indicating power and access to diversity of what flows; potential for synthesizing
- Associated with power, strategic, and influential advantage for node as possess the 'ability' to control the flow and content of resources
- Generally positive outcomes for nodes and less so for moving resources throughout a network

Data Types: Centrality

Is the network that you measured…

Then you can assess…

	Disconnected or Connected	Binary or Valued	Directed or Undirected
Degree	Both	Both	Both
Closeness	Strongly Connected	Binary	Both
Betweenness	Both	Binary	Both

Why Being Being "Central' Matters

- Drawing from different cultural or informational pools
  - synthesis, innovation, value
- Toll-taking, brokerage
- Gatekeeper (secretary-power)
- Play others off each other

Tools & Software

- DISCLAIMER: This workshop focuses on UCINET and NETDRAW. They are not the only tools out there for social network analysis and visualization, but, they are very popular and have a nice balance of usability and capability

Other Software Tools

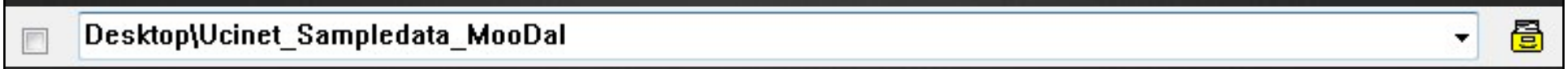
- R has packages to analyze social networks
- There are others, generally for particular niches
  - Stocnet (e.g., analysis of antecedents of ties, p2-modeling)
  - R-SIENA (longitudinal analysis of networks)
  - Pajek (Better at computational analysis of really large networks)
  - E-Net (analyzing ego networks)
  - KeyPlayer (influencing or disrupting networks)
  - ORA (analyzing large-scale semantic networks)

UCINET & NetDraw

- UCINET
  - This is social network analysis software
  - Allows for the computational aspects of analysis, including calculating various measures (e.g., centrality, cohesion, brokerage) among others, as well as hypothesis testing
- NetDraw
  - This is social network visualization software
  - Allows for graphic representation of networks including relations and attributes
  - Has some analytic capabilities that partially overlap with UCINET

Getting started with Ucinet

1. Open UCINET
2. Locate the "file drawer" on the lower right corner
3. Click and choose folder on Desktop
4. Set your working directory/folder
5. Please note UCINET creates 2 files for every data set .##h and .##d. You need BOTH files for UCINET to function properly.



Orientation to Ucinet

- Menu titles

- Detailed help files
- Hanneman & Riddle manual
- Ruler has icons; quick way to access commands

Excel/Data Grid

- Excel is the "Universal Translator"
- UCINET has a Data Grid tool that
- Looks like excel
- Can (usually) read excel files
- Works really well with Excel Cut & Paste
- As long as you click in the right place for pasting your data

Displaying a network file

- Click on spreadsheet editor
- Click on 'open' icon (2nd icon from left)
- Select file School28_MooDal to open the network file
- This is a NxN square matrix that contains network data for each individual
- Rows represent respondents' answers (choosing), columns represent 'being chosen'
- You may change/edit data here

Displaying an attribute file

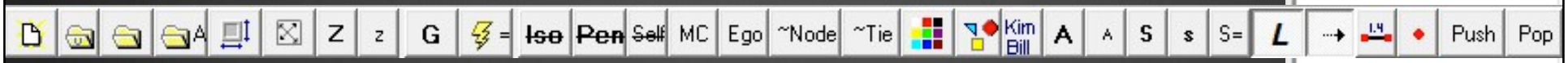
- Two types of files (network/attribute)
- Select file School28_MooDal_attr to open the attribute file
- This is a NxAttribute matrix that contains attribute data for each individual (e.g. SPSS)
- Rows represent respondents, columns represent attributes
- You may change/edit data here

Getting started with Netdraw

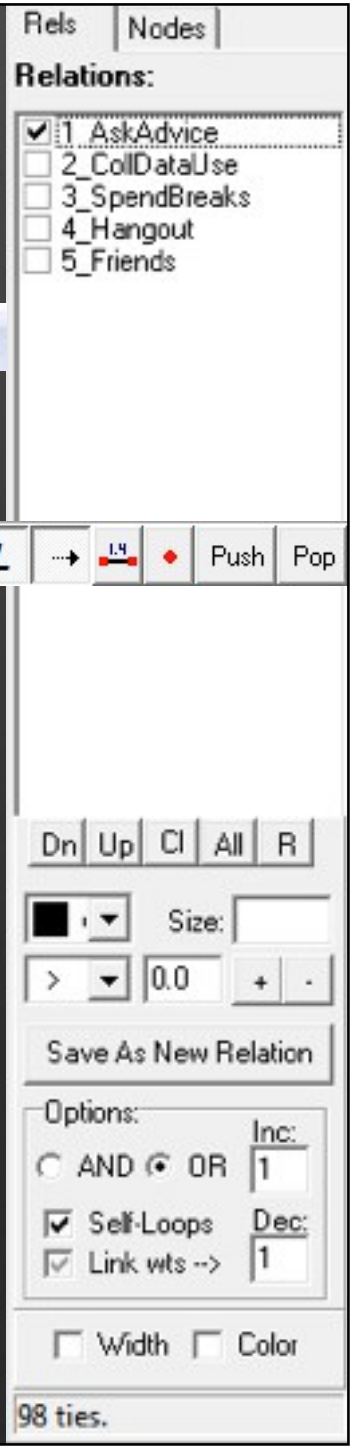
1. From UCINET, click on the Network Picture
2. This will open Netdraw

Orientation to Netdraw

- Menu titles

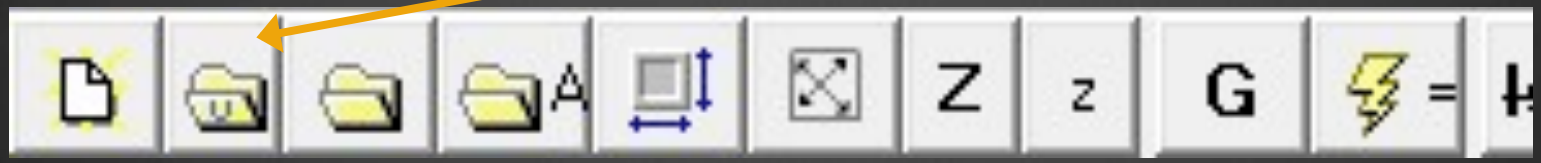


- Ruler has icons; quick way to access commands
- Right hand sidebar with options
  - Access to different networks
  - Access to attributes (later)
  - Access to valued networks



Opening a network file in Netdraw

1. Click on the open folder with a "U" on the cover



2. Notice this brings up a dialog box, which includes a number of files
3. Select the file School28_MooDal and click on open

Netdraw

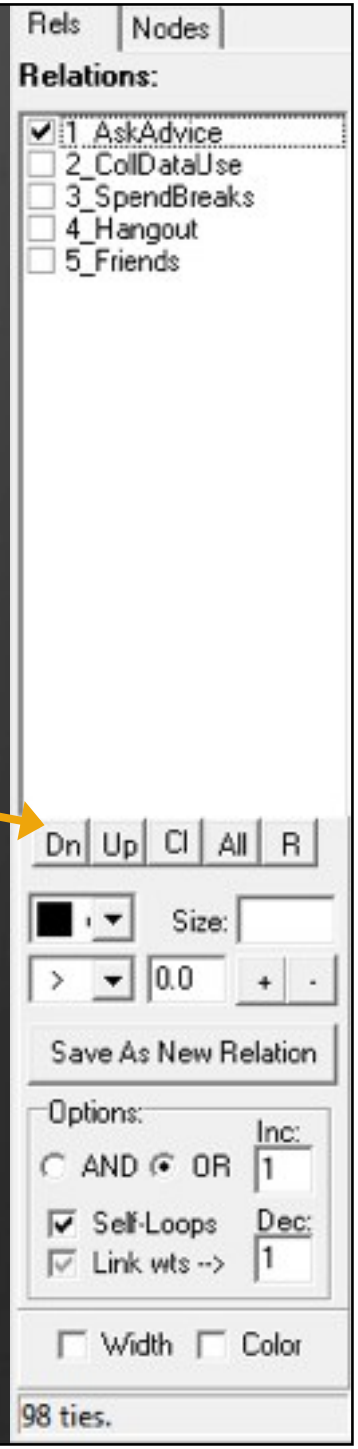
- First we examine how to layout your network
  - You may change positions of nodes
  - You may redo the default layout (MultiDimensional Scaling) using the lightning bolt (10th icon from left)

  - Right-click on the node gives you all kinds of options, more can be found in the Hanneman & Riddle manual

Keep in Mind …

- Right side bar contains multiple types of networks
- Use "Dn" and "Up" to scroll through networks
  - Again, you need to use the lightning bolt to redo the default layout or when you choose other network

- Note: nodes on left without links are isolates

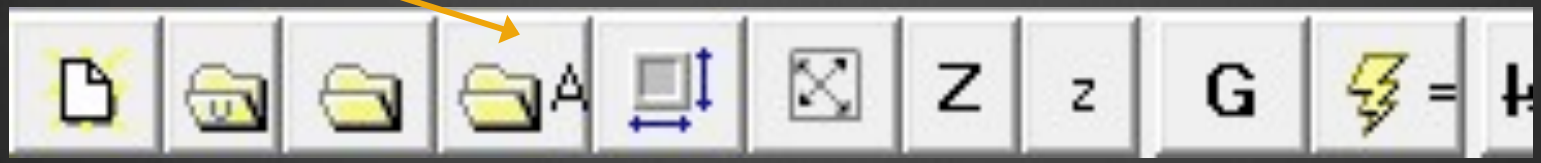


Think-Pair-Share

- Turn to your neighbor
- As you look at the structure of the different relationships, what stands out to you?

Opening an attribute file

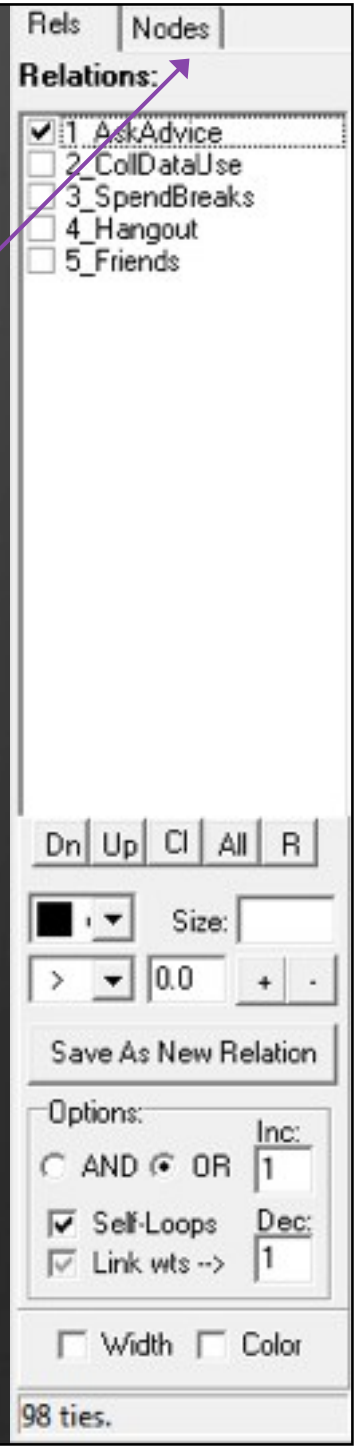
- In Netdraw, click on the 'open attribute' icon (4th icon from the left)



- Make sure that the *Type of Data* is set to *Node Attribute(s)*
- Choose School28_MooDal_attr

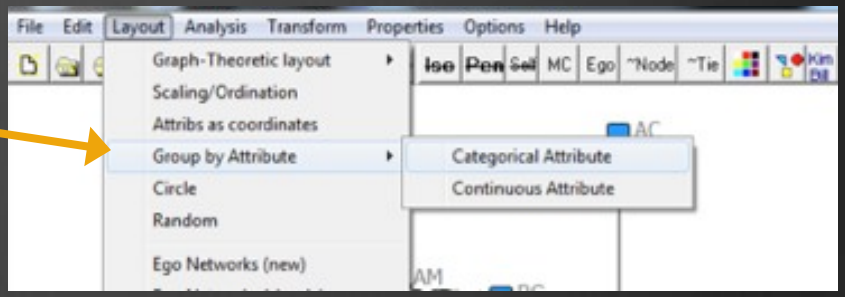
Opening an attribute file

- Go to right sidebar and click on Nodes
- Down arrow shows all attributes



Example; Grouping individuals by attribute

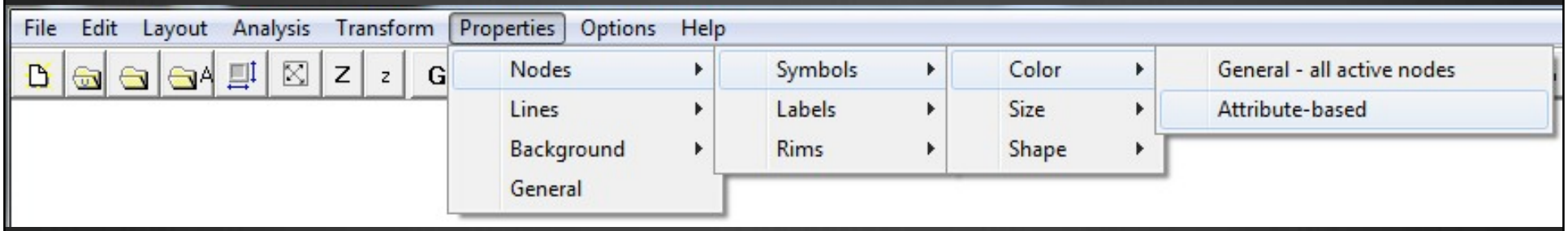
- Use Network 1_AskAdvice
- Click on Layout > Group by Attribute > Categorical Attribute



- Select attribute (Grade level), which groups the network based on upper/lower grade
- You may use this to group by grade level, gender, schools, formal position, responses on different scales, etc.

Example; Coloring individuals by attribute

- Use Network 1_AskAdvice
- Click on Properties > Nodes > Symbols > Color > Attribute-based



- Select the attribute that you'd like to color-code (e.g., grade level)
- You may want to turn on/off labels (6th icon from right)
- Right-click on the node gives you all kinds of options

Example; Sizing individuals by attribute

- Analytical way to use Netdraw
- Use Network 1_AskAdvice
- Click on Analysis> Centrality measures
- Select the measure to calculate: Degree
- Under 'Direction', select 'Directed versions'
- Click OK & OK
- Netdraw has now added Degree centrality for each individual to the attribute file

Example; Sizing individuals by attribute

- Click on Properties > Nodes > Symbols > Size > Attribute-based
- Select Attribute: Indegree
- What do you notice?
- Select Attribute: Outdegree
- What do you notice?
- Select Attribute: Betweenness
- What do you notice?
- Warning; if you choose another network, you will have to recalculate the centrality measures

Finally, saving graphs

- Note; do this before you close Netdraw
- File > Save Diagram as > .jpeg

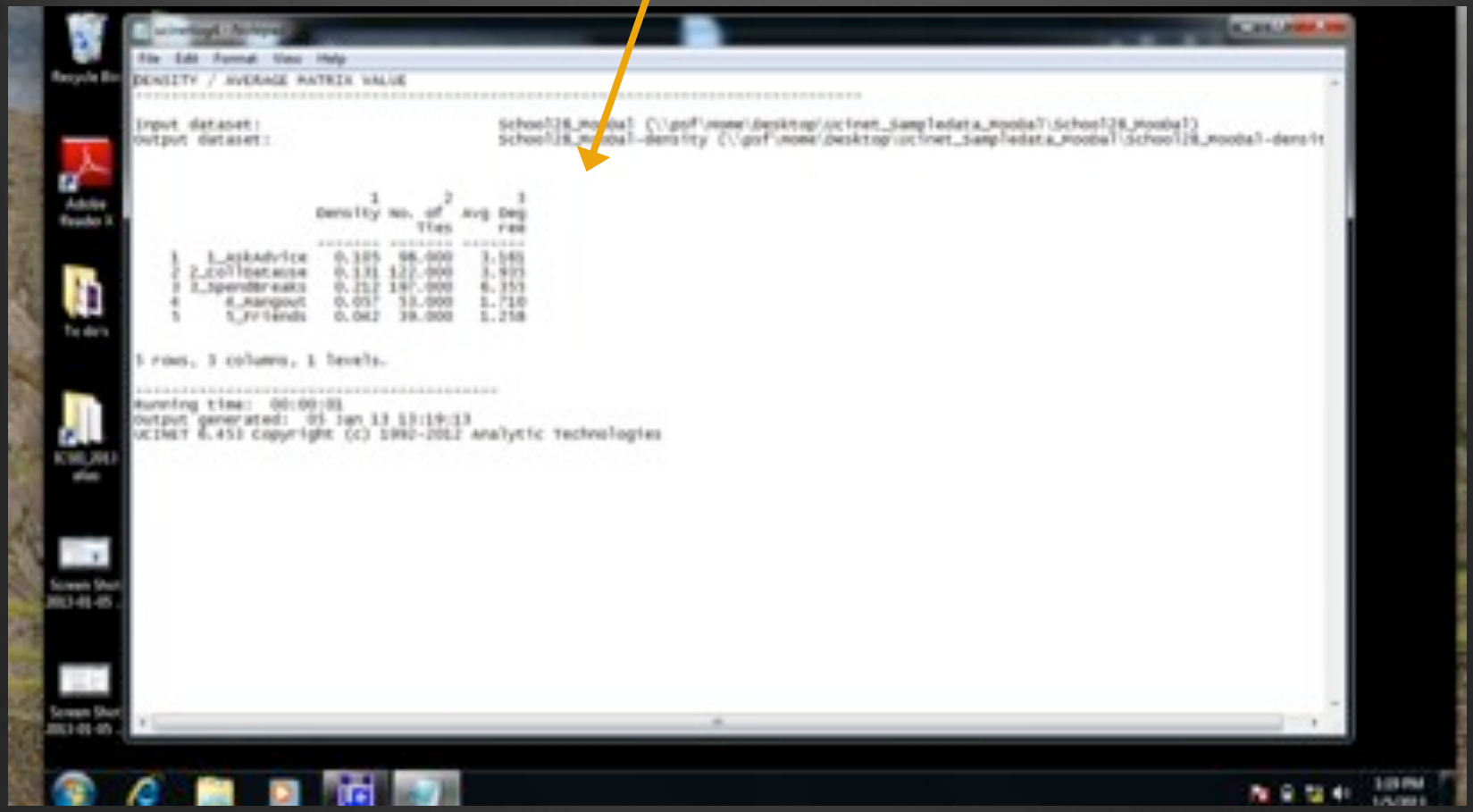
Section Overview

- Hands-on exercise with Ucinet
  - Calculating network measures:
    - Density
    - Degree centrality
    - Betweenness centrality
  - Making sense of data

Investigating Density with UCINET

- In UCINET, go to Network > Cohesion > Density > Density Overall
- Select School28_MooDal
- Example of Help-file with definition and details of density
- This gives us the density measures for each relationship (network-level)

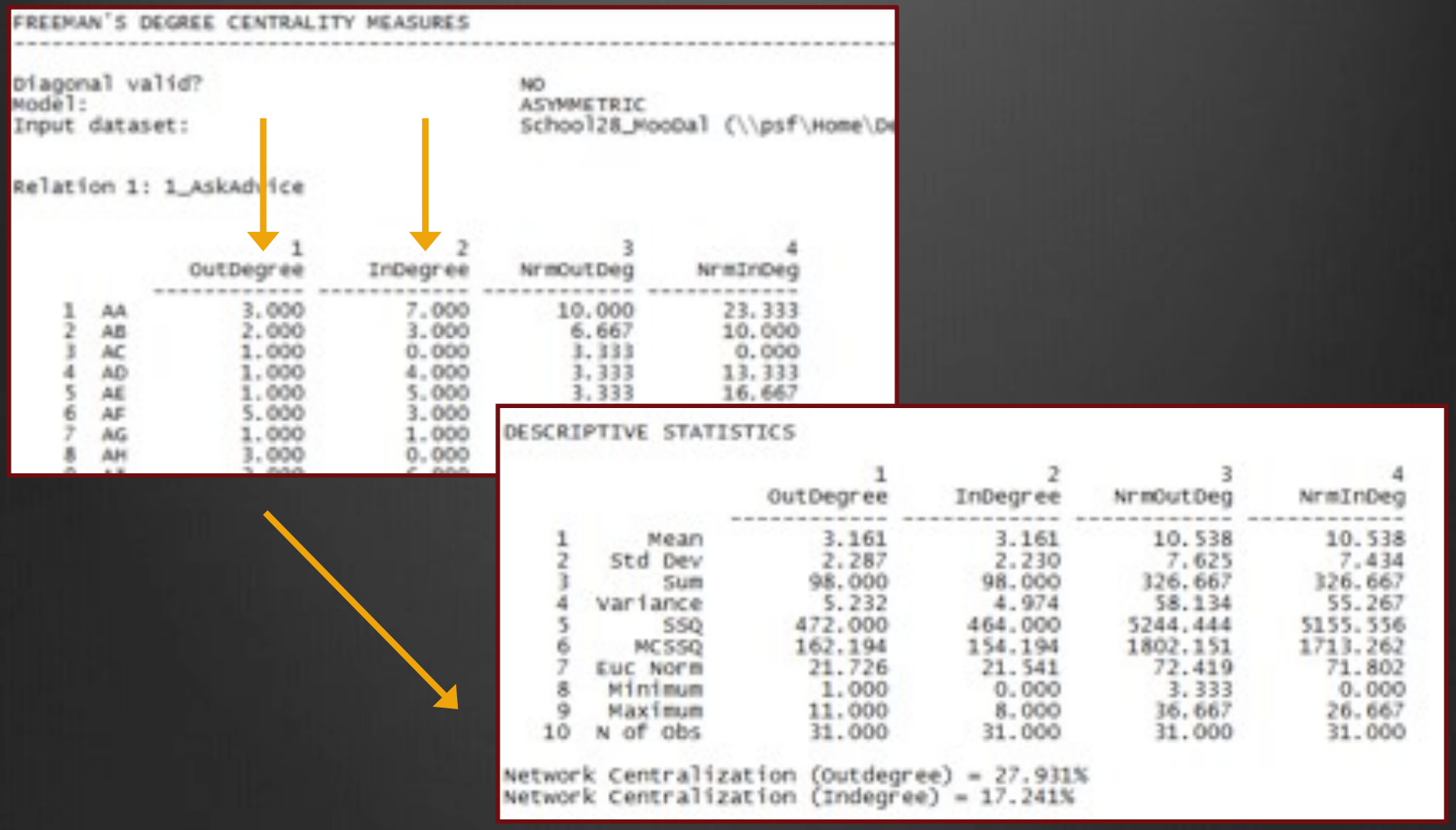
Output for density



Investigating Degree Centrality

- In UCINET, go to Network > Centrality and Power > Degree
- Select School28_MooDal
- This gives us the outdegree and in-degree measures for each individual
- As well as the centralization of the overall network

Output for Degree Centrality



FREEMAN'S DEGREE CENTRALITY MEASURES

Diagonal valid? NO
Model: ASYMMETRIC
Input dataset: School28_MooDal (\\psf\Home\D

Relation 1: 1_AskAdvice

		1 OutDegree	2 InDegree	3 NrmOutDeg	4 NrmInDeg
1	AA	3.000	7.000	10.000	23.333
2	AB	2.000	3.000	6.667	10.000
3	AC	1.000	0.000	3.333	0.000
4	AD	1.000	4.000	3.333	13.333
5	AE	1.000	5.000	3.333	16.667
6	AF	5.000	3.000		
7	AG	1.000	1.000		
8	AH	3.000	0.000		

DESCRIPTIVE STATISTICS

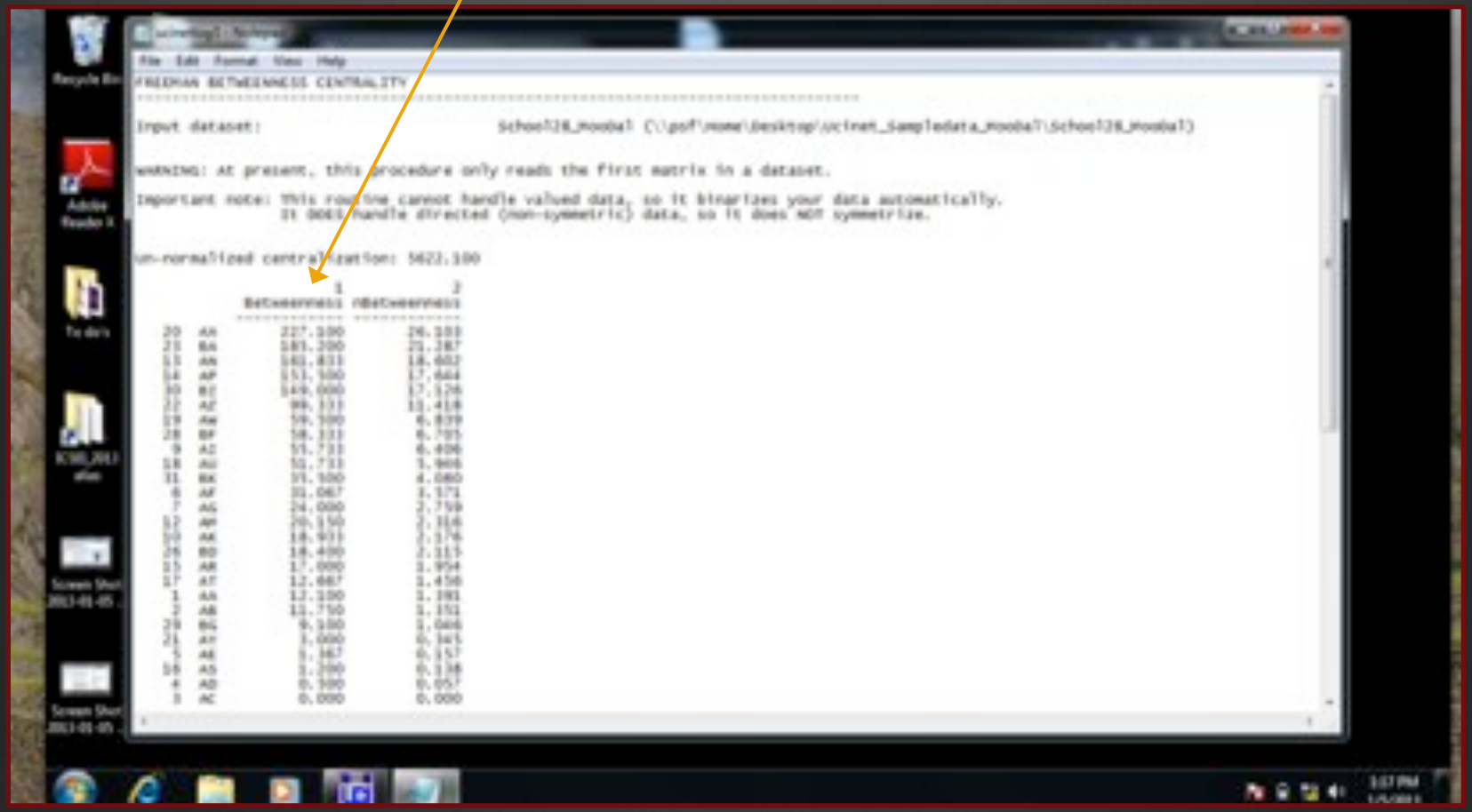
		1 OutDegree	2 InDegree	3 NrmOutDeg	4 NrmInDeg
1	Mean	3.161	3.161	10.538	10.538
2	Std Dev	2.287	2.230	7.625	7.434
3	Sum	98.000	98.000	326.667	326.667
4	Variance	5.232	4.974	58.134	55.267
5	SSQ	472.000	464.000	5244.444	5155.556
6	MCSSQ	162.194	154.194	1802.151	1713.262
7	Euc Norm	21.726	21.541	72.419	71.802
8	Minimum	1.000	0.000	3.333	0.000
9	Maximum	11.000	8.000	36.667	26.667
10	N of obs	31.000	31.000	31.000	31.000

Network Centralization (Outdegree) = 27.931%
Network Centralization (Indegree) = 17.241%

Investigating Betweenness Centrality

- In UCINET, go to Network > Centrality and Power > Freeman Betweenness
- Select School28_MooDal
- This gives us the betweenness and normalized betweenness measures for each individual

Output for Betweenness Centrality



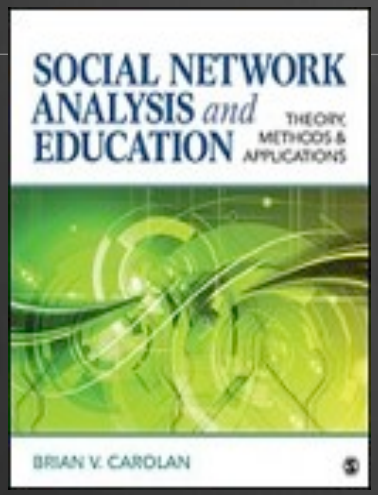
Display generated data

- In UCINET, go to spreadsheet editor icon
- Click on "open" and open up School28_MooDal-density
- This will show you the generated data for importing into SPSS, Excel, etc.
- Other generated data can be found in the same folder and opened the same way

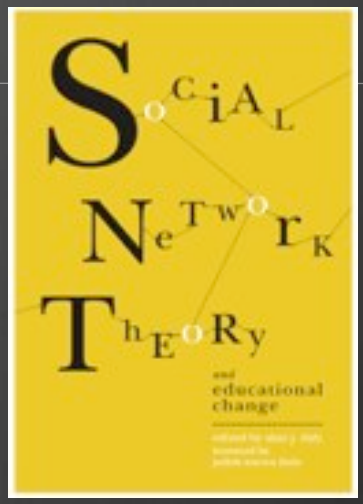
Think-Pair-Share

- Turn to your other neighbor
- Choose one of the three measures and open this in the spreadsheet editor
- How might you use these measures in answering your research question(s)?

Print Resources Specific Educational Research



Carolan B. V. (2013). *Social network analysis and education: Theory, methods, and applications*. Thousand Oaks, CA: SAGE Publications.



Daly, A. (Ed.). (2010). *Social network theory and educational change*. Cambridge, MA: Harvard Education Press.

Other Resources

- Listservs for specific SNA applications
  - UCINET: http://tech.groups.yahoo.com/group/ucinet/
  - StOCNET: http://tech.groups.yahoo.com/group/stocnet/
- International Network for Social Network Analysis (INSNA) has great website and annual conference (Sunbelt) with workshops on a wide variety of network topics
- Several courses and summer schools are offered around the world (e.g., LINKS Center for Social Network Analysis at the University of Kentucky)

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