ANG6930: Social Network Analysis
Chris McCarty
ufchris@ufl.edu
Suite 156, Ayers Building 720 SW 2nd Ave.
(352) 392-2908 x101

Social Network Analysis is a research strategy that allows researchers to quantify the pattern of relations among a set of actors. The actors are usually people, but they can also be animals, organizations, or nations. Social networks analysis can be applied to substantive problems that cut across many subjects and disciplines. Any research problem where there is a possibility of a measurable effect from the pattern of relations among the actors may benefit from social network analysis.

There are two distinct types of social network analysis. "Sociocentric" or "Whole" networks consist of the relations between all actors within a group. These actors might be members of a club, a classroom of children, a village or the executive board of a Fortune 500 company. The focus of sociocentric network studies is the structure within the group. "Egocentric" or "Personal" networks consist of the people known by individuals. Typically respondents are presented with questions or cues that elicit the names of people they know. These data are analyzed by summarizing the characteristics of the network "alters" for each respondent and correlating aggregate characteristics with the individual characteristics of the respondents themselves. Data like these enable the researcher to study topics such as the characteristics of social support networks, or the relationship between IV drug use and the transmission of HIV.

In this course you will be introduced to the research methods and theoretical approaches used in both types of social network analysis. This will be a hands-on course where you will learn how to collect social network data, how to input it into the appropriate software and how to analyze it. By the end of the course you will have a good idea about how to apply social network analysis into your own work.

Throughout the semester I will assign articles which we will discuss in class. I am not going to assign a textbook for this class, however there are some books you might find helpful:

- *Social Network Analysis: A Handbook* by John Scott, London: Sage (2000).
- Online textbook by Robert A. Hanneman and Mark Riddle. 2005. I*ntroduction to social network methods*. Riverside, CA: University of California, Riverside (published in digital form at http://faculty.ucr.edu/~hanneman/).
- *Social Network Analysis: Methods and Applications*. Stanley Wasserman and Katherine Faust. Cambridge: Cambridge University Press (1994).
- *Social Networks and Health: Models, Methods and Applications* by Tom Valente (2010) Oxford: Oxford University Press.
- *Understanding Social Networks: Theories, Concepts and Findings* (2011) Charles Kadushin's Oxford: Oxford University Pres.
- *The Development of Social Network Analysis: A Study in the Sociology of Science* Linton C. Freeman, Empirical Press, Vancouver, BC (2004).

- *The SAGE Handbook of Social Network Analysis* (2011) Eds. John Scott and Peter Carrington. London: Sage Publications

You will be required to use some software in this class, therefore all students must have a laptop. If you have a Mac it must be able to run Windows software. If it cannot, you will have to find a Windows laptop that you can use. The two main programs will be UCINET and Egonet. I will give you the software to install both programs. Egonet is a program for the collection and analysis of personal network data. It is a Java-based program available for free from Sourceforge (http://sourceforge.net/projects/egonet/). To run it you must install Java on your computer. This is available for free (www.java.com). UCINET is not free. The setup I give you in class will run for 60 days, but will then cause problems to get you to register. You must register the copy which currently costs $40. We may also use a program called SIENA and another called ORA which are available for free.

All readings and assignment materials will be distributed via this web site: http://www.bebr.ufl.edu/chrism/ang6930

Grading will mostly be based on homework assignments and a final proposal. The final proposal will incorporate the concepts we learned in class applied to your own work. This should be a ten page NSF style proposal. My office hours are by appointment – just e-mail me.

The following schedule is a guide:

August 28th: Overview, One-mode network data

- Introductions – Each student will describe their interests and possible uses of social network analysis in their research
- Overview of social networks (whole versus personal networks, one-mode versus two-mode network data)
- Getting software installed
- Collect one-mode network for class and input it into UCINET
- Introduction to UCINET

Read:
- Radcliffe-Brown, A. R. 1940. "On Social Structure." Journal of the Royal Anthropological Society of Great Britain and Ireland 70:1-12.
- Borgatti, Stephen P.; Mehra, Ajay; Brass, Daniel J.; Labianca, Giuseppe (2009) Network Analysis in the Social Sciences. *Science* 323: 892-895.
- Marsden, Peter (1990) Network data and measurement. *Annual Review of Sociology* 16:435-463.
- Marsden, Peter, Karen Campbell (1984) Measuring tie strength. *Social Forces* 63:482-501
- Stephen P. Borgatti, Martin G. Everett (1997) "Network analysis of 2-mode data", *Social Networks* 19: 243-269

Homework: One-mode assignment

September 4th : UCINET and Netdraw, two-mode data

- Go into detail of UCINET and NETDRAW
- Go over data transformation (symmetrize and dichotomize)
- Collect two-mode data from class
- Input two-mode data into UCINET

Homework: Two-mode assignment

Read:
- Kossinets, G. (2006). Effects of missing data in social networks. *Social Networks* 28: 247–268.
- Freeman, L. (1979). Centrality in social networks: Conceptual clarification. *Social Networks*. 1, 215-239.
- Costenbader, E. & Valente, T. W. (2003). The stability of centrality when networks are sampled. *Social Networks*. 25(4): 283-307.
- Borgatti, S. P., Carley, K. M., Krackhardt, D. On the Robustness of Centrality Measures under Conditions of Imperfect Data.
- Pitts, F. (1978) The Medieval River Trade Network of Russia Revisited. *Social Networks*. 1:285-292
- Boissevain, Jeremy (1979) Network Analysis: A Reappraisal *Current Anthropology*, 20 (2): 392-394
- UCINET-Quick Guide: https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnx1Y2luZXRzb2Z0d2FyZXxneDo3ZThjMzYzMmZiMTFiMDM

September 11th: Metrics

- Density
- Components
- Centrality (degree, closeness, betweenness, eigenvector)
- Centralization

- Core-Periphery
- Cliques
- Using whole network metrics in regression models
- Missing Data

Homework: Centrality assignment

Read:
- Christopher McCarty and Killworth, Peter (2007) Impact of Methods for Reducing Respondent Burden on Personal Network Structural Measures Social Networks *Social Networks* 29: 300-315.
- Brewer, D. D. (2000). Forgetting in the recall-based elicitation of personal and social networks. *Social Networks*, 22, 29-43.
- Fowler, James, Dawes, Christopher T.,Nicholas, Christakis A. (2009) "Model of genetic variation in human social networks" PNAS, 1720-1724.
- Christakis, Nicholas A., Fowler, James H. (2007) "The Spread of Obesity in a Large Social Network over 32 Years" N Engl J Med 357:370-379
- McPherson, Miller, Smith-Lovin, Lynn, Brashears, Matthew E. (2006) Social Isolation in America: Changes in Core Discussion Networks over Two Decades, American Sociological Review, 71: 353-375
- Granovetter, Mark 1973 "The strength of weak ties" *American Journal of Sociology* 78-1361-1381.

September 18th: Personal Networks

- Introduction to Personal Networks
- Introduction to Egonet
- Introduction to Vennmaker
- Introduction to E-net

Homework: Do your own 60-alter network and exchange networks with partner

Read:
- Wellman, Barry, Scot Wortley 1990 "Different strokes for different folks: Community ties and social support." *American Journal of Sociology* 96:558-588.
- Miranda J. Lubbers, Jose Luis Molina, Jurgen Lerner, Ulrik Brandes, Javier Avila, Christopher McCarty. 2010 Longitudinal analysis of personal networks. The case of Argentinean migrants in Spain, *Social Networks*, 32,(1): 91-104
- Joan S. Tucker, David Kennedy, Gery Ryan, Suzanne L. Wenzel, Daniela Golinelli, and James Zazzali, Christopher McCarty. 2009 Homeless Women's Personal Networks: Implications for Understanding Risk Behavior, *Human Organization* 68(2): 129-140
- Christopher McCarty, H. Russell Bernard, Peter D. Killworth, Eugene Johnsen and Gene A. Shelley. 1997 Eliciting Representative Samples of Personal Networks. *Social Networks* 19:303-323.

September 25th : Analyzing Personal Network Data

- Present each other's networks
- Look at data across class in SPSS

Read:
- Freeman, Linton C. (2000) Visualizing Social Networks, *Journal of Social Structure* 1:1.
- McGrath, C., Krackhardt, D., & Blythe, J. (2003). Visualizing Complexity in networks: Seeing both the forest and the trees. *Connections.*
- Christopher McCarty, Jose Luis Molina, Claudia Aguilar, Laura Rota. 2007 A comparison of social network mapping and personal network visualization. *Field Methods* 19: 145-162
- Borgatti, Stephen (2002) A Statistical Method for Comparing Aggregate Data Across A Priori Groups. *Field Methods*,14(1):88–107
- Krackhardt, David. 1992. A Caveat on the Use of the Quadratic Assignment Procedure. *Journal of Quantitative Anthropology* 3:279-296.

October 2nd: Visualization, QAP/Hypothesis Testing

- Netdraw
- Visualization algorithms
- Mage/King
- Juergen Lerner's personal network types
- Hypothesis testing in UCINET

Read:
- Alejandro Portes (1998) SOCIAL CAPITAL: Its Origins and Applications in Modern Sociology, *Annual Review of Sociology* 1998. 24:1–24
- Ron Burt (2004) Structural Holes and Good Ideas, *American Journal of Sociology* 110: 349–399
- Krackhardt, David 1999. The Ties That Torture: Simmelian Tie Analysis in Organizations. *Research in the Sociology of Organizations* 16: 183-210.
- Lin, Nan 1999 Building a Network Theory of Social Capital. *Connections* 22(1): 28-51.
- Social Capital and Health Inequality: Evidence from Taiwan
- Lijun Song and Nan Lin 2009. Social Captial and Inequality: Evidence From Taiwan *Journal of Health and Social Behavior*, 50 (2):149-163

Homework: Visualize data sets

October 9th: Social Capital, Structural holes, Simmelian Ties, Position Generators

- Social capital
- Structural holes and measures
- Simmelian ties

- Position Generators

Homework: Fill out position generators

Read:
- Travers, J. and S. Milgram 1969 'An Experimental Study of the Small World Problem,' *Sociometry* 32:425-43.
- Watts D., Strogatz S. 1998 "Collective Dynamics of Small World Networks," *Nature*, 4:440-442.
- Peter D. Killworth, H. Russell Bernard and Christopher McCarty. "Measuring Patterns of Acquaintanceship." *Current Anthropology* 25:381-397 (1984).

October 16th : Small World Networks
- Travers and Milgram small world study
- RSW
- Watts and Strogatz

Read:
- Faust, Katherine, Stanley Wasserman 1992 "Blockmodels: Interpretation and evaluation" *Social Networks* 14:5-61.
- Michaelson, Alaina, Noshir S. Contractor 1992 "Structural position in perceived similarity" *Social Psychology Quarterly* 55:300-310.
- Burt, R. (1987). Social contagion and innovation: Cohesion versus structural equivalence. American Journal of Sociology, 92, 1287-1335.
- Harrison White, Scott Boorman, and Ronald Breiger, "Social Structure from Multiple Networks I: Blockmodels of Roles and Positions." *American Journal of Sociology* 81 (1976):730-779
- Wasserman, Stanley, and Philippa Pattison. 1996. "Logit Models and Logistic Regressions for Social Networks: I. An Introduction to Markov Graphs and p*." *Psychometrika* 61:401-425.

October 23rd : Longitudinal networks, Network models

- Siena, ORA
- Equivalence
- Blockmodeling
- ERGM

Read:
- Schweizer, Thomas 1997 "Embeddedness of ethnographic cases" *Current Anthropology* 38:739-760.
- Bernard, H. R., Killworth, Peter, Kronenfeld, David, Sailer, Lee (1984) The problem of informant accuracy: The validity of retrospective data. Annual Review of Anthropology. 13: 495-517.

- Coleman, James, Elihu Katz, and Herbert Menzel. 1957. The diffusion of innovation among physicians. *Sociometry*. 20:253-270.
- Valente, Thomas W. 1996 "Social network thresholds in the diffusion of innovations" *Social Networks* 18:69-89.
- Klovdahl, A. S. (1985). Social networks and the spread of infectious diseases: The AIDS example. Social Science Medicine, 21(11), 1203-1216.
- Valente, T. W. (1996). The diffusion network game. Connections, 19(2), 30-37.

October 30th : Diffusion, Social Learning, Informant Accuracy

- Reciprocity in social networks
- Embeddedness
- Informant accuracy
- Diffusion

Read:
- Killworth, Peter D., Eugene Johnsen, Christopher McCarty, Gene A. Shelley and H. Russell Bernard. 1998 Estimation of Seroprevalence, Rape and Homelessness in the U.S. Using a Social Network Approach. *Evaluation Review* 22:289-308.
- H Russell Bernard, Tim Hallett, Alexandrina Iovita, Eugene C Johnsen, Rob Lyerla, Christopher McCarty, Mary Mahy, Matthew J Salganik, Tetiana Saliuk, Otilia Scutelniciuc, Gene A Shelley, Petchsri Sirinirund, Sharon Weir, Donna F Stroup. 2010 Counting hard-to-count populations: the network scale-up method for public health *Sexually Transmitted Infections*, 2010 86: ii11-ii15.
- Hill, R. and Dunbar, R. 2002. "Social Network Size in Humans." Human Nature, Vol. 14, No. 1, pp. 53–72.
- Dunbar, RIM (2003). The social brain: Mind, language, and society in evolutionary perspective. *Annual Review of Anthropology*. 32: 163-181.

November 6th : Network Size

- Network Scale-up
- Dunbar Number

November 13th : Citation Networks, ORA, Pajek

- Citation networks
- Networks from text
- Negative ties

November 27th : Presentations

December 4th: Presentations

Glossary of Terms

- **Adjacency Matrix** – A matrix representing the ties between nodes in a network. The labels for the rows and columns are the same. The number in the cell intersecting a given row and column indicates a tie, and its level.
- **Alter** – A network member named by a focal respondent in egocentric network analysis.
- **Asymmetric Matrix** – An adjacency matrix where the data are directed. The upper half may not mirror the lower half because two respondents may not agree on their level of interaction.
- **Betweenness Centrality** –A node is highly between-central to the extent he or she lies on many geodesics (shortest paths) between alters. Alters that are between central are brokers.
- **Betweenness Centralization** – A measure of the extent to which the network is dominated by a few between central nodes.
- **Binary Data** - Tie data that are 1 or 0, indicating only the presence or absence of a tie.
- **Closeness Centrality** –An alter is highly close-central if he or she is connected by short paths to most other alters.
- **Closeness Centralization** – A measure of the extent to which the network is dominated by a few close central nodes.
- **Cohesion** – The extent to which nodes in a network are tied (operationalized in a variety of ways).
- **Components** – A set of alters who are connected to one another directly or indirectly.
- **Degree Centrality** – An alter is highly degree-central to the extent he or she is directly connected to many other alters.
- **Degree Centralization** – A measure of the extent to which the network is dominated by a few degree central nodes.
- **Dependent Variable** – The variable representing the thing the researcher wants to predict.
- **Diagonal** – The set of cells in an adjacency matrix representing ties with each node to itself. This is ignored in most (but not all) network analyses.
- **Directed Data** – Tie data that indicate the possibility of an asymmetric relationship.
- **Edge** – See Tie
- **Ego** – The respondent in egocentric network analysis.
- **Egocentric Network** – The social relations surrounding a focal individual.
- **Graph** – A visual representation of nodes and edges (ties or links). There are many kinds of network graphs. One of the most commonly used algorithms is a spring-embedder.
- **Independent Variable** – A variable used to explain the variability in something you want to predict (the dependent variable). There is often more than one independent variable.
- **Isolates** – A node unconnected to any other node.
- **Name Generator** – A question, ro set of questions used to elicit names of alters from ego (the respondent).
- **Network Composition** – The summary of attributes of network members. Examples include the percent of network members that are women, or the average age of network members.
- **Network Structure** – The pattern of relations between network members.
- **Network Visualization** - See Graph.
- **Node** – The elementary unit of graph theory. In social networks they are typically, but not always, people. In social networks also called actors.
- **One Mode Data** – Network data representing the ties between nodes.
- **Personal Network** – An unconstrained egocentric network.
- **Respondent Burden** – The burden put on a respondent from the process of data collection.
- **Social Network Analysis** – A method for quantifying the pattern of relations between a set of actors.
- **Social Support Network** – An egocentric network constrained to a specific type of support of a focal respondent.
- **Sociocentric Network** – The social relations within a defined group.
- **Structural Hole** – Defined using network constraint (the extent to which those in an egocentric network tend to be tied to each other). It is a structural gap between groups in a sociocentric network.
- **Symmetric Matrix** – An adjacency matrix where the data are not directed. The upper half of the matrix is a mirror of the lower half.

- **Tie** – An indication of a relation between two nodes. Ties can be defined objectively by observing something (like e-mail transactions, or mutual attendance at an event), or by asking questions (such as how much two people interact).
- **Two Mode Data** – Network data where the rows represent network members and the columns represent each network member's presence at an event. For example, the event could be a social gathering, or membership in an organization.
- **Valued Data** – Tie data that indicate the level of a tie, not just its presence or absence.
- **Vertex** – See Node
- **Whole Network** – See sociocentric network.