Soc 229 Seminar on Social Networks
Professor: James Moody

Meeting Time: F 10:15 – 12:50 (for now!)
Place: Social Psych 331 (Thompson – for now!)

“To speak of social life is to speak of the association between people – their associating in work and in play, in love and in war, to trade or to worship, to help or to hinder. It is in the social relations men establish that their interests find expression and their desires become realized.”

-- Peter M. Blau, 1964

Overview:
This seminar focuses on theoretical and substantive themes within social network analysis. The theoretical heart of this approach to social science is that actors are interdependent, and that social structure emerges from regularities in this interdependence. In this seminar, we will couple the substantive and theoretical development of social network analysis with methodological tools to implement network research. By the end of the course, you should (1) know the major theoretical ideas supporting network research, (2) be able to collect social network data and, (3) be able to analyze and interpret social network data.

Social network research is unique in the extent to which methodological tools derive directly from substantive theories. As such, class time will be split almost 50-50 on methodological and substantive (theory, application, and examples) issues, with each substantive topic tied to a new method or analysis strategy. Substantive topics will include work on sexual behavior, organizational performance, delinquency, power, friendship, and much more.

Requirements:
The main requirement of this seminar is a research paper that uses the methods or ideas of social network analysis. This may be a revision of previous work (an MA paper, another course paper, etc.) or a new paper. If this is a revision of a previous paper, you need to show that the addition of network ideas or methods significantly contributes to the revision. You may collaborate with up to 2 other students (3-authors total) on your final paper. The second requirement for the class is a set of homework assignments designed to build familiarity with the software and analysis techniques. Assignments are self-graded with the solutions posted on the course webpage, they are due the next class day (so an assignment listed on class 2 is due on class 3). Finally, since this is a seminar, in-class participation is necessary.

Texts:
The main text for the class is:
- Wasserman and Faust (1994): Social Network Analysis. Cambridge University Press. This book will provide the main methodological and background reading for the course.
The three other methods/general texts are Kolaczyk (2009), Easley & Kleinberg (2010), or Jackson (2008). These are great books … feel free to work from them if you like.

I also recommend the following:
- Martin, John Levi (2009): *Social Structures*. This is a theory book on how types of relations constrain/construct types of aggregate social structures.

- Kolaczyk, Eric D. 2009 *Statistical Analysis of Network Data*. Springer. This is a statistics oriented book, great for those who want to really dig into the modeling challenges raised by network data.


- Barabasi, Albert-László *Linked: The New Science of Networks*. Provides an overview from the point of view of physicists, who have recently started thinking about networks (and social networks as part of that).

- Freeman, Linton. *The Development of Social Network Analysis* by Linton Freeman. A great history of the sociological development of the field.


Most papers we are reading will be linked to on-line sources from the class web-page version of this syllabus. If there are password protected .pdf files, the password is moodynets.

**Software:**
I will provide sample code, instruction and so forth in a number of software programs. The main ones:

1) UCI-NET. This is the industry standard social network analysis program. The most recent version is available for about $40 from Analytic technologies. Orders may be placed by web, mail, telephone, fax, or e-mail. Web: [www.analytictech.com](http://www.analytictech.com), E-mail: sales@analytictech.com. You can also use it in “trial mode” for quite some time…

2) Access to SAS, including IML, and a set of programs I have written called SPAN (Sas Programs for Analyzing Networks), which contains a set of useful routines. The SPAN program is free, and can be downloaded from here: [http://www.soc.duke.edu/~jmoody77/Span/span.zip](http://www.soc.duke.edu/~jmoody77/Span/span.zip) *this is the main software source I will instruct in.*

3) PAJEK. A program for analyzing and visualizing large networks. It is free. You can download the most recent version of PAJEK at: [http://vlado.fmf.uni-lj.si/pub/networks/pajek/default.htm](http://vlado.fmf.uni-lj.si/pub/networks/pajek/default.htm). A good book on the “how to” of PAJEK is *Exploratory Network Analysis With PAJEK*, Cambridge Press

4) R. The R platform is necessary for the statistical models of networks we will be exploring, but can also be used as a general network analysis program. I will provide links to tutorials on R for many of the topics we cover and more detailed examples for the statistical modeling projects. For those who like to program in R, the main modules to review are “SNA” (Carter Butts), “Statnet” (Handcock et al), and iGraph (Csardi). R is free.

**Online resources**
1) Class web page. This is where the most up-to-date version of the syllabus will always be, and links to all of the course material. [http://www.soc.duke.edu/~jmoody77/s884/index.htm](http://www.soc.duke.edu/~jmoody77/s884/index.htm)
2) International Network for Social Network Analysis (INSNA) home page
   http://www.insna.org/

Readings:
I list way more reading than we’ll actually cover. I can’t help it; there’s just too much great work being done right now. The primary foci will be indicated with an astray (*).

Schedule:
Class 1: Introduction, Basics & Overview (Sep 2)
Summary: First day of class. Discuss syllabus, go over the history of social network research, general trends in the field and some basic elements of how social network data differ from data social scientists are used to collecting. We then cover base data elements, format & graph drawing/exploration,

Reading:
- Background & Theory:
  * Wasserman & Faust, Chapter 1
  Kadushin: Intro & Chapter 1, Chapter 2 & Chapter 3
  Martin, J. Front matter & Chapter 1.

- Data & Programs
  * Wasserman & Faust, Chapters 3 & 4

Assignments: Family as Social Network & Substantive implications, Matrix manipulations, graph translation exercise, network drawing.

Recommended /Background Reading:
Barabási, Albert-László Linked: The New Science of Networks
Freeman, Linton The Development of Social Network Analysis
Borgatti, S.P. “A quorum of graph theoretic concepts”
Wellman, Barry: “Structural Analysis: From method and metaphor to theory and substance”
Any number of reviews of network science, see for example SCIENCE VOL 325.
Class 2. **Collecting Network Data & Two-Mode networks** (Sept 9)

*Summary:* What are the best ways to collect network data? What are the tradeoffs involved in different network data designs, how does data collection quality affect results? How do we collect data in ethically responsible ways? Since people form relations through overlapping associations, they not only create a network of people, but also a network of associations. This is captured through the duality of persons and groups, and provides a powerful way to identify network processes through commonly available (often archival) data.

*Reading:*
  - Ethics of Network Data Collection
    - Breiger, Ronald L. 2005. “Introduction to special issue: ethical dilemmas in social network research” *Social Networks* p89-93
    - Kadushin, C. **Chapter 10**
  - Strategies for & Examples of Network data Collection
    - Bearman & Parigi “Cloning Headless Frogs and Other Important Matters: Conversation Topics and Network Structure” *Social Forces*
  - 2-mode network data:
    - *Wasserman & Foust Chapter 8 (skim).*

*Assignments:* Constructing a dual (person-through-group) network, paper topic due.

*Background Reading:*
Bell, D. C. et al “Partner naming and forgetting: Recall of network members” *Social Networks* p279-299


Eagle, N. A. Pentland, and D. Lazer (2009), "Inferring Social Network Structure using Mobile Phone Data", *Proceedings of the National Academy of Sciences (PNAS)*.


Frank, K. et. al () “The Social Dynamics of Mathematics Course-taking in High School” *AJS*


Kadushin, C. “Who benefits from network analysis: ethics of social network research” *Social Networks* p139-153


Vehovar, V et al “Measuring ego-centered social networks on the web: Questionnaire design issues” *Social Networks* p213-222

Class 3. **Local Networks** (Sept 23)

**Summary:** The building blocks of a network are the sets of relations each person is embedded within. Today we discuss how positions can be defined in terms of (a) the **composition** of local network alters and (b) the **pattern** of relations among local ties. We identify sources of such data in the literature and ask how they provide resources (i.e. social capital).

**Reading:**

- **Local Network Composition**
  - Fischer, Claude: *To Dwell Among Friends*, Chapters 3, 8, 9, 12, 14 (don’t worry, they are short and easy!)

- **Local Network Patterns**
  - McPherson, Smith-Lovin, Brashears “*Social isolation in America: Changes in Core Discussion Networks over Two Decades*” *American Sociological Review*

- **Social Capital**
Assignments: Ego-Network Characteristics.

Background Reading:
Bidar, Clair “Evolutions of personal networks and life events” Social Networks p359-376
Buskens, V & van de Rijt, Arnout “Dynamics of Networks if Everyone Strives for Structural Holes” American Journal of Sociology
Everett & Borgatti (19xx) “Ego network betweenness” Social Networks p31-38
Kalish & Robins. () “Psychological predispositions and network structure: The relationship between individual predispositions, structural holes and network closure” Social Networks p56-84
Kalmijn, M et al “Homogeneity of social networks by age and marital status: A multilevel analysis of ego-centered networks” Social Networks p25-43
Lizardo, Omar () “How Cultural Tastes Shape Personal Networks” American Sociological Review
Marsden, Peter: “Core discussion networks of Americans”
Martin, J.L. “Persistence of close personal ties over a 12-year period” Social Networks p331-362
Van Der Gaag, Martin & Tom Snijders “The Resource Generator: social capital quantification with concrete items” *Social Networks*

**Class 4. Centrality. (Sept 30)**

*Summary:* Another conception of “position” in a social network deals with where an actor resides within a network. Falling under the broad heading of centrality, a series of measures are identified that highlight individuals positions in the network.

*Reading:*
- Theory & Measurement
  - W&F Chap. 5.
  - Borgatti & Everett. 2006. “A Graph-theoretic perspective on centrality” p466-484 *Social Networks*
- Application (Read one of these)

*Assignments:* Calculate and compare different measures of centrality on the same network.

*Background Reading:*


Brandes, U. “On variants of shortest-path betweenness centrality and their generic computation” Social Networks p.36-145

Clifton, Allan. Eric Turkheimer, Thomas F. Oltmanns () “Personality disorder in social networks: Network position as a marker of interpersonal dysfunction Social Networks” Pages 26-32


Kolaczyk, E.D David B. Chua, Marc Barthélemy “Group betweenness and co-betweenness: Inter-related notions of coalition centrality” Social Networks p190-203


Zemljič, Barbara & Valentina Hlebec () “Reliability of measures of centrality and prominence” Social Networks p73-88

Class 5. Micro Models of Networks: Homophily, Balance & Hierarchy (Oct 14)

Summary: We have now seen the basic structures of informal networks and details of local networks. What interpersonal process could generate these features? Can we identify local level mechanisms that would generate such structures? Will also introduce the problem of statistical measurement of network attributes & the difficulties inherent in modeling such.

Reading:
*W&F chap 6 & 14 (skim 14)
*Chase, Ivan. “Social process and hierarchy formation in small groups: A comparative perspective.” American Sociological Review


Assignments: Identify transitivity levels in a network, triad distribution.

Background Reading:


Class 6. Network Topology: Distance, Small Worlds & Cohesion (Oct 21)

Summary: Much of the power of networks comes from the inter-connection of local networks into wider populations. Based on what we know of local networks and people’s involvement in activities, what should networks look like at the global level?

Reading:


Kadushin, C. *Chapter 7*

Bearman, Farris, & Moody, "Blocking the Future" Social Science History 23:501-533

Background Reading:
Newmann, M. E. J. 1999. “Models of the Small World”
Schnettler, S. 2009. “A structured overview of 50 years of small-world research” Social Networks

Class 7. Sub-Groups: Communities & Roles (Oct 28)
Summary: Primary groups are common in social interaction. How important are these groups and how do we identify them? We will go over multiple methods for identifying a primary group.

Reading:
- Communities/Groups
  * Wasserman & Faust Ch 9
  * Newman, MEJ. 2006. “Modularity and Community Structure in Networks” PNAS
Porter, Onnela & Mucha 2009. “Communities in Networks”

- Roles / Positions
  * Nadel, A Theory of Social Structure Chapter 4.
  * W&F Chapter 10. Blockmodeling
Montgomery, JD. “The structure of norms and relations in patronage systems” Social Networks p565-584

Assignments: Identify cohesive groups in test data, blockmodels

Background Reading:
  Carroll, C. () “Canonical correlation analysis: Assessing links between multiplex networks” Social Networks p310-330
  Doreian, P. () “A multiple indicator approach to blockmodeling signed networks” Social Networks p247-258
  Frank, K. A. 1996. "Mapping Interactions Within and Between Cohesive
Class 8. Diffusion & Peer Influence Models (Nov 4)

**Summary:** Networks are conduits for the flow of information and influence. Thus, the behavior of individuals is often a complex interaction of individual and interpersonal effects. This is a large and growing section of the field, particularly relevant in political/opinion and health research.

**Reading:**
- Peer Influence


- **Diffusion/Cascades**
  *Moody R21 proposal on networks & diffusion.*
  *Fowler, James H. and Nicholas A. Christakis. 2010. “Cooperative Behavior Cascades in Human Social Networks” PNAS 107:5334-5338*
  *Durrett, Rick. 2010. “Some features of the spread of epidemics and information on a random graph” PNAS 107: 4491-4498*

Assignments: Calculate peer influence measures for example data.

**Background Reading:**


*Mikolajczyk, RT & Mirjam Kretzschmar () “Collecting social contact data in the context of disease transmission: Prospective and retrospective study designs” *Social Networks* p127-135*

*Paez et al () “Weight matrices for social influence analysis: An investigation of measurement errors and their effect on model identification and estimation quality” *Social Networks* p309-317*

**Class 20. Statistical Modeling of Social Networks I, Random Graph Models (Nov 11)**

**Summary:** Recent statistical developments have made it possible to model networks statistically, allowing us to incorporate uncertainty from measurement and sampling. In this session we discuss the frame for statistical modeling networks and identify the ERGM method for doing so.
Reading:
STATNET Tutorial (online) & J. of Statistical Software review issue (links here).
Read one of:

Assignments: Calculate ERGM on an example graph.

Background Reading:
This is a quickly growing field with roots in random graph theory. Good background can be had by reading Bayesian modeling books and statistical graph theory work. Some current/classics relevant to sociology here:

Duijn, Glle & Handcock () “A framework for the comparison of maximum pseudo-likelihood and maximum likelihood estimation of exponential family random graph models” Social Networks p52-62
Krivitsky, Handcock, Raftery & Hoff (2009) “Representing degree distributions, clustering, and homophily in social networks with latent cluster random effects models” Social Networks
Robins, Pattison & Wang () “Closure, connectivity and degree distributions: Exponential random graph (p*) models for directed social networks” Social Networks p105-117
Wang, Sharpe Robins & Pattison (*) “Exponential random graph (p*) models for affiliation networks” Social Networks p12-25

Class 10. Statistical Modeling of Social Networks II, Dynamics & Latent Space Models (Nov 18)

Reading:
Substantive SIENA paper TBA.
Ward/Hoff bit using latent networks


Schaefer SN piece on dynamics of transitivity…

Assignments: Create SoNIA movie of network

Background Reading:

Class 23. New Frontiers: Summary discussion of what’s new in the field (Dec 2)
Summary: Student reports on new substantive work.
Reading:
Assignments: Report/present on final projects.
Background Reading:
Topics not covered this term:

**Social Exchange**

*Summary:* Networks provide constraints and opportunities for actors. In an exchange setting, this structure will lead to differences in power. We contrast direct exchange and generalized exchange.

*Reading:*
- Martin, Chapter 3

*Assignments:* Identify power status of a set of example networks.

*Background Reading:*
- Barrera, D () “The impact of negotiated exchange on trust and trustworthiness” Social Networks p508-526
- Blau, Peter s. *Exchange and power in Social Life*
- Doğan, Gönül () “The stability of exchange networks” *Social Networks* p118-125,
- Molm, LD et al (*) “Building Solidarity through Generalized Exchange: A Theory of Reciprocity” *American Journal of Sociology*
- Van Assen and van de Rijt () “Dynamic exchange networks” *Social Networks* p.266-278
- Vande Rijt, A & Assen () “Theories of network exchange: Anomalies, desirable properties, and critical networks” Social Networks p259-271
- Ziegler, R. () “What makes the Kula go round?: A simulation model of the spontaneous emergence of a ceremonial exchange system” *Social Networks* p107-126