

Statistical Analysis of Networks

Arizona State University
Criminology and Criminal Justice (CRJ) 605
Spring Semester 2019

Time: Thursdays, 1:30-4:00 PM
Room: UCENT 214

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Overview

Network *science* is a paradigm (i.e. a model of how the world works) that takes as its domain of interest the interdependence among units. This paradigm examines patterns or regularities in relationships (i.e. *structure*) among interacting units and focuses on a) how such patterns influence the behavior of these units and b) how such patterns are generated. Network *analysis* characterizes a broad class of techniques for describing and making inferences about research questions generated within this paradigm.

This course provides an introduction to these various techniques. The overarching goal of the course is that, upon completion, you will be capable of developing research questions from a network perspective and incorporating network-based tools in your own research. The course is designed to be primarily methodological, dedicating the majority of our time to working through the mechanics of network-based tools. Students will also gain experience with R, a commonly used software program for network data management, analysis, and visualization. The course is divided into two primary sections. First, we will examine what network data "look like," how to work with these data in R, how to describe the properties of a network (i.e. descriptive statistics). The second section of the course will focus on inferential analysis of networks (i.e. hypothesis testing on cross-sectional and longitudinal data structures).

Prerequisites

Graduate level probability and statistics (including standard hypothesis testing and regression methods) is assumed. Additional mathematical and computational background is not required. Prior knowledge of network analysis is not assumed. Prior experience with R is not assumed.

Course Materials

Required Texts:

There are 2 books required for this course:

Wasserman, Stanley and Katherine Faust. 1997. *Social Network Analysis: Methods and Applications*. Cambridge: Cambridge University Press.
Luke, Douglas A. 2015. *A User's Guide to Network Analysis I R*. New York: Springer.

Additional readings for each week are available through links embedded in this document.

Suggested (Optional) Texts:

Below are several suggested texts that are optional. These are not required, but will substantially aid in your understanding of the material we cover. In addition to these general texts, suggested additional readings for specific topics are listed in the course outline.

Kadushin, C. 2012. *Understanding Social Networks: Theories, Concepts, and Findings*. New York: Oxford University Press.

Scott, J. & Carrington, P. J. 2011. *The SAGE Handbook of Social Network Analysis*. London: Sage Publications.

Knoke, D. & Yang, S. 2004. *Social Network Analysis*. 2nd Editions. Thousand Oaks: Sage Publications.

Adler, Joseph. 2010. *R in a Nutshell*. California: O'Reilly Media Inc.

Online Resources, Listservs and Websites:

Course materials will be made available on Canvas and will be posted to the course page of my website: <https://www.jacobtnyoung.com/networks-course.html>.

I recommend signing up for two listservs for this course: SOcNET (<https://lists.ufl.edu/cgi-bin/wa?SUBED1=SOcNET&A=1>) is a general social network listserv for posting questions. I like this listserv because you get a sense of what kinds of questions people are asking in network science. Rbloggers (<https://www.r-bloggers.com/>) is a daily email that covers a variety of topics in R. I like this listserv because it provides a robust coverage of what can be done in R, what people are doing with R, and always provides the code for reproducing what is being discussed.

You should also take a look at the International Social Network Analysis (INSNA, <https://www.insna.org/>) website. This is the main professional association for social network researchers. If you really want to get involved with network analysis, go to INSNA's annual conference, *Sunbelt* (see INSNA website for details).

Software:

There are many software options for network analysis and visualization. In this course, we will rely exclusively on R. R is a very flexible tool for a wide range of statistical analyses. If you are not familiar with R do not worry, we will be spending a lot of time working through examples. R can be downloaded at: <http://www.cran.r-project.org>.

We will primarily work with R in RStudio. RStudio is one of several projects to build an easier-to-use GUI (graphical user interface) for R. It is a free, open-source IDE (integrated development environment) for working with R. RStudio can be downloaded from: <http://www.rstudio.com>.

Want a non-iatrogenic "boot-camp" experience with R? Materials for an R workshop I teach in the summer are available on a page at my website: <http://www.jacobtnyoung.com/r-workshop.html>. I would encourage you to work through the labs as they are thoroughly commented and are very basic.

NOTE: I would strongly encourage you to bring a laptop to every class. If necessary you can share with one other person. Please try to keep computer sharing to dyads (i.e. avoid triads).

Course Requirements

Your grade in this course will be based on homework assignments (20% of your grade), the preparation and presentation of an original research paper based on the course content (65% of your grade), and class participation (15% of your grade).

1. Homework: Roughly each week you will be asked to complete a homework assignment based on the week's content. The goal of the assignments is to familiarize you with the concepts **and** the software. You will **really** learn how to "do" network analysis by getting your hands dirty using the software and working with real data. Working on homework with your classmates is acceptable and a good way to learn. However, students must complete their **own** analyses and submit their own write-ups of the analyses. Homework will not be graded. Instead, you will receive points for completing all of the assigned problems. I will post a set of solutions to the course website the day I hand back the homework assignments and we will work through the homework in class.

2. Course Project: Each student will prepare an original research paper using either network data or a network concept applied to the topic of the student's choice. Topics will be chosen by you **and approved by me**. As with any paper you write in a graduate seminar, your aim should be the development of a publishable manuscript. Students are **encouraged** to work in groups, but groups can be no larger than two students.

To help you make progress on the project, I require you to hand in 2 brief *research proposals* (these proposals are ungraded and are simply for your benefit). The first proposal (a paragraph is fine) should describe generally what your topic is, what questions you are asking, and what data you might use. The second proposal is more detailed and should include your research questions, hypotheses (if appropriate), and identify relevant literature and theory, describe the dataset, and indicate analyses you will perform. Your project may evolve after the second proposal is submitted, but I want you to begin thinking about all of these issues early. Also, by this time, you should have the data you are going to use. The second proposal should be 2-3 pages. On the same day you submit your second proposal, you will give a *mini presentation* discussing the content of your second proposal. The presentation is graded and is worth 50 points. Rubric for grading the presentation will be provided prior to the mini presentation to help you prepare. Due dates for each proposal and mini presentation are given in the course calendar.

During the last two class sessions (**April 18th and 25th**), students will present their data/findings to the class in the format of a conference style presentation (more information about the presentation format will be provided later). Every project will be randomly assigned to present on one of the two dates. The full presentation is graded and is worth 200 points. Rubric for grading the presentation will be provided prior to the full presentation to help you prepare.

The final paper is to be no longer than 25 pages in length, but no less than 2,500 words double-spaced, 1" margins, and 12-point Times New Roman font. The written paper is due by 5 pm on either **April 25th** or **May 6th**, depending on your group assignment. The final paper is worth 400 points. Rubric for grading the final paper will be provided prior to due date to help you prepare.

3. Class Participation: I will not keep record of attendance. Keep in mind that coming to class, participating in discussions and labs, and asking questions will help you learn. This course is not taught in the seminar format, but I expect you to be an active participant in this course.

In all, your grade breakdown will be as follows:

Homeworks (50 points x 4)	200 points
Mini Presentation	50 points
Full Presentation	200 points
Final Paper	400 points
Class participation (10 points x 15)	<u>150 points</u>
Total	1000 points

Your grade will be assigned based on the following scale (passing grades are in **bold**):

A+ 980-1000	A 920-979	A- 900-919
B+ 850-899	B 800-849	B- 750-799
C+ 700-749	C 600-690	D 0-599

Keys to Success

Time Investment: The Arizona Board of Regents, the governing board for ASU, has a policy for how much time students should invest in their courses: "A minimum of 45 hours of work by each student is required for each unit of credit" (<http://azregents.asu.edu/rrc/Policy%20Manual/2-224-Academic%20Credit.pdf>). As a rule of thumb, for every hour of class you should expect to dedicate 3 hours outside of class to the course. This is the investment needed to succeed in this course.

Time Budgeting: For each week's workload, I strongly encourage you to create a time budget (just Google [or Ask Jeeves] "time budget examples"). Budgeting your time will help you get through the reading and provide sufficient time to work with the syntax for analyses.

Work with Others: Your fellow classmates are an excellent resource for developing your understanding of the material. I would encourage you to find a study partner or form a study group. Among other things, working with others helps create socially enforceable deadlines (i.e. accountability). Also, syntax is a quasi-public good with the property of non-subtractability!

Care about your Work: I understand that you have competing time commitments, that there are multiple demands on your day, and that you may come to this particular course with varying levels of interest. Not everyone will make network analysis a part of their career, but a primary concern I have is that, independent of your long-term substantive interests, you take pride in all of the work that you do in this course.

Miscellaneous Course Information

Late Assignments: I will not accept late assignments and they cannot be made up.

Extra Credit: There is no extra credit in this course.

Honesty: Information regarding cheating and plagiarism can be found at: <http://provost.asu.edu/academicintegrity>. I strongly encourage you to read this not only for my course, but to protect your interests as a student.

Students with special needs: If you require special accommodations for class, please see <https://eoss.asu.edu/drc> for ASU policies and procedures. The Disability Resource Center will provide you with a letter noting the classroom modifications that you will need to fully take part in class activities. With this letter, contact me during my office hours and I will gladly make the appropriate adjustments.

Course Evaluation: Teaching evaluations are very important and I strongly encourage you to take the time to complete it. Your participation is essential for improving the course. Evaluations are easy to access, just go to MyASU, click on My Classes, and then click Course Evaluations. Select CRJ 605 and you are ready to go. I will remind you when the evaluation survey for this course is available.

COURSE OUTLINE

1/10: Introduction to Network Analysis

Required Readings:

Luke, Chapter 1: Introducing Network Analysis in R.

Wasserman and Faust, Chapter 1: Social Network Analysis in the Social and Behavioral Sciences.

Suggested Additional Readings:

Mills, B. J. 2017. Social Network Analysis in Archaeology. *Annual Review of Anthropology*, 46, 379-397.

Przulj, N., & Malod-Dognin, N. 2016. Network analytics in the age of big data: How can we holistically mine big data? *Science*, 353(6295), 123-124. <http://science.sciencemag.org/content/353/6295/123>.

Burt, R. S., Kilduff, M., & Tasselli, S. 2013. Social network analysis: foundations and frontiers on advantage. *Annu Rev Psychol*, 64, 527-547.

Everton S. F. 2012. *Disrupting Dark Networks*. New York: Cambridge University Press.

Knoke, D. 2012. *Economic Networks*. Cambridge: Polity Press.

Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. 2009. Network Analysis in the Social Sciences. *Science*, 323(5916), 892-895.

Freeman, L. C. 2004. *The Development of Social Network Analysis: A Study in the Sociology of Science*. Vancouver: Empirical Press.

Emirbayer, M., & Goodwin, J. 1994. Network Analysis, Culture, and the Problem of Agency. *American Journal of Sociology*, 99(6), 1411-1454.

Simmel, G. 1906. The Sociology of Secrecy and of Secret Societies. *American Journal of Sociology*, 11(4), 441-498. <https://www.jstor.org/stable/2762562>.

1/17: Network Data Structures and Sources of Network Data

Required Readings:

Luke, Chapter 2: The Network Analysis 'Five-Number Summary'.

Wasserman and Faust, Chapter 2: Social Network Data.

Wasserman and Faust, Chapter 3: Notation for Social Network Data.

Wasserman and Faust, Chapter 4: Graphs and Matrices.

Suggested Additional Readings:

Namboodiri, K. 1984. *Matrix Algebra: An Introduction*. Thousand Oaks: Sage Publications.

Jackson, M. 2008. *Social and Economic Networks*. Princeton: Princeton University Press.

Young, J. T. N., Decker, S. H., & Sweeten, G. 2018. The Boston Special Youth Project Affiliation Dataset. *Connections*, 37(1&2), 85-88. <https://www.exeley.com/connections/doi/10.21307/connections-2017-006>.

Rostami, A., & Mondani, H. (2015). The complexity of crime network data: a case study of its consequences for crime control and the study of networks. *PLoS One*, 10(3), e0119309. <http://doi.org/10.1371/journal.pone.0119309>.

1/24: Getting Started with R & Network Visualization

Assignments: Brief Proposal #1 *DUE*.

Required Readings:

Luke, Chapter 3: Network Data Management in R.

Butts, C. T. 2008. network : A Package for Managing Relational Data in R. *Journal Of Statistical Software*, 24(2). <http://www.jstatsoft.org/v24/i02>.

Butts, C. T. 2008. Social Network Analysis with sna. *Journal of Statistical Software*, 24(6). <http://www.jstatsoft.org/v24/i06>.

Luke, Chapter 4: Basic Network Plotting and Layout.

Luke, Chapter 5: Effect Network Graphic Design.

Suggested Additional Readings:

Luke, Chapter 6: Advanced Network Graphics.

Moody, J., McFarland, D., & Bender-deMoll, S. 2005. Dynamic Network Visualization. *American Journal of Sociology*, 110(4), 1206-1241.

Krebs, V. E. 2002. Mapping Networks of Terrorist Cells. *Connections*, 24(3), 43-52.

1/31: Centrality

Assignments: Homework #1 Distributed.

Required Readings:

Luke, Chapter 7: Actor Prominence.

Wasserman and Faust, Chapter 5: Centrality and Prestige.

Young, J. T. N. 2013. "Role Magnets"? An Empirical Investigation of Popularity Trajectories for Life-Course Persistent Individuals During Adolescence. *Journal of youth and adolescence*.

<http://link.springer.com/article/10.1007%2Fs10964-013-9946-0>.

Suggested Additional Readings:

Bryan, B. (2017). Paternal Incarceration and Adolescent Social Network Disadvantage. *Demography*, 54(4), 1477-1501. <http://doi.org/10.1007/s13524-017-0589-8>.

Hughes, L. A. (2013). Group Cohesiveness, Gang Member Prestige, and Delinquency and Violence in Chicago, 1959-1962. *Criminology*, 51(4), 795-832. <http://doi.org/10.1111/1745-9125.12020>.

Moody, J., Brynildsen, W. D., Osgood, D. W., Feinberg, M. E., & Gest, S. (2011). Popularity Trajectories and Substance Use in early Adolescence. *Soc Networks*, 33(2), 101-112. <http://doi.org/10.1016/j.socnet.2010.10.001>.

Borgatti, S. P., & Everett, M. G. (2006). A Graph-theoretic perspective on centrality. *Social Networks*, 28(4), 466-484. <http://www.sciencedirect.com/science/article/pii/S0378873305000833>.

Freeman, L. C. (1978/79). "Centrality in Social Networks Conceptual Clarification." *Social Networks* 1: 215-239. <http://www.sciencedirect.com/science/article/pii/0378873378900217#>.

Sauder, M., Lynn, F., & Podolny, J. M. (2012). Status: Insights from Organizational Sociology. *Annual Review of Sociology*, 38(1), 267-283. <http://doi.org/10.1146/annurev-soc-071811-145503>.

Bavelas, A. (1950). Communication Patterns in Task-Oriented Groups. *The Journal of the Acoustical Society of America*, 22(6), 725-730. <http://doi.org/10.1121/1.1906679>.

2/7: (MORE) Centrality

Required Readings:

Luke, Chapter 7: Actor Prominence.

Wasserman and Faust, Chapter 5: Centrality and Prestige.

Baker, W. E., & Faulkner, R. R. 1993. The Social Organization of Conspiracy: Illegal Networks in the Heavy Electrical Equipment Industry. *American Sociological Review*, 58(6), 837-860.

<http://www.jstor.org/stable/2095954>.

Suggested Additional Readings:

Davies, T., & Johnson, S. D. 2014. Examining the Relationship Between Road Structure and Burglary Risk Via Quantitative Network Analysis. *Journal of Quantitative Criminology*, 31(3), 481-507.

Duijn, P. A., Kashirin, V., & Sloot, P. M. (2014). The relative ineffectiveness of criminal network disruption. *Sci Rep*, 4, 4238. <http://doi.org/10.1038/srep04238>.

Goldweber, A., Cauffman, E., & Cillessen, A. H. (2014). Peer Status Among Incarcerated Female Offenders:

- Associations With Social Behavior and Adjustment. *J Res Adolesc*, 24(4), 720-733.
<http://doi.org/10.1111/jora.12078>.
- Vargas, R. (2014). Criminal Group Embeddedness and the Adverse Effects of Arresting a Gang's Leader: A Comparative Case Study. *Criminology*, 52(2), 143-168. <http://doi.org/10.1111/1745-9125.12033>.
- Bright, D. A., Hughes, C. E., & Chalmers, J. (2011). Illuminating dark networks: a social network analysis of an Australian drug trafficking syndicate. *Crime, Law and Social Change*, 57(2), 151-176.
<http://doi.org/10.1007/s10611-011-9336-z>.
- Granovetter, M. 1985. Economic Action and Social Structure: The Problem of Embeddedness. *American Journal of Sociology*, 91(3), 481-510.
- Granovetter, M. 1973. The Strength of Weak Ties. *American Journal of Sociology*, 78(6), 1360-1380.

2/14: Review Homework # 1 & Identifying Subgroups

Assignments: Homework #1 *DUE*.

Required Readings:

- Luke, Chapter 8: Subgroups.
- Wasserman and Faust, Chapter 7: Cohesive Subgroups.
- Purple blues: Many writers try to span America's political divide. *The Economist*.
<https://www.economist.com/books-and-arts/2017/09/30/many-writers-try-to-span-americas-political-divide>.
- How to judge a book by its network: A breakdown of purchasing habits shows where science books fall on the political spectrum. *Nature*, 544 (6) 5-6. <http://doi.org/10.1038/544005b>.

Suggested Additional Readings:

- Tulin, M., Pollet, T. V., & Lehmann-Willenbrock, N. 2018. Perceived group cohesion versus actual social structure: A study using social network analysis of egocentric Facebook networks. *Soc Sci Res*, 74, 161-175.
<http://doi.org/10.1016/j.ssresearch.2018.04.004>.
- Calderoni, F., Brunetto, D., & Piccardi, C. 2017. Communities in criminal networks: A case study. *Social Networks*, 48, 116-125. <http://doi.org/10.1016/j.socnet.2016.08.003>.
- DellaPosta, D. 2017. Network closure and integration in the mid-20th century American mafia. *Social Networks*, 51, 148-157. <http://doi.org/10.1016/j.socnet.2016.11.005>.
- Schaefer, D. R., Bouchard, M., Young, J. T. N., & Kreager, D. A. 2017. Friends in Locked Places: An Investigation of Prison Inmate Network Structure. *Soc Networks*, 51, 88-103.
<http://doi.org/10.1016/j.socnet.2016.12.006>.
- Osgood, D. W., Feinberg, M. E., Wallace, L. N., & Moody, J. (2014). Friendship group position and substance use. *Addict Behav*, 39(5), 923-933. <http://doi.org/10.1016/j.addbeh.2013.12.009>.
- Kreager, D. A., Rulison, K., & Moody, J. (2011). Delinquency and the Structure of Adolescent Peer Groups. *Criminology*, 49(1), 95-127. <http://doi.org/10.1111/j.1745-9125.2010.00219.x>.

2/21: Two-Mode Networks/Bipartite Graphs

Required Readings:

- Luke, Chapter 9: Affiliation Networks.
- Wasserman and Faust, Chapter 8: Affiliation and Overlapping Subgroups.
- Young, J. T. N., & Ready, J. T. (2014). Diffusion of Ideas and Technology: The Role of Networks in Influencing the Endorsement and Use of On-Officer Video Cameras. *Journal of Contemporary Criminal Justice*, 31(3), 243-261. <http://doi.org/10.1177/1043986214553380>.

Suggested Additional Readings:

- Bastomski, S., Brazil, N., & Papachristos, A. V. (2017). Neighborhood co-offending networks, structural embeddedness, and violent crime in Chicago. *Social Networks*, 51, 23-39.

- <http://doi.org/10.1016/j.socnet.2016.12.003>.
- Boutyline, A., & Vaisey, S. (2017). Belief Network Analysis: A Relational Approach to Understanding the Structure of Attitudes. *American Journal of Sociology*, 122(5), 1371-1447.
- Browning, C. R., Calder, C. A., Soller, B., Jackson, A. L., & Dirlam, J. (2017). Ecological Networks and Neighborhood Social Organization. *American Journal of Sociology*, 122(61939-1988).
- Browning, C. R., Calder, C. A., Boettner, B., & Smith, A. (2017). Ecological Networks and Urban Crime: The Structure of Shared Routine Activity Locations and Neighborhood-Level Informal Control Capacity. *Criminology*, 55(4), 754-778. <http://doi.org/10.1111/1745-9125.12152>.
- Grund, T., & Morselli, C. (2017). Overlapping crime: Stability and specialization of co-offending relationships. *Social Networks*, 51, 14-22. <http://doi.org/10.1016/j.socnet.2017.03.008>.
- Jasny, L., & Lubell, M. (2015). Two-mode brokerage in policy networks. *Social Networks*, 41, 36-47. <http://doi.org/10.1016/j.socnet.2014.11.005>.
- Shjarback, J. A., & Young, J. T. N. (2017). The “Tough on Crime” Competition: a Network Approach to Understanding the Social Mechanisms Leading to Federal Crime Control Legislation in the United States from 1973–2014. *American Journal of Criminal Justice*, 43(2), 197-221. <http://doi.org/10.1007/s12103-017-9395-5>.
- Papachristos, A. V., Braga, A. A., Piza, E., & Grossman, L. S. (2015). The Company You Keep? The Spillover Effects of Gang Membership on Individual Gunshot Victimization in a Co-Offending Network. *Criminology*, 53(4), 624-649. <http://doi.org/10.1111/1745-9125.12091>.
- Papachristos, A. V., Wildeman, C., & Roberto, E. (2015). Tragic, but not random: the social contagion of nonfatal gunshot injuries. *Soc Sci Med*, 125, 139-150. <http://doi.org/10.1016/j.socscimed.2014.01.056>.
- Rawlings, C. M., McFarland, D. A., Dahlander, L., & Wang, D. (2015). Streams of Thought: Knowledge Flows and Intellectual Cohesion in a Multidisciplinary Era. *Social Forces*, 93(4), 1687-1722. <http://doi.org/10.1093/sf/sov004>.
- Opsahl, T. (2013). Triadic closure in two-mode networks: Redefining the global and local clustering coefficients. *Social Networks*, 35(2), 159–167. <http://www.sciencedirect.com.ezproxy1.lib.asu.edu/science/article/pii/S0378873311000360>.
- Moody, J. (2004). The Structure of a Social Science Collaboration Network: Disciplinary Cohesion from 1963 to 1999. *American Sociological Review*, 69, 213-238.
- Newman, M. E. J. (2001). Scientific collaboration networks. II. Shortest paths, weighted networks, and centrality. *Physical Review E*, 64(1). <http://www-personal.umich.edu/~mejn/papers/016132.pdf>.
- Borgatti, S. P., & Everett, M. G. (1997). Network analysis of 2-mode data. *Social Networks*, 19(3), 243–269. <http://www.sciencedirect.com.ezproxy1.lib.asu.edu/science/article/pii/S0378873396003012>.
- Fararo, T. J., & Doreian, P. (1984). Tripartite Structural Analysis: Generalizing the Brieger-Wilson Formalism. *Social Networks*, 6, 141–175. <http://www.sciencedirect.com.ezproxy1.lib.asu.edu/science/article/pii/0378873384900157>.
- Breiger, R. L. (1974). The Duality of Persons and Groups. *Social Forces*, 53(2), 181–190. <http://www.jstor.org.ezproxy1.lib.asu.edu/stable/2576011>.

2/28: Mini Presentations

Assignments: Brief Proposal #2 DUE & Homework # 2 Distributed.

3/7: No Class (Spring Break)

3/14: Review Homework #2 & Cross-Sectional Network Analysis using Exponential Random Graph Models

Assignments: Homework #2 DUE & Homework #3 Distributed.

Required Readings:

Luke, Chapter 11: Statistical Network Models.

Suggested Additional Readings:

- Jenine K. Harris. 2014. *An Introduction to Exponential Random Graph Modeling*. Thousand Oaks: Sage Publications.
- Lusher, D. Johan Koskinen, and Garry Robbins. 2013. *Exponential Random Graph Models for Social Networks: Theory, Methods, and Applications*. New York: Cambridge University Press.
- Robins, G., Snijders, T., Wang, P., Handcock, M., & Pattison, P. 2007. Recent developments in exponential random graph (p*) models for social networks. *Social Networks*, 29(2), 192–215.
<http://www.sciencedirect.com/science/article/pii/S0378873306000384>.
- Robins, G., Pattison, P., Kalish, Y., & Lusher, D. 2007. An introduction to exponential random graph (p) models for social networks. *Social Networks*, 29(2), 173–191.
<http://www.sciencedirect.com/science/article/pii/S0378873306000372>.

3/21: (MORE) Exponential Random Graph Models

Required Readings:

- Schaefer, D. R., Bouchard, M., Young, J. T. N., & Kreager, D. A. (2017). Friends in Locked Places: An Investigation of Prison Inmate Network Structure. *Soc Networks*, 51, 88-103.
<http://doi.org/10.1016/j.socnet.2016.12.006>.
- Young, J. T. N. (2011). How Do They “End Up Together”? A Social Network Analysis of Self-Control, Homophily, and Adolescent Relationships. *Journal of Quantitative Criminology*, 27(3), 251–273.
<http://link.springer.com/article/10.1007%2Fs10940-010-9105-7>.

Suggested Additional Readings:

- Kreager, D. A., Young, J. T. N., Haynie, D. L., Bouchard, M., Schaefer, D. R., & Zajac, G. (2017). Where "Old Heads" Prevail: Inmate Hierarchy in a Men's Prison Unit. *Am Sociol Rev*, 82(4), 685-718.
<http://doi.org/10.1177/0003122417710462>.
- Ouellet, M., Bouchard, M., & Hart, M. (2017). Criminal collaboration and risk: The drivers of Al Qaeda's network structure before and after 9/11. *Social Networks*, 51, 171-177.
<http://doi.org/10.1016/j.socnet.2017.01.005>.
- Adams, J. (2015). Glee's McKinley High: Following Middle America's sexual taboos. *Network Science*, 3(02), 293-295. <http://doi.org/10.1017/nws.2015.16>.
- Grund, T. U., & Densley, J. A. (2014). Ethnic Homophily and Triad Closure. *Journal of Contemporary Criminal Justice*, 31(3), 354-370. <http://doi.org/10.1177/1043986214553377>.
- Rivera, M. T., Soderstrom, S. B., & Uzzi, B. (2010). Dynamics of Dyads in Social Networks: Assortative, Relational, and Proximity Mechanisms. *Annual Review of Sociology*, 36(1), 91-115.
<http://doi.org/10.1146/annurev.soc.34.040507.134743>.

3/28: Review Homework #3 & Longitudinal Network Analysis using Stochastic Actor-Based Models

Assignments:

Homework #3 *DUE* & Homework #4 Distributed.

Required Readings:

Luke, Chapter 12: Dynamic Network Models.

Suggested Additional Readings:

- Block, P., Stadtfeld, C., & Snijders, T. A. B. (2016). Forms of Dependence: Comparing SAOMs and ERGMs From Basic Principles. *Sociological Methods & Research*. <http://doi.org/10.1177/0049124116672680>.
- Ripley, R. and Snijders, T.A.B., Boda, Z., Voros, A., and Preciado, P. 2013. *Manual for RSiena (version 1.1-250)*.
http://www.stats.ox.ac.uk/~snijders/siena/RSiena_Manual.pdf.

- Snijders, T. a. B., van de Bunt, G. G., & Steglich, C. E. G. (2010). Introduction to stochastic actor-based models for network dynamics. *Social Networks*, 32(1), 44–60. <http://www.sciencedirect.com/science/article/pii/S0378873309000069>.
- Steglich, C., Snijders, T. a. B., & Pearson, M. (2010). Dynamic Networks and Behavior: Separating Selection From Influence. *Sociological Methodology*, 40(1), 329–393. <http://onlinelibrary.wiley.com/doi/10.1111/j.1467-9531.2010.01225.x/full>.
- Snijders, T.A.B. 2001. The Statistical Evaluation of Social Network Dynamics. *Sociological Methodology*, 31: 361-395. <http://onlinelibrary.wiley.com/doi/10.1111/0081-1750.00099/pdf>.

4/4: (MORE) Longitudinal Network Analysis using Stochastic Actor-Based Models

Suggested Additional Readings:

- Simone, M., Long, E., & Lockhart, G. (2018). The Dynamic Relationship between Unhealthy Weight Control and Adolescent Friendships: A Social Network Approach. *J Youth Adolesc*, 47(7), 373-1384. <http://doi.org/10.1007/s10964-017-0796-z>.
- Ennett, S. T., Faris, R. W., Hussong, A. M., Gottfredson, N., & Cole, V. (2018). Depressive Symptomology as a Moderator of Friend Selection and Influence on Substance Use Involvement: Estimates from Grades 6 to 12 in Six Longitudinal School-Based Social Networks. *J Youth Adolesc*, 47(11), 2337-2352. <http://doi.org/10.1007/s10964-018-0915-5>.
- Schaefer, D. R. (2016). A Network Analysis of Factors Leading Adolescents to Befriend Substance-Using Peers. *Journal of Quantitative Criminology*, 34(1), 275-312. <http://doi.org/10.1007/s10940-016-9335-4>.
- Turanovic, J. J., & Young, J. T. N. (2016). Violent Offending and Victimization in Adolescence: Social Network Mechanisms and Homophily. *Criminology*, 54(3), 487-519. <http://doi.org/10.1111/1745-9125.12112>.
- Fortuin, J., van Geel, M., & Vedder, P. (2015). Peer influences on internalizing and externalizing problems among adolescents: a longitudinal social network analysis. *J Youth Adolesc*, 44(4), 887-897. <http://doi.org/10.1007/s10964-014-0168-x>.
- Jose, R., Hipp, J. R., Butts, C. T., Wang, C., & Lakon, C. M. (2015). Network Structure, Influence, Selection, and Adolescent Delinquent Behavior. *Criminal Justice and Behavior*, 43(2), 264-284. <http://doi.org/10.1177/0093854815605524>.
- Haynie, D. L., Doogan, N. J., & Soller, B. (2014). Gender, Friendship Networks, and Delinquency: A Dynamic Network Approach. *Criminology*, 52(4), 688-722. <http://doi.org/10.1111/1745-9125.12052>.
- Schaefer, D. R., Haas, S. A., & Bishop, N. J. (2012). A dynamic model of US adolescents' smoking and friendship networks. *Am J Public Health*, 102(6), e12-18. <http://doi.org/10.2105/AJPH.2012.300705>.
- Schaefer, D. R., Light, J. M., Fabes, R. A., Hanish, L. D., & Martin, C. L. (2010). Fundamental Principles of Network Formation among Preschool Children. *Soc Networks*, 32(1), 61-71. <http://doi.org/10.1016/j.socnet.2009.04.003>.
- Weerman, F. M., Wilcox, P., & Sullivan, C. J. (2018). The Short-Term Dynamics of Peers and Delinquent Behavior: An Analysis of Bi-weekly Changes Within a High School Student Network. *J Quant Criminol*, 34(2), 431-463. <http://doi.org/10.1007/s10940-017-9340-2>.

4/11: Review Homework # 4 & Presentation Instructions

Assignments: Homework #4 *DUE*.

Suggested Additional Readings:

Missing Data:

- Hipp, J. R., Wang, C., Butts, C. T., Jose, R., & Lakon, C. M. (2015). Research Note: The consequences of different methods for handling missing network data in Stochastic Actor Based Models. *Soc Networks*, 41, 56-71. <http://doi.org/10.1016/j.socnet.2014.12.004>.
- Koskinen, J. H., Robins, G. L., & Pattison, P. E. (2010). Analysing exponential random graph (p-star) models with missing data using Bayesian data augmentation. *Statistical Methodology*, 7, 366-384.

<http://doi.org/10.1016/j.stamet.2009.09.007>.

Wang, C., Butts, C. T., Hipp, J. R., Jose, R., & Lakon, C. M. (2016). Multiple Imputation for Missing Edge Data: A Predictive Evaluation Method with Application to Add Health. *Soc Networks*, 45, 89-98.

<http://doi.org/10.1016/j.socnet.2015.12.003>.

de la Haye, K., Embree, J., Punkay, M., Espelage, D. L., Tucker, J. S., & Green, H. D., Jr. (2017). Analytic Strategies for Longitudinal Networks with Missing Data. *Soc Networks*, 50, 17-25.

<http://doi.org/10.1016/j.socnet.2017.02.001>.

Smith, J. A., Moody, J., & Morgan, J. (2017). Network sampling coverage II: The effect of non-random missing data on network measurement. *Soc Networks*, 48, 78-99. <http://doi.org/10.1016/j.socnet.2016.04.005>.

4/18: Presentations for Group 1

4/25: Presentations for Group 2 (Final Paper Due for Group #1)

5/2: Final Paper Due for Group #2

BRIEF COURSE OUTLINE

1/10: Introduction to Network Analysis

1/17: Network Data Structures and Sources of Network Data

1/24: Getting Started with R & Network Visualization

Assignments: Brief Proposal # 1 *DUE*.

1/31: Centrality

Assignments: Homework #1 Distributed.

2/7: (MORE) Centrality

2/14: Review Homework # 1 & Identifying Subgroups

Assignments: Homework #1 *DUE*.

2/21: Two-Mode Networks/Bipartite Graphs

2/28: Mini Presentations

Assignments: Brief Proposal #2 *DUE* & Homework # 2 Distributed.

3/7: No Class (*Spring Break*)

3/14: Review Homework #2 & Cross-Sectional Network Analysis using Exponential Random Graph Models

Assignments: Homework #2 *DUE* & Homework #3 Distributed.

3/21: (MORE) Exponential Random Graph Models

3/28: Review Homework #3 & Longitudinal Network Analysis using Stochastic Actor-Based Models

Assignments:

Homework #3 *DUE* & Homework #4 Distributed.

4/4: (MORE) Longitudinal Network Analysis using Stochastic Actor-Based Models

4/11: Review Homework # 4 & Presentation Instructions

Assignments: Homework #4 *DUE*.

4/18: Presentations for Group 1

4/25: Presentations for Group 2 (Final Paper Due for Group #1)

5/2: Final Paper Due for Group #2