

Inferential Network Analysis Workshop
University of Konstanz
10th – 13th December 2013

Schedule

Date	Time	Room
Tuesday, 10th December	8:15 – 9:45	F 423
Tuesday, 10th December	10:00 – 11:30	D 404
Tuesday, 10th December	13:30 – 15:00	D 436
Wednesday, 11th December	8:15 – 9:45	F 423
Wednesday, 11th December	10:00 – 11:30	M 627
Thursday, 12th December	8:15 – 9:45	F 427
Thursday, 12th December	17:00 – 18:30	F 428
Friday, 13th December	11:45 – 13:15	G 306
Friday, 13th December	13:30 – 15:00	G 306
Friday, 13th December	15:15 – 16:45	G 306

Instructor contact

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Prerequisite knowledge

This is an advanced workshop on network analysis. The workshop assumes existing knowledge of basic social science research methods at least through generalized linear models (logit, poisson, etc...) as well as basic knowledge of network analysis. It will be helpful, though not essential, if participants know the basic anatomy of networks as well as the descriptive tools of network analysis (e.g. measures of centrality, plotting and visualization, etc...). Lastly, all techniques will be demonstrated using the R statistical language. While this is not a course *about* software, basic familiarity with R will be quite helpful for students as I will not go into great detail about how to load/manage data or use R's more basic functions. That said, a high level of R (e.g. programming competency) is not necessary.

Short course outline

This course will cover topics in the advanced modeling of social and political networks. The primary goal is to move beyond descriptive analysis of networks and develop inferential models; primarily the exponential random graph model (ERGM), but alternative techniques such as the stochastic actor-based model (i.e. Sienna) and latent space models will be considered as well.

Long course outline

This course revolves around the idea of creating probabilistic statistical models of networks. This is a big departure from the descriptive analysis of networks (e.g. measuring the centrality of a node) and also a fairly big departure from the statistical modeling of non-network data with the

regression framework. Our goal for the course will be the development of statistical models that can accomplish the same general objectives as regression models (fitting parameters to data with probabilistic models), while accounting for the substantial endogenous complexity that is inherent to network data.

In order to accomplish the above, we will consider two basic approaches to modeling networks. The approach we will spend the most time on involves explicitly modeling the network dependencies present in the data. Starting cross-sectionally, we will introduce the exponential random graph model (ERGM) and consider it in some detail - including specification, estimation, fit checking, diagnosing problems, and limitations. We will then extend our knowledge of this approach to longitudinal networks by considering both the Temporal ERGM and the stochastic actor oriented model (SAOM, more commonly known as SIENA), which are closely related. We will close by considering an alternative approach to modeling networks, in which the network dependencies are projected into the error term rather than explicitly modeled - the so-called latent space network model. For each topic we cover, we will also consider how to perform such analyses in R using several example datasets.

Day-to-day schedule (Tuesday to Friday)

	Topic(s)	Details
Day 1	Introduction and why we need network-specific models (and not regressions)	Lecture. Basic intro to R.
Day 1	Introduction to the ERGM, form, specification, estimation, and interpretation.	Lecture with some lab
Day 2	The ERGM, form, specification, estimation, and interpretation (continued).	Some lecture with substantial lab
Day 3	Longitudinal network models: TERGM vs SIENA	Lecture, lab
Day 4	Latent space models and conclusion	Lecture, lab

Day-to-day reading list

	Readings (please list at least the compulsory reading for the scheduled day)
Day 1	- Cranmer, Skyler J., Bruce A. Desmarais and Elizabeth Menninga. Forthcoming. "Complex Dependencies in the Alliance Network." <i>Conflict Management and Peace Science</i> .
Day 1	- Lusher, Dean, Johan Koskinen and Garry Robins. 2012. <i>Exponential Random Graph Models for Social Networks</i> . New York, NY: Cambridge University Press. Chapters 2-4 - Desmarais, Bruce A. and Skyler J. Cranmer. Forthcoming. "Micro-Level Interpretation of Exponential Random Graph Models with Application to Estuary Networks." <i>Policy Studies Journal</i> .
Day 2	- Hunter, David R., Mark S. Handcock, Carter T. Butts, Steven M. Goodreau and Martina Morris. 2008. "ergm: A Package to Fit, Simulate and Diagnose Exponential-Family Models for Networks." <i>Journal of Statistical Software</i> 24(3):1-29.
Day 3	- Hanneke, Steve, Wenjie Fu and Eric P. Xing. 2010. "Discrete Temporal Models of Social Networks." <i>Electronic Journal of Statistics</i> 4:585-605. - Desmarais, Bruce A. and Skyler J. Cranmer. 2012. "Statistical

	Mechanics of Networks: Estimation and Uncertainty." <i>Physica A</i> 391(4):1865-1876.
Day 4	- Hoff, Peter D., Adrian E. Raftery and Mark S. Handcock. 2002. "Latent Space Approaches to Social Network Analysis." <i>Journal of the American Statistical Association</i> 97(460):pp.1090-1098. - Krivitsky, Pavel N. and Mark S. Handcock. 2008. "Fitting Latent Cluster Models for Networks with latentnet." <i>Journal of Statistical Software</i> 24(5):1{23.

Software and hardware requirements

All software we use will be free: R and several of its packages (e.g. ergm, latentnet). Participants should bring their laptop for lab. Pre-installing the latest version of R and the code-editor of one's choice (I like Komodo with the R plugin, but many [most] like R Studio; anything that works is fine).

Literature

- Berardo, Ramiro and John T. Scholz. 2010. "Self-Organizing Policy Networks: Risk, Partner Selection, and Cooperation in Estuaries." *American Journal of Political Science* 54(3):632-649.
- Butts, Carter T. 2008. "Social Network Analysis with sna." *Journal of Statistical Software* 24(6):1-51.
- Cranmer, Skyler J., Bruce A. Desmarais and Elizabeth Menninga. Forthcoming. "Complex Dependencies in the Alliance Network." *Conflict Management and Peace Science*.
- Desmarais, Bruce A. and Skyler J. Cranmer. 2011. Forecasting the Locational Dynamics of Transnational Terrorism: A Network Analytic Approach. In *Proceedings of the European Intelligence and Security Informatics Conference (EISIC) 2011*. IEEE Computer Society.
- Desmarais, Bruce A. and Skyler J. Cranmer. 2012. "Statistical Mechanics of Networks: Estimation and Uncertainty." *Physica A* 391(4):1865-1876.
- Desmarais, Bruce A. and Skyler J. Cranmer. Forthcoming. "Micro-Level Interpretation of Exponential Random Graph Models with Application to Estuary Networks." *Policy Studies Journal*.
- Dreiling, Michael and Derek Darves. 2011. "Corporate Unity in American Trade Policy: A Network Analysis of Corporate-Dyad Political Action." *American Journal of Sociology* 116(5):pp. 1514{63.
- Goodreau, Steven .M., James A. Kitts and Martina Morris. 2009. "Birds of a feather, or friend of a friend? Using exponential random graph models to investigate adolescent social networks." *Demography* 46(1):103{25.
- Hanneke, Steve, Wenjie Fu and Eric P. Xing. 2010. "Discrete Temporal Models of Social Networks." *Electronic Journal of Statistics* 4:585{605.
- Ho, Peter D., Adrian E. Raftery and Mark S. Handcock. 2002. "Latent Space Approaches to Social Network Analysis." *Journal of the American Statistical Association* 97(460):pp. 1090-1098.

- Hunter, David R., Mark S. Handcock, Carter T. Butts, Steven M. Goodreau and Martina Morris. 2008. \ergm: A Package to Fit, Simulate and Diagnose Exponential-Family Models for Networks." *Journal of Statistical Software* 24(3):1 {29.
- Krackhardt, David. 1988. \Predicting with networks: Nonparametric multiple regression analysis of dyadic data." *Social Networks* 10(4):359 { 381.
- Krivitsky, Pavel N. and Mark S. Handcock. 2008. \Fitting Latent Cluster Models for Networks with latentnet." *Journal of Statistical Software* 24(5):1 {23.
URL: <http://www.jstatsoft.org/v24/i05>
- Lazega, Emmanuel, Lise Mounier, Tom Snijders and Paola Tubaro. 2012. "Norms, status and the dynamics of advice networks: A case study." *Social Networks* 34(3):323 { 332.
- Lusher, Dean, Johan Koskinen and Garry Robins. 2012. *Exponential Random Graph Models for Social Networks*. New York, NY: Cambridge University Press.
- Mercken, L., T.A.B. Snijders, C. Steglich, E. Vartiainen and H. de Vries. 2010. "Dynamics of adolescent friendship networks and smoking behavior." *Social Networks* 32(1):72 { 81.
- Olson, Jamie F. and Kathleen M. Carley. 2009. "Content Network Indices with latent Space Models." *Neural Information Processing Systems* .
- Robins, Garry and Philippa Pattison. 2001. \Random Graph Models for Temporal Processes in Social Networks." *Journal of Mathematical Sociology* 25(1):5 { 41.
- Snijders, Tom A.B., Gerhard G. van de Bunt and Christian E.G. Steglich. 2010. "Introduction to stochastic actor-based models for network dynamics." *Social Networks* 32(1):44 - 60.
- Ward, Michael D., Randolph M. Siverson and Xun Cao. 2007. \Disputes, Democracies, and Dependencies: A Reexamination of the Kantian Peace." *American Journal of Political Science* 51(3):pp. 583 {601.
- Wasserman, Stanley and Katherine Faust. 1997. *Social Network Analysis*. New York, NY: Cambridge University Press.
- Wimmer, Andreas and Kevin Lewis. 2010. \Beyond and Below Racial Homophily: ERG Models of a Friendship Network Documented on Facebook." *American Journal of Sociology* 116(2):pp. 583 {642.