INTRODUCTION TO THE STATISTICAL ANALYSIS OF SOCIAL NETWORKS WITH EXPONENTIAL RANDOM GRAPH MODELS

Social Network Analysis Research (SONAR) Center, University of Italian Switzerland – Lugano (CH)

April 18-20, 2016

Introduction

The statistical analysis of empirical social network data has experienced rapid methodological development in a relatively short time. The presence of complex network dependence militates against the use of standard statistical approaches for network data, so novel methods are required. Exponential random graph models (ERGMs) are a class of statistical models for social networks based on explicit hypotheses about network dependence. By accounting for the presence of network ties, they provide a model for network structure in terms of endogenous self-organizing structural effects as well as different types of exogenous factors. ERGMs originate in spatial statistics and bear similarity to models in statistical mechanics. In this workshop the general theoretical background to ERGMs will be reviewed, model formulation discussed, and simulation, estimation and goodness of fit procedures presented. Meaningful interpretation of parameter estimates will be emphasized. Social selection models incorporating individual-level attributes will also be described. Hands-on exercises using the MPnet software will be included, both in simulating networks and in fitting illustrative data sets. Extensions to models for bipartite networks and to models for social influence will also be presented. New models for multilevel networks will be introduced, as well as approaches to data with missing network ties. If time allows, we will briefly describe our new approaches based on snowball sampling for using ERGMs on "Big Data" – datasets for which the computational resources that typically available to social scientists are insufficient. The workshop presenters will illustrate the methods with empirical examples based on their own research.

Learning objectives

The workshop pursues three related objectives. The first is to make participants aware of the considerable range of possibilities offered by the most recent generation of ERGMs for the analysis of social networks. The second objective is to help students develop sufficient familiarity with the specification and estimation of ERGMs so that they can get started on – or make progress with their own network projects. The third objective involves helping students to become informed consumers of contemporary research based on ERGMs.

Participants

The workshop is addressed to doctoral and post-doctoral students in the social sciences for whom the empirical analysis of social networks represents an important part of their dissertation or a major component of their current research work. Empirical examples that will be used to illustrate modeling concepts will be drawn mostly, even if not exclusively, from current research on organizational social networks.

Instructors

Alessandro Lomi is a Professor of Organization Theory and Behavior in the University of Italian Switzerland where he directs the Social Network Analysis Research (SONAR) Center. He is a honorary research fellow of the School of Psychological Sciences of the University of Melbourne and a member of the Swiss National Science foundation. He is a board member of the International Network for Social Network Analysis (INSNA) and an associate editor of the journal *Computational and Mathematical Organization Theory.* His interests include the analysis of social networks within and between organizations, models of peer effects and the longitudinal analysis of social interaction data.

Garry Robins is a Professor in the Melbourne School of Psychological Sciences at the University of Melbourne. He is a member of the International Advisory Board of the SONAR Center, co-editor of the journal *Network Science,* a member of the Board of the International Network for Social Network Analysis (INSNA), and former editor of the *Journal of Social Structure*. His research has been centred on the development of Exponential random graph models for social networks, as well as a wide range of empirical and applied social network studies.

Paola Zappa is a Swiss National Science Foundation (SNSF) post-doctoral Fellow at the University of Italian Switzerland. Her interests include multilevel network models and the longitudinal analysis of social networks.

Prerequisites

While no prior experience with ERGMs will be assumed, participants will be expected to understand fundamental social network concepts and terminology, and to have some knowledge of basic concepts in statistical inference. The workshop will be conducted in English, and be open to doctoral students in the social sciences and neighboring disciplines. Students will be encouraged to work on their own data during the workshop. Sufficient time will be set aside for students to interact individually with the instructors and discuss their own research projects and problems.

Material requirements

Participants will be expected to bring their own portable laptop computer. The software packages Pnet and MPnet will be used extensively throughout the workshop and will be freely available to participants (Please note that Pnet is written for PCs and may not function well on Apple computers).

Venue, dates and contacts

The workshop will be held in the Lugano campus of the University of Italian Switzerland (Università della Svizzera italiana or USi). Students are expected to arrive on Sunday April 17, 2016. **Classes will start in the morning of Monday April 18, and end the afternoon of Wednesday April 20.** Classes will run from 9:00am to 12:00 noon and from 2:00pm to 5:00pm. Additional information may be obtained by writing to **ergm2016usi@gmail.com**.

Pricing and payment

For international students, and USi students and Staff the fee is set at 350 CHF (Swiss Francs). All other attendees 500 CHF. The fee covers 18 hours of face-to-face teaching over 3 days and lunches on campus for 3 days. The fee excludes travel and accommodation. Payment is due by **April 1, 2016**.

About USi Lugano

Located in Ticino, the Italian speaking part of Switzerland, the University of Italian Switzerland (USi) is the most international Swiss university. USi comprises four Faculties, with a student population of 3,000, 65% of which made up of international students from more than 100 different countries. Additional information on USi may be found by visiting: http://www.usi.ch/en/universita/about_usi/university_about_usi.htm. The workshop will be held at the Lugano campus of USi. More about the city of Lugano here: http://lugano-tourism.ch/en/32/tourist-information.aspx

Background readings

Useful introductory textbooks that participants may consult as general reference include:

- Borgatti, S., Everett, M., & Johnson, J. (2013). *Analyzing social networks*. Sage Publishing.
- Scott, J. (2013). *Social Network Analysis*. Sage Publishing.

Major methodological papers that will be used as background material include:

- Lusher, D., Koskinen, J., & Robins, G. (2013). *Exponential random graph models for social networks: Theories, methods and applications.* Cambridge University Press.
- Robins, G., Pattison, P., Kalish, Y., & Lusher, D. (2007). An introduction to exponential random graph (*p**) models for social networks. *Social Networks, 29,* 173-191.
- Robins, G., Pattison, P., & Wang, P. (2009). Closure, connectivity and degree distributions: Exponential random graph (p*) models for directed social networks. *Social Networks*, *31*(2), 105-117.
- Robins, G., Snijders, T.A.B., Wang, P., Handcock, M., & Pattison, P. (2007). Recent developments in exponential random graph (*p**) models for social networks. *Social Networks, 29*, 192-215.
- Wang, P., Robins, G., Pattison, P., & Lazega, E. (2013). Exponential random graph models for multilevel networks. Social Networks, *35*(1), 96-115.
- Wang, P., Sharpe, K., Robins, G. L., & Pattison, P. E. (2009). Exponential random graph (p∗) models for affiliation networks. Social Networks, *31*(1), 12-25.

Examples of empirical research based on ERGM recently published in international journals include:

- Caimo, A., & Lomi, A. (2015). Knowledge sharing in organizations: A Bayesian analysis of the role of reciprocity and formal structure. Journal of Management Forthcoming.
- Conaldi, G., & Lomi, A. (2013). The Dual Network Structure of Organizational Problem Solving: A Case Study on Open Source Software Development. *Social Networks, 35*(2): 237-250.
- Lomi, A., Lusher, D., Pattison, P., & Robins, G. (2014). The focused organization of advice relations: A case study of boundary-crossing ties in a multi-unit business group. *Organization Science, 25*: 438-457.
- Lomi, A., & Pattison, P. (2006). Manufacturing relations: An empirical study of the organization of production across multiple networks. *Organization Science*, *17*(3): 313-332.

- Srivastava, S.B., & Banaji. M.R. (2011). Culture, Cognition, and Collaborative Networks in Organizations. *American Sociological Review, 76*(2), 207-233.
- Wimmer, A., & Lewis, K. (2010). Beyond and Below Racial Homophily: ERG Models of a Friendship Network Documented on Facebook. *American Journal of Sociology, 116*(2): 583–642.