Network Analysis

Ph.D. in Management – Ca' Foscari University of Venice

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Course description

Network Science is a distinct domain of data science concerned with the collection, representation, and analysis of relational data. This type of data is gathered by recording relationships between pairs of entities. It is usually represented as a graph, where the nodes are entities, and the edges are the relationships among them. The bulk of the discipline is the analysis and explanation of the dependencies among the pairs of entities.

In this course, we review basic network concepts and focus on the statistical models to analyze both cross-sectional and longitudinal relational data. We illustrate the applicability of these models by using examples from several disciplines (e.g., Economics, Organizational and Social Sciences) and the software R.

Objectives

By the end of this course, students will be able to apply descriptive statistics and stochastic models to analyze relational data in a variety of different contexts.
They can achieve this by doing the following:

- describe the introduced methods and analyze the commonalities and differences among them
- identify adequate methods to analyze relational data and motivate the choice
- perform statistical analysis using the software R:
  descriptive analysis, parameter estimation, interpretation, and critically assessment of the results obtained
- explain the models and communicate the results to an audience that might be unfamiliar with network methods

Schedule

- 17.01.2023
  Introduction to relational data, recalls of notation and basic concepts
- Introduction to R
- 18.01.2023
  - Network descriptive statistics (Degree distributions, Centrality, Clustering): analysis implemented with R
  - Introduction to network modeling
- 19.01.2023
  Exponential Random Graph Models: theory and analysis implemented with R
- 24.01.2023
  Stochastic actor-oriented models for the network evolution: theory and analysis implemented with R
- 25.01.2023
  - Stochastic actor-oriented models for the co-evolution of networks and behavior: theory and analysis implemented with R
  - Relational event models
- 26.01.2023
  Miscellaneous: extensions of the introduced models, latent variable models, stochastic block-modeling

References

- Robins, G., Pattison, P., Kalish, Y., and Lusher, D. (2007). An introduction to exponential random graph (p^*) models for social networks. Social networks, 29(2): 173-191.
- Lusher, D., Koskinen, J., and Robins, G. (Eds.). (2013). Exponential random graph models for social networks: Theory, methods, and applications. Cambridge University Press.
- Snijders, T. A. B., Van de Bunt, G.G., and Steglich, C. (2010). Introduction to stochastic actor-based models for network dynamics. Social networks 32(1): 44-60.

- Steglich, C., Snijders, T. A. B., and Pearson, M. (2010). Dynamic networks and behavior: Separating selection from influence. Sociological methodology, 40(1): 329-393.
- Butts, C. T. (2008). A relational event framework for social action. Sociological Methodology, 38(1): 155-200.
- Stadtfeld, C., and Block, P. (2017). Interactions, actors, and time: Dynamic network actor models for relational events.Sociological Science, 4: 318-352
- Slides and additional readings provided by the instructor

Prerequisites

- Course "Mathematics for modelling in management", prof. Marco Tolotti
- A sound understanding of estimation methods, hypothesis testing and linear regression models (OLS)
- Download and install R and R Studio.