

Course: **Social Network Analysis**

Instructor: **Prof. Luca De Benedictis**, Professor at University of Macerata and Luiss, Italy.

Date: July 9-10, 2020, from 9h00-13h00.

Short description of the course:

Network Analysis is a rapidly growing field among quantitative social sciences. Networks permeated everyday life and contemporary social phenomena are increasingly represented as networks: from the participation to online social media, to the structure of relations in a working environment, to the description of political movements, to the analysis of the diffusion of banking crises. The boundaries of *Network Science* go well beyond social sciences, including applications to history, biology, glottology, statistics and computer science.

Network Analysis focuses on the relationships that exist between units of analysis, and studies those relationships through the tools of Graph Theory. This course will introduce the participants to Applied Network Analysis concentrating on measurement, data collection and manipulation, description and visualization of networks. Some inferential statistical techniques will be presented at the end of the course. Examples will be drawn from economics, political science, and sociology, and replication exercises will be discussed in class and implemented by the participants. The course has a hands-on character, and the class will apply the concepts presented by the instructor using R libraries and RStudio: R libraries will be used most of the time, with some incursion into SocNetV, and Pajek and Gephi, for large networks visualizations. A little knowledge of R is therefore recommended to get the best out of this short applied introduction to Social Network Analysis.

The course will cover the following topics:

- **General introduction to Network Analysis**
 - o History of (Social) Network Analysis
 - o Terminology and basic definitions
 - o Software
 - o Data
 - o References
- **Types of Networks**
 - o Directed and undirected graphs
 - o Weighted and unweighted graphs
 - o Two mode networks
 - o Multiplex
- **Network Data**
 - o Imputing network data
 - o Manipulating network objects: Nodes, Edges and Graph Attributes
 - o Generating networks: Random Graphs, Small-World models, Preferential Attachment
- **Visualizing Networks**
 - o Introduction to layout algorithms
 - o Elements of networks visualizations
 - o Decorating Graphs Layouts
 - o Visualizing Large Networks
- **Centrality**
 - o Degree centrality

- Closeness centrality
- Betweenness centrality
- Eigenvector centrality
- Network Cohesion
 - Subgraphs and Censuses
 - Density and relative frequencies of edges
 - Connectivity and cuts
 - Assortativity and segregation
- Graph Partitioning
 - Hierarchical clustering
 - Spectral partitioning
 - Modularity and communities in networks
- Statistical Models for Network Data
 - Correlation networks
 - Exponential Random Graphs Models

References:

While not required, the following references are useful background readings for the course:

Jackson M. (2019), *The Human Network*, Atlantic Books, London.

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

Jackson M., B. Rogers and Y. Zenou (2017), "The Economic Consequences of Social Network Structure", *Journal of Economic Literature*, 55:1, 49-95.

Bramoullé Y., A. Galeotti and B. Rogers (eds), *The Oxford Handbook of the Economics of Networks*. Oxford University Press, 2016.

de Martí, J. and Y. Zenou (2011), "Social networks" In: I. Jarvie and J. Zamora-Bonilla (Eds.), *Handbook of Philosophy of Social Science*, London: SAGE Publications, Chap. 16, 339-361.

De Benedictis L. and L. Tajoli (2011), "The World Trade Network." *The World Economy*, 34, 8, 1417-1454.

De Benedictis L., S. Nenci, G. Santoni, L. Tajoli and C. Vicarelli (2014), "Network Analysis of World Trade using the BACI-CEPII dataset." *Global Economy Journal*, 14(3-4), 287-343.

About the Instructor:

Prof. Luca De Benedictis currently works at the Department of Economics and Law, University of Macerata, Italy. He has been teaching international trade courses at the graduate and undergraduate level in several contexts, from Luiss University to the Italian Institute for Foreign Trade (ICE), from The Polytechnic University in Gdansk, Poland, to the AGRODEP consortium in Dakar, Senegal. His main research interests are in the areas of applied econometrics, gravity models of international trade and migration, causal inference and network analysis. He has published more than fifty articles in international peer-reviewed journals such as *The World Economy*; *The Review of World Economics*; and *Network Science*.

Participation:

The course is directed to anyone involved and/or interested in network analysis, especially experts from commercial organizations with a social science background, and students of statistics, economics, political science and sociology. A maximum of 30 people can participate. Participants will be admitted on a first-come first-serve basis: the first 30 people who sign up and pay the registration fee will be accepted.

Prerequisites for the course are basic knowledge of statistics. Previous use of R and R-Studio is advisable.