

## Professional Training Course

# Network Analysis Techniques For Applications in Finance and Economics

 @FBF\_School

**22-24 March 2021**

Sala Europa - Villa Schifanoia, Via Boccaccio 121 - Florence

Instructors:

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## Introduction

Over the last years, network analysis has become an active topic of research, with numerous applications in macroeconomics and finance. In a nutshell, network analysis is concerned with representing the interconnections of a large panel as a graph: the vertices of the graph represent the variables in the panel, and the presence of an edge between two vertices denotes the presence of some appropriate measure of dependence between the two variables. Dependence can derive from direct exposures or from indirect or common exposures. From an economic perspective, the interest on networks has been boosted by the research of, inter alia, Acemoglu et al. (2012), which shows that individual entities can have a non-negligible effect on the aggregate behavior of the economy when the system has a high degree of interconnectedness. Especially since the 2008 global financial crisis, the interest in analyzing the role of network structure in transmitting - or dissipating - stress has grown significantly.

This work is concerned with the theory and practice network analysis techniques for applications in finance and economics.



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## Programme

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### 22 March

13.15 - 13.30 *Welcome Coffee*

13.30 - 13.45 **Introduction by the Florence School of Banking and Finance and *tour de table***

13.45 - 15.30 **Session 1 Introduction to Networks**

- Basic terminology and concepts
- Vertices, edges, network properties, random graphs

15.30 - 16.00 *Coffee break*

16.00 - 17.30 **Direct exposures in interbank networks**

- What theoretical results about the stability have been derived? There are some strong results but based on strong assumptions
- How do these theoretical results hold up in practice?

After the course *Social Activities outside the EUI (TBD)*

### 23 March

09.30 - 11.00 **Partial correlation networks**

- Modelling contemporaneous dependence in large panels of time series
  - Partial correlation network
- Estimation of large dimensional partial correlation network models
  - LASSO Estimation, the workhorse of Big Data
- Applications:
  - Network interdependence in the constituents of the S&P 100
  - Network interdependence in the default intensities of Eurozone financial institutions

11.00 - 11.30 *Coffee Break*

11.30 - 13.00 **Session 4 Indirect exposure**

- Contagion due to direct exposures is generally thought to be limited. In reality we do see significant contagion. How can we explain this?
- We will explore three possible explanations:
  - Overlapping portfolios: similarity in business models
  - Crowded trading: synchronised actions
  - Multilayer: interaction between different markets

13.00 - 14.00 *Lunch break*

14.00 - 15.30 **Session 5 Dynamic networks**

- Modelling dynamic dependence in large panels of time series
  - Granger Networks

- Connectedness Table
- More tools for the estimation of large network models
  - Elastic Net
- Application:
  - Determining the network of volatility spillover effects among financial institutions

15.30 - 16.00 *Coffee break*

16.00 - 17.30 **Session 6 Identifying network structure**

- If the structure is important, how can we identify certain types of networks? We will discuss:
  - statistical models of networks
  - core-periphery
  - ensemble methods
- Information on networks generally assumes full information which is often not true in practice. What can be done if some information is missing?
- How to represent networks and network results in an accessible way?

After the course *Social Activities outside the EUI (TBD)*

**24 March**

09.30 - 11.00 **Session 7 Identifying network structures**

- Detecting Community Structures
  - Stochastic Block Model
  - Spectral clustering
  - Detecting block structures in large panels
- Detecting Central Units
  - Eigenvector centrality
- Granular and dominant units
- Applications:
  - Business cycle synchronization in the US
  - Detecting systemic institutions in the US banking system

11.00 - 11.30 *Coffee Break*

11.30 - 13.00 **Session 8 How to use network models in policy**

- We have seen that networks effects are important in some applications. How can we now use these results in policy making. An issue to tackle is that behaviour is generally out of scope and we thus need to develop dynamic models. Agent Based Modelling (ABM) could be one solution.
- We will look at several use cases:
  - identifying key institutions
  - stress testing

13.00 -14.30 Lunch session with Keynote speech by **Marco D'Errico** | European Systemic Risk Board