The Alan Turing Institute

Network Science in Financial Services

Friday 06 Dec 2019

Agenda

The Alan Turing Institute is located on the first floor of The British Library (96 Euston Road NW1 2DB) and can be accessed via the main doors from 9:30 onwards. Please allow 15 minutes for queuing when planning your journey.

9:30 – 9:50 Registration & Coffee

9:50 – 10:00 Welcome / Introduction

Session 1

10:00 – 10:15 **Communities in temporal multilayer networks, with an application to financial correlation networks** - Marya Bazzi (The Alan Turing Institute, University of Warwick)

10:15 – 10:30 **Sector Neutral Portfolios: Long memory motifs persistence in market structure dynamics -** Jeremy Turiel (University College London)

10:30 – 10:45 **Applications of financial networks in finance and challenges faced -** Kimmo Soramäki (FNA - Financial Network Analytics)

10:45 – 11:00 **Q&A**

11:00 – 11:10 **Coffee**

Session 2

11:10 – 11:25 **Network theory for finance** - Ginestra Bianconi (Queen Mary University of London)

11:25 – 11:40 **Network models of systemic risk** - Fabio Caccioli (University College London)

11:40 – 11:50 **Q&A**

11:50 – 12:30 Lunch

Session 3

12:30 – 12:45 **Dynamic network models in finance** - Paolo Barucca (University College London)

12:45 – 13:00 **Anomaly detection and core-periphery structure in networks** – Andrew Elliott (The Alan Turing Institute)

13:00 – 13:15 **Money Laundering Networks** - Peter Mitic (Santander UK)

13:15 – 13:30 **Q&A**

Session 4

13:30 – 13:45 **An ecosystem perspective on financial and industrial networks** – Felix Reed-Tsochas (University of Oxford)

13:45 – 14:00 **Network-based learning for understanding collective human behaviour** – Xiaowen Dong (University of Oxford)

14:00 – 14:15 **Shape of strategy** - Chandler Wilson (HSBC)

14:15 – 14:30 **Q&A**

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Abstracts

Speakers from Academia

Communities in temporal multilayer networks, with an application to financial correlation networks

Marya Bazzi (The Alan Turing Institute & University of Warwick)

Networks are a convenient way to represent systems of interacting entities. Many networks contain "communities" of nodes that are more densely connected to each other than to nodes in the rest of the network. Most methods for detecting communities are designed for static networks. However, in many applications, entities and/or interactions between entities evolve in time.

We investigate "multilayer modularity maximization", a method for detecting communities in temporal networks. The main difference between this method and most previous methods for detecting communities in temporal networks is that communities identified in one temporal snapshot are not independent of connectivity patterns in other snapshots. We show how the resulting partition reflects a trade-off between static community structure within snapshots and persistence of community structure between snapshots. As a focal real-world example, we study time-dependent financial asset correlation networks.

Sector Neutral Portfolios: Long memory motifs persistence in market structure dynamics

Jeremy Turiel (University College London)

We study soft persistence (existence in subsequent temporal layers of motifs from the initial layer) of motif structures in Triangulated Maximally Filtered Graphs (TMFG) generated from time-varying Kendall correlation matrices computed from stock prices log-returns over rolling windows with exponential smoothing. We observe long-memory processes in these structures in the form of power law decays in the number of persistent motifs. The decays then transition to a plateau regime with a power-law decay with smaller exponent. We demonstrate that identifying persistent motifs allows for forecasting and applications to portfolio diversification. Balanced portfolios are often constructed from the analysis of historic correlations, however not all past correlations are persistently reflected into the future. Sector neutrality has also been a central theme in portfolio diversification and systemic risk. We present an unsupervised technique to identify persistently correlated sets of stocks. These are empirically found to identify sectors driven by strong fundamentals. Applications of these findings are tested in two distinct ways on four different markets, resulting in significant reduction in portfolio volatility. A persistence-based measure for portfolio allocation is proposed and shown to outperform volatility weighting when tested out of sample.

Network theory for finance

Ginestra Bianconi (Queen Mary University of London)

Network models of systemic risk

Fabio Caccioli (University College London)

Systemic risk, the risk associated with the breakdown of the financial system, emerges from the interactions between financial institutions. Some of these interactions can be modelled in terms of dynamical processes on networks, where nodes represent financial institutions and links represent contracts between financial institutions. We will discuss the relation between the structure of interbank networks and their stability, and we will show how, in some cases, the attempt to reduce individual risk may end up increasing systemic risk.

Dynamic network models in finance:

Paolo Barucca (University College London)

I will present a series of statistical models and results originated from the analysis of interbank networks. The studies presented will deal with the modelling of systems embedded in networks of relationships that evolve over time, with the aim of performing a node, link or graph classification analysis and forecasting network features.

Anomaly detection and core-periphery structure in networks

Andrew Elliott (The Alan Turing Institute)

I will briefly discuss two recent lines of work, both with applicability to financial networks. Anomalies in networks may come in many forms, such as a compromised computer in a cyber network, a bad actor in a social network, or a series of suspicious transactions in a financial transaction network. In recent work, we considered the detection of anomalies in networks of financial transactions, with accounts as nodes and a directed weighted edge between two nodes denoting a money transfer. We construct a method based on a combination of features from network comparison, spectral analysis, and local statistics, and validate it on synthetic data. In a second strand of work, we consider the core-periphery structure, which has been used to model interbank lending networks. We consider a generalisation of the classic structure to the setting of directed graphs, and propose several methods to find this structure. We identify instances of it in three real world data sets, illustrating that this directed core–periphery structure can offer novel insights about the underlying networks.

Network-based learning for understanding collective human behaviour
Xiaowen Dong (University of Oxford)

In today's connected society, behaviour of individuals are often influenced by the ones to whom they are connected in an underlying social network. Network-based learning therefore plays a key role in the understanding of collective human behaviour and decision-making. In this talk, I will provide two such examples on network-based learning, i.e., 1) how a known social network affects decision-making in an adoption scenario, and 2) if the network is unobserved, how to infer its topology from observed individual decisions.

An ecosystem perspective on financial and industrial networks
Felix Reed-Tsochas (University of Oxford)

I will consider two domains of interest to business where questions and methods partially inspired by theoretical ecology, based on a well-established tradition of constructing measures and building models that help us understand the structure of ecological networks, have the potential to lead to new insights. The first empirical domain concerns large-scale supply chains, where thousands of firms are involved in the production of complex products such as cars. The second empirical domain concerns the network of interdependences generated by lending relationships between banks and firms across a national economy. Questions that arise in both settings are what local mechanisms generate the observed structural features of networks between different organisations, how organisational or strategic choices between specialist and generalist roles affect the resulting structure, and the systemic consequences (such as resilience) of different structural arrangements.

Speakers from Industry

Applications of financial networks in finance and challenges faced
Kimmo Soramäki (FNA - Financial Network Analytics)

I will talk about three challenges that FNA regularly faces while developing solutions for central banks, market infrastructures & global banks. First, robust methods for predicting properties of links and nodes (and whether they should be present in a given network in a time series) have many applications in financial networks, e.g. in forecasting and anomaly detection. Second, explorative analysis of large and complex networks often forms a first step in any project. However better dynamic filtering methods, node and link bundling algorithms and other techniques to filter signal from noise would make this faster and visual inference more accurate. Third, new domain-specific models of trade networks and shocks to these would help in climate impact modelling and analysis of trade wars and sanctions.

Money Laundering Networks

Peter Mitic (Santander UK)

Financial fraud that exploits money laundering is an increasingly common, and problematic, phenomenon. We describe a simple way in which money laundering can be achieved within a network, and highlight the problems that arise when trying to detect this type of fraud. Detection is difficult if parts of the network are effectively 'invisible' because those parts are only known to another bank. Consequently detecting the entry points to the 'known' network are vitally important.

Shape of strategy

Speaker: Chandler Wilson (HSBC)

We will explore how open source intelligence, machine learning, and networks are redefining how HSBC anchors its strategy.