Università
della
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italiana

**Institute of
Computational
Science
ICS**

Public EU-COST Conference
Future of Statistical Network Science

Date: 8 April 2019
Time: 13:30-17:30
Room: 251 (Main Building, Via G. Buffi 13, Lugano)
Title: *Future of Statistical Network Science*

Registration: free (send an email to wite@usi.ch before 1 April for numbers)

Programme:

13:30   **Gesine Reinert (Oxford)**
             Anomaly detection in networks
14:00   **Anuška Ferligoj (Ljubljana)**
             Scientific collaboration in Slovenian scientific communities
14:30   **Clelia di Serio (San Raffaele)**, TBA
15:00   **Steffen Lauritzen (Copenhagen)**
             Harmonic analysis of random graphs and exponential families

15:30   coffee break

16:00   **Antonietta Mira (Università della Svizzera italiana)**
             Bayesian Inference of Spreading Processes on Networks
16:30   **Vladimir Batagelj (Ljubljana)**
             On Fractional Approach to Analysis of Linked Networks
17:00   **Göran Kauermann (Ludwig-Maximilians-Universität München)**
             Temporal Network Models: understanding the trading of arms

Title and abstracts:

Göran Kauermann (Ludwig-Maximilians-Universität München)
Temporal Network Models: understanding the trading of arms

Abstract: The talk starts with an introduction to Exponential Random Graph Models (ERGM), the statistical work-horse model for the analysis of network data. We demonstrate the central modeling idea and discuss estimation strategies. The model class of ERGMs is then extended towards dynamic models, that is for network data which are observed at different time-points t=1,….T. We discuss two central models in this field. First, the temporal Exponential Random Graph Model (tERGM), which is an extension of the classical ERGM by allowing network statistics to depend on previous networks. Secondly, we introduce the separable temporal Exponential Random Graph Model (stERGM), which allows to decompose temporal changes into edges that develop and edges that vanish from one time-point to the next.

The models are applied to network data on arm trading, provided by the Stockholm Peace Research Institute (SIPRI). The data give inter-state arm trading of heavy conventional weapons (tanks, air crafts, missiles etc.) from the 50th up to the recent years. We explore what drives the changes in the network by employing the two proposed temporal network models.

Gesine Reinert (Oxford)
Anomaly detection in networks

Abstract: Detecting financial fraud is a global challenge. This talk will mainly focus on financial transaction networks. In such networks, examples of anomalies are long paths of large transaction amounts, rings of large payments, and cliques of accounts. There are many methods available to detect specific anomalies. Our aim is to detect unknown anomalies. To that purpose we use a strategy with derives features from network comparison methods and spectral analysis, and then apply a random forest method to classify nodes as normal or anomalous. We test the method on synthetic data which we generated, and then on synthetic data without us having had access to the ground truth. This talk is based on joint work with Andrew Elliott and Mihai Cucuringu, (Alan Turing Institute) as well as Milton Martinez Luaces and Paul Reidy (Accenture).

Anuška Ferligoj (Ljubljana)
Scientific collaboration in Slovenian scientific communities

Abstract**:** The last ten years we have studied the scientific collaboration using
- bibliometric analysis (Ferligoj and Kronegger 2009; Mali et al. 2010, 2012, 2017: Kronegger et al. 2011, 2012, 2015; Ferligoj et al. 2015 ; Cugmas et al. 2016),
- survey analysis (Groboljšek et al. 2014; Iglič et al. 2017; Mali et al. 2018),
- qualitative approach (Groboljšek et al. 2014; Mali et al. 2017, 2018)
of co-authorship networks using longitudinal data on the Slovenian science system in order to explore and explain their dynamics in the scientific fields and the scientific disciplines.

In the presentation an overview of the obtained results will be given.

Steffen Lauritzen (Copenhagen)
Harmonic analysis of random graphs and exponential families

Abstract: The lecture attempts to understand graph limits or graphons in terms of harmonic analysis on semigroups, thereby providing an alternative derivation of de Finetti's theorem for random exchangeable graphs, indicating that graphons indeed represent natural exponential families of random graph models.

Vladimir Batagelj (Ljubljana)
On Fractional Approach to Analysis of Linked Networks

Abstract: We present the outer product decomposition of a product of compatible linked networks. It provides a foundation for the fractional approach in network analysis. We discuss the standard and Newman's normalization of networks. We propose some alternatives for fractional bibliographic coupling measures.

Antonietta Mira (Università della Svizzera italiana)
Bayesian Inference of Spreading Processes on Networks

Infectious diseases are studied to understand their spreading mechanisms, to evaluate control strategies and to predict the risk and course of future outbreaks. Because people only interact with a small number of individuals, and because the structure of these interactions matters for spreading processes, the pairwise relationships between individuals in a population can be usefully represented by a network. Although the underlying processes of transmission are different, the network approach can be used to study the spread of pathogens in a contact network or the spread of rumors in an online social network. We study simulated simple and complex epidemics on synthetic networks and on two empirical networks, a social / contact network in an Indian village and an online social network in the U.S. Our goal is to learn simultaneously about the spreading process parameters and the source node (first infected node) of the epidemic, given a fixed and known network structure, and observations about state of nodes at several points in time. Our inference scheme is based on approximate Bayesian computation (ABC), an inference technique for complex models with likelihood functions that are either expensive to evaluate or analytically intractable. ABC enables us to adopt a Bayesian approach to the problem despite the posterior distribution being very complex. Our method is agnostic about the topology of the network and the nature of the spreading process. It generally performs well and, somewhat counter-intuitively, the inference problem appears to be easier on more heterogeneous network topologies, which enhances its future applicability to real-world settings where few networks have homogeneous topologies.
This is joint work with Ritabrata Dutta (Warwick University) and JP Onnela (Department of Biostatistics, Harvard University)