5th European Conference on Social Networks

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This is the booklet of the sessions admitted to the conference call.
For more detailed information about EUSN2021 please refer to:
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Workshops **45**

Advances in multilayer network analysis: methods and applications

Matteo Magnani and Luca Rossi

Multilayer networks, Methods, Applications

Graphs, that is, vertices and edges, are used as one of the basic mathematical representations of social networks. Multilayer networks extend graphs with the concept of layer, allowing to model a multitude of scenarios from the different types of ties we find in a multiplex network, to different types of actors and temporal snapshots of the relations between the same group of actors.

While specific types of multilayer networks have been used in social network analysis for over a century, the recent burst in interest in multilayer social networks has highlighted new challenges and opportunities. First, multilayer networks allow us to introduce new research questions (and corresponding social network analysis measures and methods). For example, instead of asking how central an actor is, we can focus on the role of the different layers in determining the centrality of the actors. Second, existing social network analysis concepts do not always have a clear corresponding extension for multilayer networks. For example, it is still unclear how communities spanning multiple layers should look like, or what it means for a shortest path between two actors to traverse different layers, or how to effectively visualise multiple layers in the same plot if their edges are not similar. In addition, multilayer networks allow to use multiple types of layers (e.g., in temporal multiplex networks), which requires the joint application of methods developed for simpler models (e.g., only temporal, or only multiplex).

This session focuses on recent advances in the analysis of multilayer networks, either in terms of new research questions, or new methods, or new applications. More specifically, topics for this session include but are not limited to

1. New models for multilayer networks;
2. Multilayer network measures;
3. Community discovery in multilayer networks;
4. Multilayer network embedding;
5. Visualisation of multilayer networks;
6. Multilayer network simplification (e.g., sampling, filtering, flattening, projections);
7. Applications of multilayer networks;
8. Software.

Agent-based models of social networks

Filip Agneessens, Federico Bianchi, Andreas Flache and Károly Takács

Agent-based models, Simulation network dynamic, Behaviour-network, co-evolution

Bridging micro- and macro-scales is pivotal to both social network research and agent-based modelling (ABMs), which has recently stimulated exchanges between the two fields. Recent developments in statistical modelling of longitudinal network data have brought up further discussions on the use of simulations in social network research. ABMs can explain network dynamics and macro-level outcomes through micro-level mechanisms. Unlike in the early days, the network component of an ABM can be calibrated with empirical data, which allows ABM modellers to move beyond the use of abstract networks. Moreover, ABM can be used as complementary tools to increase generalizability of statistical analysis of network data.

This session invites papers that attempt to explain macro-level outcomes by linking individuals' behaviour to social network dynamics through ABMs in e.g., opinion polarization, social inequality, social conflicts, or economic collaboration. Particularly — but not exclusively — welcome are contributions bridging theoretical ABM, empirical data, and statistical models of network-generating processes (e.g., ERGM, SAOM).

Avoiding and handling missing and sampled network data

Robert Krause and Stepan Zarteckii

Missing data, Sampled data, Snowball sample, Imputation, ERGM, BERGM, SAOM

Empirical network research often faces problems already in the data collection stage. Sometimes it is infeasible to collect the entire relevant sociocentric network (e.g., when the relevant network boundary is unknown or too large), other times, information on some nodes and, more importantly, their (outgoing) links is missing (e.g., because of non-response of some nodes). Sampled and missing data does not only reduce power and representativity, they also hinder statistical analysis in the first place. For networks, missing data constitute a far bigger problem, than for non-network research, because of the strong dependencies inherent to network data.

In this session we thus want to focus on submissions providing analytic, creative, or theoretical solutions to handling missing or sampled network data, and/or focusing on better data collection to avoid these problems in the first place.

Blockmodeling dynamic or temporal, multilevel and linked networks

Aleš Žiberna and Marjan Cugmas

Blockmodeling, Clustering, Dynamic networks, Temporal networks, Network dynamics, Linked networks, Multilevel networks

Blockmodeling is a technique for finding clusters of units that are equivalent based on some notion of equivalence (structural, regular, generalized, etc.) and therefore occupy similar position in the network. It also deals with determining ties among these clusters. Here we focus on blockmodeling approaches that are able to handle dynamic or temporal networks, that is, networks with a temporal component. Several versions of such networks exist, the most prominent examples are networks that are networks measured at specific time-points (or periods) and networks where each tie (and possibly vertex) has a time-stamp (or time-period) associated with it. In addition, submissions covering blockmodeling approaches for other more "complex" networks, such as some variants of the linked networks are also welcome. A linked network is a collection of one-mode networks, where the units from different one-mode networks are connected through two-mode networks. Special cases of linked networks include multilevel networks, dynamic networks and dynamic multilevel networks. Multilevel networks are composed of one mode networks that represent ties among units at a certain level and two-mode networks that tie units from different levels. In a typical multilevel network, first-level units are persons, second-level units are organizations and the two-mode network represents the membership of persons in organizations. Dynamic multilevel networks are multilevel networks measured at several points in time.

Collaboration networks

Maria Prosperina Vitale, Giuseppe Giordano and Giancarlo Ragozini

Scientific collaboration, Organizational networks, Data collection methods, COINs

Collaboration networks attract a lot of attention in many scientific domains. The session focuses on presenting methodological developments and novel applications related to the session topics.

Special interest is on the analysis of collaboration networks in presence of complex data structure, and on collaboration data extraction and empirical data collection.

The organizers solicit the submission of abstracts dealing with the following topics:

- Academic and scientific networks;

- Analysis of collaboration networks in economics, cultural and social environments;

- Co-authorship networks;

- Collaborative innovation networks;

- Community detection in collaboration networks;

- Dynamics and evolution patterns of collaboration networks;

- Empirical data collection;

- Mixed methods for data collection and data analysis.

Community detection on attributed networks

Roberto Rondinelli, Martin Atzmueller and Francesco Santelli

In the context of Social Networks and Complex Networks, communities can be defined as cohesive subsets of nodes that are densely connected internally and sparsely connected between the respective subsets (externally). "Such clusters, or communities, can be considered as fairly independent compartments of a graph, playing a similar role like, e.g., the tissues or the organs in the human body" (Fortunato, 2009). Resolution and accuracy of detected communities of nodes inside Networks has been improved recently by the development of new algorithms as well as improvements of existing algorithms from the literature. Most of them work exclusively on the relational structure (Newman, 2018) of the connections among nodes of the network, discerning between the various types of links that can be formed between them based on the nature of the relationship: binary, weighted, directed, and so on.

In order to explain social, economic or other real events, what matters about a Network is not only the structure of relations among its nodes, but even their characteristics. In the domain of Network Analysis, they are called attributes and can be included into the classification algorithm to expressly direct the composition of groups or can be an efficient support to describe communities. Attributes can often be an excellent vehicle for understanding the composition of communities, using attributes often as independent factors encouraging the birth or the break of connections among nodes, aggregated according to very common rules in network formation processes. Homophily, territorial proximity, counterfactual factors, spreading and conformism are some of such a phenomenon that affects relational mechanism and the eventual composition of communities. A survey on methods providing and discussing several examples of the use of attributes in the context of community detection can be found in Atzmueller et al. (2021); here, for example, the COMODO algorithm (Atzmueller et al. 2016) includes maximization function for "description-oriented community detection using subgroup discovery" providing "both structurally valid and interpretable communities". A further example is Ferligoj and Batagelj (1982), where authors incorporate in the "standard" hierarchical clustering procedure an optimization based on relational constraints.

Since the importance that attributes hold to find coherent communities, this session is dedicated to the recent topic-field of "Community Detection on attributed networks", that plays a fundamental role in both improving further the consistent division of a network in communities and the quality of their description. We are glad to receive submissions inherent this topic, including applications, theoretical improvements or implementations of new algorithms.

Comparing and validating networks, methods and applications

Valeria Policastro, Luisa Cutillo and Annamaria Carissimo

Comparison, Validation, Community detection, Single network, Multiple networks, Integration

The session will cover different types of methodologies and applications for network comparison and validation. These will address important and challenging problems in network analysis that comes across in different application fields and especially in social science.

The session will be devoted to methodologies dealing both with single networks and multiple networks. The state of the art of network validation relies on different approaches, such as analysing the network structure, comparing partitions detected by different community detection algorithms or analysing the network robustness using a null model as a reference.

When collecting several datasets on a given phenomenon of interest, for instance, social relationships as a result of several types of interaction among actors (e.g. neighbourship, friendship, membership) different networks will be constructed. The comparison between such networks has recently received great interest resulting in a huge variety of methodologies focusing on nodes, edges or structure similarities.

Different and diversified types of comparison can be developed and applied in multiple networks analysis. A possible approach is to attempt to integrate the networks of interest into a single one, in order to pull out the shared information in the study.

Despite the growing interest in this field, comparing and validating networks is still an open problem. The aim of this session is to investigate the most recent contributions on this topic.

Criminal networks

Nynke Niezink, Paolo Campana and Tomáš Diviák

Covert networks, Criminology, Methodological innovation, Co-offending violence, Organised crime, Illegal markets

The importance of social networks for analysing and explaining criminal behaviour has been widely recognized. A wide range of illegal activities, such as drug trafficking, human smuggling, or terrorism requires coordination among offenders to be successfully performed. It is not surprising, therefore, that the network perspective on crime has recently gained popularity, both among academics and law enforcement practitioners, as it captures the essence of such activities. However, the study of criminal networks is challenging. Data collection is difficult in situations where subjects themselves aim not to be detected. Gathering first-hand evidence on such phenomena is therefore extremely difficult, and in some cases dangerous. Scholars have thus relied on police data, such as arrests, or investigative evidence, such as electronic surveillance or phone records, to build an empirical base for their analysis. A second challenge is methodological, i.e. matching/developing the right statistical models based on the specificities of criminal networks to adequately test criminological theories, allowing to move beyond descriptive network measures.

This session is dedicated to innovative research at the intersection of network analysis and criminology. We welcome a wide range of submissions focused on criminal networks, including methodological, theoretical, and empirical studies. Topics may include

- collection of criminal network data;

- testing theories of co-offending;

- victimizations and violence using network data;

- case studies of specific criminal groups;

- statistical modelling tailored to the complexities of criminal network data

Target group: both applied and methodological researchers interested in criminal network analysis, and law enforcement professionals. This session aims to bridge disciplines, to inspire discussion and collaboration.

Data gathering for policy networks: different approaches, different challenges

Marlene Kammerer and Ruth Wiedemann

Policy networks scholars draw on different datasets to test hypotheses about policy actors and their behaviour (e.g., collaboration), relations, beliefs, and their roles in a policy subsystem. Collecting relational data, like policy networks, is connected to various challenges and different techniques measure different phenomena. Thus, relational data collected via text analysis differ from network data collected by a survey even if it investigates the same set of policy actors.

To date, network literature lacks an overview of diverse data types used, systematically assessing typical strengths and weaknesses, as well as their most appropriate areas of use. This could be helpful to understand what type of network data serves best to operationalize specific theoretical concepts. Further, such an overview would provide some practical guidelines for specific research projects in the context of concrete questions related to time, personnel, or other substantive constraints. Most networks studies rely either on survey data or on text data. Both have their advantages and disadvantages. Ideally, survey-based network data provides the researcher with rich data on the beliefs and perceived relations of policy actors. However, the quality of such data strongly depends on the researcher, who defines the actor list, the network boundary, and the questionnaire. Also, the data quality depends on the access to key actors in a policy field.

Additionally, conducting a survey can be time consuming and costly, particularly in large-scale research settings. Finally, surveys are difficult to replicate, as respondents may change their opinions over time. In consequence, studies based on surveys are usually limited in scope and mostly focus on small-scale policy processes at the national, sub-national, or local level and mostly at a single point in time. In contrast, using documents (such as protocols, media articles, or position papers) as data source for network analysis often yields in so-called affiliation data. Rarely, documents give insights about direct interactions. Rather, they tell the researcher something about the actors and their participation in meetings, their ideological positions in a policy field, etc. The main advantage of text data is that the researcher is able to reconstruct political developments over time and that the reporting of ties between two actors does not depend on response rates or the perception of respondents. This improves the replicability and reliability of the network data set and decreases missing data problems. Nevertheless, the network data may be biased by the coding scheme and issues of intra- or inter-coder reliability may arise. However, the main advantage of this data collection approach is the possibility to collect large-scale data sets and to reconstruct historical developments in a time and cost-efficient manner.

Against this backdrop, this session promotes papers, which are questioning the different methods of data gathering for policy networks. Thus, we specifically look for papers, which compare different sources of network data, elaborate on the multiple ways to gather them (e.g., hyperlink data versus survey data) and contribute to a discussion about strengths and weaknesses of different methods of data collection.

Doing SNA in ethnography: a mixed-methods session

Dafne Muntanyola-Saura

Mixed-methods, Ethnography, Reflexivity, Indexicality, Methodological situationism

SNA is a relevant tool to formalize ethnographic data. This session will gather specific empirical examples on mixed-methods with a strong ethnographic component. Studies from a wide range of contexts, from professional artistic communities, to more informal settings, such as those of the youth, belong to such a methodological tradition. On the one hand, the relational background of SNA theoretical paradigm complements the principles of indexicality and the methodological situationism of ethnographic settings. On the other hand, from a more instrumental point of view, the mathematical structure of networks and its epistemological principles, such as simmelian ties, homology or the strength of ties, goes well with the analysis of rich ethnographic data. Moreover, in subjective data gathering, SNA questionnaire structures research questions on social capital, mobilization of social contacts and the like; when doing empirical analysis on both subjective and objective data software such as Ucinet, Visone or Space Syntax allow researchers to quantitatively filter discourse as well as organize pragmatic information on spatial practices. SNA opens up the field to audiovisual aspects of social processes, since data visualization of maps and networks is a key aspect of the final product.

In all, we propose to apply the sociological gaze on ethnographies that include, in any point of the research process, SNA theories, tools and visualizations. We will discuss the relevance, adequacy and productivity of such methodologies, and list reflexively the criteria that make them candidates to mixed-methods.

Erasmus mobility flows and project cooperation in network perspectives

Kristijan Breznik and Marialuisa Restaino

Erasmus mobility project, Cooperation networks

The internationalization of higher education has become of increasing relevance for the university system. Universities are diversifying and expanding international collaborations to strengthen the quality of their research and teaching activities and they encourage students and/or academic staff to participate in international mobility programs. Mobility, and in particular Erasmus mobility, has long called attention to study patterns and trajectories within national and transnational borders. Likewise, the collaboration in research projects among countries (such as FP7 and Horizon2020) is a key factor for knowledge diffusion and economic growth for a country or a region with welfare implications. Several studies have focused on this topic in order to describe the flows of Erasmus mobility and the project cooperation, and study the attractiveness of different territories and countries. In this scenario, social network analysis can be adopted to better understand the complexity of the phenomenon.

This session aims to highlight the richness and variety of social network studies in both Erasmus mobility and projects collaboration, suggesting new frontiers in research on the topic. We are particularly interested in studies of networks that analyse both phenomena. Topics of interest include, but are not limited to

- the role of social networks in studying the Erasmus mobility flows and the projects collaboration;

- the composition, structure, and dynamics etc. of Erasmus mobility flows and projects collaboration;

- comparative studies of networks;

- mixed-methods studies of projects cooperation and Erasmus mobility social networks;

- Multilayer, Multilevel and Multimode Networks for projects cooperation and Erasmus mobility.

Family networks and personal networks through the life-course

Vera de Bel, Marlène Sapin and Eric Widmer

Family networks, Personal networks, Life course

Life-course trajectories and transitions are intertwined within the complex webs of family and personal relationships. These networks may provide individual network members with resources, often referred to as social capital, supporting them through life-course events and transitions. However, these networks, depending on their composition or the pattern of interactions, do not only exert a positive influence on the individual members of the network. Family and personal networks may also cause stress or strain on the individual and the network level. In addition, family and personal networks change over time, which may have consequences on the access to resources and may for example affect individual network members' well-being, behaviour, and life chances.

This session invites papers on family networks and personal networks focusing on situations where family relationships play a significant role in various stages and transitions of the life-course. Papers with a longitudinal design are encouraged to be submitted, but cross-sectional studies on life-course transitions or stages are also welcome. Quantitative as well as case studies on specific normative or non-normative life events are also of interest to this session.

Gender and networks

Elisa Bellotti

Gender, Personal networks, Social networks, Network composition, Network mechanisms, Homophily, Brokerage, Social capital

Social network research studies the mechanisms that drive formations of network structures as well as the outcomes of such structures on social behaviour. A well investigated area of research focuses on gender differences in network formations and outcomes in personal and professional networks. Researchers have looked, for example, at the different styles of socializations of boys and girls in early age, varieties of gendered network structures in different cultures, gender differences in peer networks and educational outcomes, gendered structural and cultural constrains of network strategies in organizational studies, different network positions and relational strategies between men and women at work, gender unbalance in academic networks and interlocking directorates.

This session wants to bring together interdisciplinary perspectives on gender similarities and differences in social networks which might be investigated with a variety of methods and modelling techniques. We welcome both highly quantitative modelling studies as well as qualitative research that looks at how discourses and narratives may impact the relational strategies embedded in network structures. We also welcome research that expand the very definition of gender to investigate peculiarities and differences of LGBT social networks. Topics of the session might include, but are not limited to

- Gender differences in structure and composition of personal networks;

- Gender differences in tie formation in early life;

- Gender dynamics in educational settings;

- Gender and social support over the lifetime;

- Gender, social capital and brokerage;

- Gender differences in interlocking directorates, academic networks and organizational studies;

- Gendered narratives in relational strategies;

- Gendered perceptions of SNA.

Health, wellbeing, and rural networks

Emily Long and Sebastian Stevens

Rural, Health, Personal networks, Whole networks, Well-being

Social networks are increasingly recognised for playing a pivotal role in shaping a range of health and well-being outcomes, including physical and mental health, as well as perceptions of social isolation and loneliness. Rural communities face unique challenges to maintaining health and well-being, including ageing populations, limited access to health and care services, and higher levels of mental health stigma. Rural areas also face specific challenges related to social isolation, such as limited public transportation, digital access and exclusion, and practical constraints on facilitating relationships between people who live more remotely, issues only exacerbated by the recent Covid-19 pandemic.

Given the unique context of rural environments, this session will provide a forum to present the latest research and innovation in the field of social networks and health/wellbeing in rural communities. We particularly welcome abstracts exploring urban/rural differences in social networks, personal network structures in rural communities, qualitative or quantitative explorations of rural networks and health outcomes, as well as innovations to support the health and well-being of rural communities using network-based interventions. Egocentric and whole network approaches are both encouraged.

Insight of mobility in higher education using social network analysis methodologies

Giovanni Boscaino and Isabella Sulis

Students mobility, University assessment, Social network analysis, Degree mobility chain, Migration

The study of students and graduates' mobility choices and patterns has become a topic of great relevance in recent years, as strictly connected to the demographic and socio-economic debate on (i) the brain drain of human capital from the most disadvantaged geographical areas, (ii) anticipatory migration strategies addressed to maximise future job opportunities and (iii) the assessment of divergences in the university and degree program quality. In this framework, Social Network Analysis (SNA) is a useful methodology for extracting relevant information from the student and graduates' mobility data. It allows shedding some light on multiple aspects involved in the relationships between observed flows (actors, their characteristics and determinants)

Applied contributions that adopt SNA to analyse students' mobility flows from an economic, demographic and sociological perspective are strongly encouraged. The proposal for new SNA techniques or their improvements to understand student mobility data and support decision-making in university governance is welcome. Topics of the session might include, but are not limited to

- Dynamics and evolution patterns of student mobility flow

- University quality/reputation

- Intra-national student mobility

- Degree program quality/reputation

- Chain migration

- University assessment

Modelling network dynamics

Per Block, Robert Hellpap, Nynke Niezink, Tom Snijders and Christoph Stadtfeld

Network dynamics, Longitudinal network data, Actor-oriented models, Network event models, Dynam, LERGM, TERGM, Siena, Relevant goldfish

Important insights into social networks can be obtained with the help of longitudinal observation designs. Such designs can be of a varied nature. Panel data is the structure used traditionally for self-reported networks; regular time series and time-stamped data can be obtained from official or automatic records; but this does not exhaust the types of longitudinal network designs. Corresponding to these differences in data collection, a variety of longitudinal methods of analysis have been developed, such as continuous-time actor-oriented and tie-oriented models for panel and time series data, network autoregressive models for time series at regular intervals, and network event models for data with a fine-grained time resolution. Some of these methods are based on actor-oriented models, others on tie-oriented models.

This session will be open to methodological as well as applied presentations about models for network dynamics. Papers can have a mathematical, statistical, theoretical, or empirical subject-matter focus, as long as they are relevant for empirical social science.

Modelling social influence

Viviana Amati, Robert Krause, Tom A.B. Snijders and Christian E.G. Steglich

Social influence, Contagion diffusion selection and influence, Co-evolution networks and behaviours, Multiplex networks, Two-mode networks, Siena

The number of empirical studies of social influence using longitudinal network-and-behaviour designs has increased steadily with the availability of appropriate methods, software, and data. We can now study quite nuanced mechanisms by which influence operates in a diversity of research domains. For example, it is now possible to examine influence based on structural equivalence (having the same network contacts) as an alternative mechanism to influence based on cohesion (direct ties). Also, we can address the question about who influences whom in a network. Social influence is conceptually not even limited to network-and-behaviour studies. We can also investigate mechanisms of network-network influence, where one (one-mode) network defines the reference group of social actors that exerts influence, and another (one- or two-mode) network indicates what is being influenced.

In this session, we welcome methodological, theoretical, and applied contributions, as long as they are relevant for empirical research on social influence mechanisms.

Multiplex networks and individual outcomes in school

András Vörös, Zsófia Boda and Elisa Bellotti

Multiplex networks, Education, Student communities, Network dynamics, Social influence

The importance of multiplexity is increasingly recognised in (educational) network research. While research into the effects of peer networks has traditionally focused on a single network dimension at a time, most commonly on friendship, this approach has been shifting lately. A wave of studies in recent years has showed how multiple forms of social ties emerge between students and affect a variety of their outcomes. Relevant networks include personal relations such as liking or "friendly" ties, spending free-time together, studying together, dislike, conflict, victimisation, and romantic ties. Besides these, interpersonal perceptions appear to have an impact on student behaviour and outcomes as well: such as perceptions about the status, social roles, or personality of peers. Longitudinal studies have demonstrated that the emergence and change of the various network dimensions is interconnected. Multiplex social networks jointly influence individual outcomes, such as academic achievement, school attitudes, mental and physical health, political attitudes, and so on.

This section invites presentations which explore the importance of multiplex networks for individual outcomes in educational settings. Particularly (but not exclusively), we would be happy to hear about work that focuses on

- data collection techniques for multiplex networks in school;

- statistical methods that are specific to multiplex networks in school;

- empirical data analyses and results involving the evolution of multiplex networks in school;

- empirical data analyses and results involving the relationship of multiplex networks and individual outcomes in school.

The list is not exhaustive: we are very much open to a wide range of studies on the topic of multiplexity in schools. We hope to bring together a diverse set of research projects and facilitate discussion and collaboration between scholars interested in educational network research.

Network analysis in sports

Riccardo Ievoli, Filipe Manuel Clemente and Lucio Palazzo

Team sports, Multi-mode networks, Player transfer market, Passing networks, Network structure, Network indices

Performance analysis is becoming truly helpful for recognizing the strengths and weaknesses of individual players and collective behaviours of teams. Using such information is possible to make better decisions and organize the strategy to achieve greater success. Therefore, the rise of sport analytics tools mixed with the availability of data allow the spread of innovative methodologies in a broad range of sports. In this context, relational data are also arising.

Thus, the proposed session focuses on contributions regarding network analysis in sport data, with particular attention to sports involving interactions between players. On one hand, network analysis should help to unveil the key elements regarding tactics and/or strategies on the pitch. On the other hand, the search of appropriate methodologies to deal with those data remains an open issue. The audience of interest may include experts of statistics, operations research, machine learning, scientific computing, economics, and sports management, interested in expanding these topics in a network perspective. Audience members will become aware of the most current thinking on common problems of interest in network modelling or analysis of sports data.

The session welcomes empirical, methodological and/or theoretical contributions exploiting the role of Network Analysis in sports including, but not limited to

1. Local network structures;

2. Temporal networks;

3. Network indicators and sport outcomes;

4. Signed networks;

5. Multimodal networks;

6. Multilayer networks;

7. Complex networks.

Innovative approaches of network analysis for popular team sports (e.g., football, basketball, and volleyball) as well as original applications based on less known sports are also welcome.

Networks and the labour market

Stefan Bernhard and Joan Miquel Verd

Labour market, Employment, Social Capital, Migration, Industrial relations, Companies, Recruitment strategies

Since Granovetter's work on the importance of weak ties to find a job, the role of social networks in the labour market has attracted widespread attention. The importance of social capital in the labour market outcomes has been also widely addressed by Bourdieu, Lin or Burt — to name just a few seminal authors.

As in other areas of life, COVID-19 has had significant consequences for networks and labour markets. Among other things, telework changes working and collaboration routines, changing (personal) networks impact upon flows of information and job searches and jobs are threatened or lost. This Organised Session is open also to topics such as

- Social capital and status attainment

- Social networking and job seeking strategies

- Personal networks' dynamics and labour market trajectories

- Migrant populations and labour market networks

- Networks, recruitment strategies and labour market segmentation

- Networks of companies, of employments or of workers

- COVID-19, social capital and labour markets

If you are interested in the above-mentioned questions, or in any other issue linked to labour markets or employment that may be analysed using the social network perspective, please consider submitting an abstract to this Organised Session.

Networks and the study of the human past

Martin Stark, Maria Carmela Schisani, Aline Deicke and Paolo Cimadomo

Human past history, Archaeological historical disciplines, Network analysis, Network science, Network theory

A growing number of studies in history and archaeology have shown that network research has the potential to constructively enhance our understanding of the human past. Moreover, it is becoming clear that archaeological and historical data sources pose interesting challenges and opportunities to network analysts and network scientists. How did human networks change over huge timescales? How can old texts and material artefacts help in answering this question? However, many questions in the practical application of network analysis and network science in the historical disciplines still remain, as methodologies to analyse and reconstruct the past are continuously developed further.

The aim of this session is twofold. Firstly, we want to present new findings and approaches within historical and archaeological network research, and promote contacts between the various disciplines that approach past phenomena using methods derived from network analysis or network science. Secondly, we strive to further the development of a context specific historical and archaeological network research, drawing on the relational thinking of network theory and the analytical possibilities of network analysis or network science in combination with archaeological and historical source critique and reasoning.

The session invites contributions from various disciplines applying methods of formal network analysis and network science to the study of the human past. We welcome submissions concerning any period, geographical area or topic, which might include but are not limited to: economics, politics, military issues, religion, science, culture, kinship and migration, interpersonal or organizational relations, artistic transmissions, material and immaterial connections, material sources as proxy evidence for social phenomena, networks extracted from texts, geospatial or temporal networks, big data and data collection from fragmented sources.

Networks, social resources and subjective well-being

Marina Hennig and Stefan Hundsdorfer

Social resources, Well-being, Life-course culture

This session focuses on papers that analyse resources embedded in social networks which are indispensable for the production of subjective well-being. During the life course an ego is embedded in ever changing networks. What these networks have in common is that a broad set of resources — material, affective or cognitive — is embedded in them. A multitude of research tasks can be derived from that observation. Identifying the composition of resources necessary to secure well-being, creating resource-oriented network typologies or analysing the requirements of resource access, to only name a few options. However, the extent to which social resources are integrated into networks also depends on culture and traditions and can therefore vary between societies in their importance for well-being. An approach that is focused on resources within networks can tackle questions ranging from life course analysis to social inequality and beyond.

Research work — be it quantitatively or qualitatively oriented — that is concerned with subjective well-being and the resources necessary for obtaining it, is highly welcome. Theoretical and/or methodological contribution from all relevant fields (e.g. sociology, economy, anthropology, medicine, psychology, educational sciences, statistics etc.) is desired.

Organizational networks

Spyros Angelopoulos, Paola Zappa, Francesca Pallotti and Emmanuel Lazega

Organizational networks, Organizational networks dynamics, Organizational multilevel networks

The networked nature of organizations and the organizational contexts of network dynamics create a complex ecosystem where individuals, groups, units, and other organizations are entangled and recursively active. Such entanglement shapes organizations in a dynamic way, and affects their outcomes at multiple levels.

This session aims to bring together studies on organizational networks addressing antecedents, dynamics, and implications of the cross-level processes leading to the emergence of relations and outcomes at various levels. Submissions to this session can refer, but are not limited, to the following areas of research

- Micro-foundations of organizational networks: How individual characteristics affect the emergence of network structures and how, in turn, these network structures affect individuals;

- Dynamics of organizational networks: How network structures at various levels co-evolve and affect one another, as well as organizational processes and outcomes;

- Issues of time-dependence in organizational networks: How organizational networks at various levels change at different paces over time;

- Overlap and interplay between social and other kinds of networks within and across organizational settings: How organizational networks are affected by the affiliation of individuals, or organizations to events or contexts.

We welcome both theoretical as well as empirical contributions that address the various aspects and implications of organizational networks research.

Policy networks: efficiency and impact evaluation

Grigoriy Khvatskiy, Dmitry Zaytsev, Valentina Kuskova and Anna Sokol

During the last few decades, the interest in policy processes generated the number of formal theoretical explanation. Among them are the Advocacy coalition framework (Sabatier, Hank Jenkins-Smith 1993), Punctuated equilibrium theory (Frank R. Baumgartner and Bryan D. Jones 1993), Multiple streams approach (Kingdon 1984), Policy styles theories (Richardson et al. 1982), Policy design & Policy capacity framework (Howlett et. Al 2018), Pragmatic approach to public policy (Zittoun 2014), and some others. Each of them makes its own unique contributions explaining the multidimensional and complex nature of public policy and policy change; attempt to grasp the multiactor nature of policy-making. Variety of actors in public policy is reflected in such terms as policy communities, policy coalitions, and policy networks.

The results of policy-making are dependent on activity and configuration of such policy networks and various conditions. SNA provides us with terms, methods, and quantitative statistical techniques that allow us to model the complicated policy processes for a given policy and offer an opportunity to test and develop theories of policy processes that go above and beyond what other instruments afford. At present time, however, we still lack comparative empirical research - verification and validation of developed theories.

We welcome papers that use SNA to test a particular policy that models the complexity of policy-making as a conjunction of variety of actors and factors external to the policy actors' activity. The papers can use a variety of SNA techniques: policy networks visualizations, calculation of centrality measures, building social influence, and social selection models, ERGM models, longitudinal network analysis, multimode and multilevel networks. We also welcome papers that are testing a variety of hypotheses, but they should be aimed at answering the questions about the reasons why policy networks influence policy change. The special concern of this panel is to test, challenge, verify, and validate the current and developing theories of policy process.

Political networks

Manuel Fischer, Mario Diani, Christina Prell, James Hollway and Petr Ocelík

Policy networks, Social movement networks, Elite networks, Online networks

The Session provides a multidisciplinary space of convergence for scholars that, while holding diverse research interests in the study of politics, policy-making and political behaviour share an analytic approach to network processes in political life, coupled with strong attention to the integration of theory and empirical data.

Political networks are conceived of in a broad sense - as defined around political actors, events that are relevant to the political biographies of individuals as well as around the use of digital communication technologies within political dynamics, among others. Thus, ties can consist of exchanges of resources, information, and symbols, as well as of collaborations and communications that may occur both on- and offline.

Substantive issues that researchers in political networks have been dealing with are policy networks around climate change on the local, national and international levels, networks of social movement organizations, comparisons of networks across different institutional contexts, or political interactions within new social media, among others.

Qualitative network research

Tom Töpfer, Andreas Herz and Theresa Manderscheid

Qualitative network research, Interpretive paradigm, Network theory, Network methodology, Network methods

In the last few decades there has been an increasing discussion of qualitative approaches in social network research. Network research is increasingly being inspired by theoretical and methodological approaches of the interpretive paradigm (e.g., symbolic interactionism, phenomenology, hermeneutic approaches). In empirical network studies diverse qualitative methods are applied for collecting data (e.g., qualitative interviews, ethnographic approaches) and analysing different kinds of relational data (e.g., Grounded Theory Methodology, discourse analysis). Fundamental to qualitative network research is the close entanglement of theory and method in the sense of a methodical holism. We understand qualitative network research as the analysis of relational structures through a specific perspective. Relational structures are contexts of social action and social positioning that arise from meaningful interactions. Relationships and their fabrics do not simply exist but are continually actualized, i.e. a processual and interpretive perspective on social reality is necessary. This understanding of social reality requires a specific research perspective on relationships in larger relational structures, which qualitative methodology and methods can provide. Objects of qualitative network research can be network(ed) concepts (e.g., interactions, relationships, groups), network processes (e.g., genesis of networks, networking practices), functions (e.g., integration, knowledge diffusion, social support) as well as specific social worlds and phenomena (e.g., milieus, family, status passages). In this session on qualitative network research, we want to engage in a discussion on how different traditions and schools of thought orient qualitative network research.

We invite participants — amongst other foci — to present their empirical approaches, to discuss how researchers integrate theory, methodology and method in their work and how qualitative research approaches conceptualize relationships and relational structures. Contributions may tackle questions such as the following:

- How do qualitative methodical procedures relate to methodological and theoretical positions of network research and how can they be integrated to analyse social networks?
- What do the various strands of qualitative research offer for the analysis of social networks?
- What are the comparative potentials and drawbacks of different qualitative perspectives (such as narrative inquiry or ethnography) for analysing social networks?
- How do we integrate qualitative research strategies with perspectives taken from (quantitative) structural analysis and how can this be done in a theoretically and methodologically consistent manner?
- What are historical examples of qualitative network analysis?

The organizers of this session are part of the network "Qualitative Network Research (QUALNET)", funded by the German Research Foundation (DFG), which brings together researchers of different disciplines to further the conversation around qualitative network research. The session aims to promote exchange between work within and beyond the DFG network on qualitative network research.

Recent ethical challenges in social network analysis

Paola Tubaro, Louise Ryan, Antonio Casilli and Alessio D'Angelo

Research ethics, Social network analysis, Reflexivity, Social impact

Research on social networks raises formidable ethical issues that often fall outside existing regulations and guidelines. Even standard informed consent and anonymization are difficult to implement with data bout personal relationships. Today, state-of-the-art tools to collect, handle, and store personal data expose both researchers and participants to new risks. Political, military and corporate interests interfere with scientific priorities and practices, while legal and social ramifications of studies of personal ties and human networks come to the surface.

The proposed session is meant to present a special issue of the journal Social Networks, entitled "Recent Ethical Challenges in Social Network Analysis" and due to be published in July 2021. The seven papers that form the special issue explore different aspects of ethical issues in contemporary social networks research. The special issue also includes a broad introduction by the guest editors (ourselves) and two invited comments.

We believe the topic is of interest to many colleagues and students in the social network analysis community, and a presentation at the EUSN will benefit many participants who may have questions and doubts about ethics, or unresolved issues with their institutions' review boards. Previous round tables on related topics (notably at the 2015 Sunbelt in Brighton) raised significant interest. We would love this to be an invited panel with authors and editors of the special issue as presenters.

REDES panel: promoting collaboration and new studies in the community

Francisca Ortiz, Isidro Maya-Jariego and José Luis Molina

Networks, Social network analysis, Mesa hispana, Lista REDES, Personal networks

Social network analysts' community, working in Latin America, Spain, Portugal and other countries, is vibrant, diverse, growing and dedicated both to research and the applications of SNA to critical social problems. Since the XXI Sunbelt (Budapest, 2001) the workshop "Mesa Hispana" has gathered researchers interested in SNA from the Latin American world aimed to develop this community within the INSNA framework (Maya Jariego & Molina, 2004), helping to initiate and maintain links amongst this transnational community of researchers. The EUSN 2021 is an auspicious occasion to bring together again community representatives, start new collaborative projects, having close theoretical and practical discussions, and review recent developments across disciplines.

In this panel, is to have a space of discussion about the last advances made in the Hispanic community. Hispanic panel aims to promote an environment of collaboration among people doing research in Spanish. In fact, historically, this panel has been a bridge between the international community and the Hispanic of social network analysis; then, the idea would it be to maintain that vision this year in EUSN 2021.

SNA and geometric data analysis to design fields and uncover relational processes

Fabien Eloire, Elisa Klüger, Thierry Rossier and Marco Serino

Geometric data analysis, Correspondence analysis, Fields relations, Capitals, Social capital

This session aims to explore relational processes among social networks and fields. It focuses on 1) the configurations of capitals, assets and resources in autonomous social spaces; and 2) structural network relations, as a particularly important resource within fields, i.e. social capital. We highlight the cross-contribution of two methodologies, namely social network analysis (SNA) and geometric data analysis (GDA) (in particular correspondence analysis). Whereas SNA allows to map interactions and uncover the effects of social capital in fields, GDA permits to situate spatially structural relations and interactions based on forms of capitals.

We encourage a wide range of submissions integrating SNA and GDA methodologies to uncover relational processes within a variety of social fields, such as

- interlocking boards and power relations within elite fields;

- artists' networks and symbolic issues in artistic fields;

- processes of scientific collaboration and scientific recognition;

- interactions with the state and the private sector and professional recognition in medical and legal fields;

Presentations should contribute to the description and analysis of relational processes occurring in fields and networks. In addition to open contribution-paper slots, one part of this session is dedicated to two panels: "Networks and fields of power" and "Mapping spaces of culture and education".

Social media analysis and network analytics

Lara Fontanella, Mara Maretti and Maria Prosperina Vitale

Social media, Network analytics, Graph mining

The dissemination and use of social media have grown widely worldwide in the last 15 years. Social media influence politics and economics and redefine identity, social practices, and lifestyles. The enormity and high variance of information propagate virally through large communities of users.

In this "Big Data" era, the ubiquity and quantity of content created every day by social media provide great opportunities and unique challenges for applying network analytics to unstructured data, such as, for example, social media interactions and textual contents. In big data applications, graphs are huge, with thousands, even millions of nodes and edges. Graph spectra, graph summarization and network sampling techniques can be employed to understand the information encoded in large graphs. In addition, graph theory and network analytics can help in inferring information and analysing community structures in social media networks.

Social Network Analysis can provide insights into different research fields, such as computational propaganda, dis/misinformation mining, fake news and bot detection, opinion and emotion mining, virtual community of practice. Topics:

- Graph mining of social media data;

- Network sampling for social media data

- Network simulation models

- Social Media Network Analysis

- Social Media Visualization and Community Detection

- Social Network Analysis for Fake News and Bot detection

- Social Network Analysis for online dis/misinformation mining

- Social Network Analysis for online opinion and emotion mining

- Social Network Analysis for the analysis of virtual community of practice

- Online communication networks

Social network perspective and multilevel analysis for the study of welfare communities

Andrea Salvini and Antonietta Riccardo

Multilevel analysis, Network approach, Communities, Welfare, Third sectors, Community performance, Formal and informal Network, Network governance, Inter-organizational network, Inter-personal network

The networked structure of community welfare generates a complex system where organizations, local institution, Third sector actors or Individuals are knitted together. Such knitting shapes both formal and informal structures of participation for the construction of intervention communities and affects their results and performance at multiple levels. SNA provides a wide range of measures, tools, useful not only for reading and interpreting the phenomena of community welfare network, community participation, and governance, but also for implementing network policies with the aim of generating social change.

This organized session aims to bring together studies on community welfare and formal and informal participation networks that address the structure of networks and the implications of one-level o cross-level processes that lead to the emergence of relationships and outcomes at various levels.

Interested participants are allowed to submit theoretical, methodological, or empirical papers, contributing to one or several of the following thematic areas: a) Multilevel network between social and other kinds of networks within and across community settings: how networks structure are affected by the affiliation of individuals or organizations to events or groups; b) Formal and informal participation networks between various actors in the intervention communities: what factors in these networks are able to influence individual and community performance.

Social networks and fandom

Simona Castellano and Mario Tirino

Social networks, Fandom, Social media, Participatory culture, Community

The concept of network society (Castells 1996) has been accompanied to an increasingly relevant new way of thinking and forming society (Boccia Artieri 2012). The logic of networking has spread widely, becoming the «principle of emergent connection, which characterizes the media system and the organizational forms of society» (Boccia Artieri 2021: 31-32). Within a structure conceived in this way, social connections and relationships become constitutive elements of networking (Boccia Artieri 2012), enabled in contemporary society also by net connections (Papacharissi 2011) and in particular by social media. The social network society allows therefore to have a privileged vision of some phenomena which concern the digital society in a more general way, and the network practices more specifically. Among these practices, a relational and community dimension that takes on peculiar physiognomies and characteristics, although in an ever-greater coalescence between online and offline (Boccia Artieri et al. 2017), in the forms mediated by social media is the one that falls under the name of fandom (Jenkins 1992). Fandoms represent a type of collectivity, because they act as a community and not at an individual level (Jenkins, Ford, Green 2013), in forms that go back to grassroots cultures not necessarily linked to digital; moreover, they exemplify a form of connectivity that is amplified in contemporary society by access to forms of net communication (Jenkins, Ford, Green 2013). The discourse on fandom is part of a broader examination of the participatory cultures (Jenkins 1992, 2006), and the productivity (Fiske 1992) and the performativity (Tirino 2020) of the publics, phenomena that have received a considerable boost from the emergence of social media and of social networks intended as platforms that enable connections between people online, constituting themselves as highly engaging affective formations (Grusin 2017, Paasonen 2021). In this sense, fandoms contribute to revitalizing the exchanges between mainstream culture and grassroots culture (Jenkins, Ford and Green 2013), revealing themselves as vital actors of the cultural innovation and the circulation of contemporary ideas, figures and narratives, with particular reference to long fictional cycles (Hills 2002, 2013), such as film sagas and TV series. The purpose of the session is to stimulate studies that reflect on cultural processes that affect fandoms on social platforms: forms of identity and relational construction, symbolic reappropriation of narrative universes, acts of contestation and cultural subversion through the production of cultural artefacts (digital and non-digital). In addition, the session invites to reflect on innovative fandom analysis methodologies within the online community, especially in social media. Within the session, proposals can be accepted mainly, but not exclusively, on the following topics

- analysis of case histories of fandom on Facebook, Instagram and other social networks;
- fandom and political activism;
- fandom and fanfiction;
- fandom and sports cultures;
- local and glocal fandoms and media cultures;
- analysis of socio-cultural dynamics (hierarchies, conflicts, cooperation, etc.) within the fandom communities;
- fandom and cultural innovation;
- fandom and transformation of digital cultures.

Statistical analysis and synthesis of ego-networks: methods and applications

Domenico De Stefano and Susanna Zaccarin

Ego-network design, Ego-network typologies, Ego-network clustering, Software for ego-network analysis

In an ego-network design a sample of focal individuals (the egos) is identified to collect information on the interaction they activate with other people (the alters). Ego is asked about characteristics of each alter, characteristics of each ego-alter relation, and characteristics of alter-alter relations. The ego-network design can be easily embedded as part of a representative survey of a large population in order to provide representative samples of the social environments surrounding people.

In that framework each sampled unit determines an ego-network with attributes leading to a far more complex data structure with respect to classical survey data. Typically, these data are analysed extracting structural summary variables on each ego-network, which can subsequently be linked to other ego attributes and/or outcomes. Other less frequent approaches are devoted to the development of methods to detect ego-network similarities among multiple ego-network structures. Since large collections of ego-networks have becoming common in empirical research — even in recent studies on implications of the Covid-19 pandemic — is crucial to identify innovative methods for the analysis and the synthesis of such ensembles of ego-networks.

More specifically, topics for this session include but are not limited to:

1. Developments in statistical methods for detecting ego-network typologies and/or similarities;

2. Network clustering and classification methods for ego-networks;

3. Software for ego-network collection and analysis;

4. Ego-network analysis and empirical applications.

Statistical analysis of populations of networks

Simone Vantini and Anna Calissano

Populations of networks, Object-oriented data analysis, Nonparametric statistics

Statistical analysis of populations of networks is gathering attention across different scientific communities (statistics, mathematics, computer science) and many applications fields (mobility, social sciences, life sciences, etc.). Populations of networks include all those dataset where the statistical unit is a network (es. a snapshot of a network evolving in time, a social network related to different individuals, etc.).

The aim of this session is to gather together researchers interested in presenting a scientific contribution related to the analysis of populations of networks. Both methodological and applied contributions will be presented.

Structures and agency in social networks

Ingrid Salvatore and Roberto Rossi

Structural explanations, Methodological individualism, Agency, Social policies

The dispute between individualists and structuralists (holists), is of long standing (Popper, Wellman & Berkowits). Recently, however, after a long period in which individualistic approaches have dominated the social sciences — in economics, the most individualistic of these, but also in sociology (Elster, Coleman) — structuralism has begun to make its voice heard again (Haslanger, Shelby). In political terms, what holists reproach individualists is the opacity to forms of oppression and, in general, to non-agentive forms of injustice (Kinkaid, Garfinkel), proposing policies and interventions aimed at empowering the individual they leave behind, however, the background conditions remain untouched. On the other hand, structuralism is often accused of approaching social issues according to what has been called a "medicalizing model" (Shelby, Foucault). This approach, it is argued, by adopting a technocratic perspective, does not pay enough attention to the agency of individuals. The attempt to reconcile structural properties and individual properties (defined in terms of cognitive resources and abilities, agency, Giddens) is proposed today as one of the most significant and urgent for the definition of appropriate strategies for a great variety of political and social issues from poverty, to immigration, to the coexistence of multicultural communities, to the condition of women, and so on.

The analysis of social networks seems consistent with a structuralist approach. The properties of the nodes are defined by the position, but the cognitive and agential capacities attributed to the actors and the mechanisms through which their interactions develop, seem to play a role in the generation and dynamics of networks. In the same way, the rules that delimit the inclusion and exclusion from the networks are generated, and the operations that mediate the output of the interaction. The hypothesis is that the alternative between holist and individualist approaches is not sufficient to account for the functioning of networks and that this has significant implications for the analysis of social policies.

The purpose of the panel, organized in collaboration with the Research Laboratory on Societies and Institutions in Global Spaces (SISG) of the Department of Political and Social Studies of the University of Salerno, is to open a discussion around the individualism/structuralism debate and the role of social networks as a tool for describing and understanding welfare and social inclusion systems. The idea is to bring together multidisciplinary interventions and discussion points to verify the state of the art of scientific research and outline possible research frontiers. Among the possible proposals in which the panel is interested

- hyper-socialization and hypo-socialization of welfare systems;
- social networks and norms;
- weak bonds;
- path-dependent systems.

Territorial studies from a social network analysis perspective

Ilaria Marotta, Anna Maria Zaccaria, Mariacamilla Fraudatario and Riccardo Zaccaria

Territories, Governance, Innovation

This session is intended for all scholars who prefer the application of Social Network Analysis in territorial systems and dynamics studies. Territory is a complex and organized social system, in which individual and collective actors assume different centralities in directing and guiding social, political, economic, and cultural processes. Territory is configured as a dense network of interactions that unfold at various levels. Therefore, it is a field of study that naturally can be read through the theoretical-methodological approach of Social Network Analysis, especially from a multilevel perspective. SNA has now a long tradition of studying the dynamics of consent and conflict, participation and governance, processes of social inclusion and exclusion, politics, and policy-making, etc. (Cross, Borgatti, Parker, 2001; Salvini, 2020). As an effective heuristic tool, the network enters the public and political debate about the management and planning of territories, and more recently in the design and implementation of social innovation interventions (D'Esposito, Giordano, Vitale, 2011). The specific nature of the territorial perspective lies in locating systems and relationships flows in the spatial-temporal context of reference. At the same time, it allows us to understand the elastic and changing dimension of the relationship's boundaries. The evolution achieved in the methodological and applicative field of SNA has produced increasingly sophisticated tools for the collection, processing, and analysis of relational data. This has made it possible to work on complex network structures (multi-layer and multiplex networks) and to understand their deep dynamics, which are difficult to capture with traditional methodological approaches.

The aims of this session are: to discuss scientific contributions based on a methodology that combines the relational and territorial dimensions; to deepen processes, dynamics and governance of territorial innovation. Here are some possible areas of application, they should be considered only indicative and not exclusive:

- Urban and rural landscapes;
- Paths of social inclusion and/or integration;
- Social welfare and third sector;
- Enhancement of territories, tangible and intangible heritage;
- Social movements and civic participation;
- Governance and socio-economic innovation;
- Housing dynamics;
- Tourism;
- Urban mobility and accessibility;
- Socio-urban transformation and regeneration;
- Territorial government;
- Risk and emergency management.

Value co-creation in networks

Marcella De Martino, Alfonso Morvillo and Fevzi Okumus

Value co-creation, Open innovation, Sustainable development, Service network,s SMEs competitiveness

Social Network Analysis (SNA) has grown exponentially in the last 10 years. It has been the subject of specific interest in the literature on management and organization. Areas of increasing concern are represented by the study of open innovation networks, local sustainable development and more recently, value co-creation processes within and among service networks, where interactions among people, organizations and technology are dynamic and adaptive. Interaction is the primary interface between parties involved in co-creation. This is because it enables an actor to enter into the value creating processes of other parties, supporting them, and benefitting from them. Interaction processes can be favored by technologies and digital platform and, with an increasing level of trust and mutual dependence, by partnerships among network actors. Furthermore, knowledge is the most important resource for exchange in value co-creation. This is because it can be shared, developed and learned in social interactions among actors in a network. However, while the emergence and importance of interaction process in studying value co-creation has been acknowledged, there is limited research on how networks structural characteristics can determine actors' access to financial, economic, human and technological resources, favor information circulation, enhance knowledge acquisition and sharing, thus impacting on the competitiveness of Small and Medium Enterprises (SMEs) and regional ecosystems.

This session offers a unique platform to reflect and discuss recent progresses in the analysis of value co-creation in customers-suppliers interactions, in service co-design processes and in multi-actor engagement for collaborative management within and among service networks, comprising port-logistics, tourism destinations, cultural heritage, and others service industries. The discussion will lead researchers, managers, decision-makers, professionals and students to a deeper understanding of social networks' dynamics in the current ever-changing social and economic context.

Visualization of complex networks: graph embedding and factorization

Maria Rosaria D'Esposito, Giuseppe Giordano and Giancarlo Ragozini

Graph embedding, *Matrix factorization*, *Large network visualization*

One of the main steps in complex network analysis consists in finding effective network data representation and visualization so to conduct efficiently advanced analytic tasks, such as pattern and community discovery, analysis and prediction. An efficient network visualization could help in isolating the most relevant feature of the network too. However, the traditional network representation in not anymore useful with large-scale network processing and analysis. The main barrier comes from representing the relationships explicitly using a set of edges. In literature, "To tackle the challenge, substantial effort has been committed to develop novel network embedding, i.e., learning low-dimensional vector representations for network nodes.

In the network embedding space, the relationships among the nodes, which were originally represented by edges or other high-order topological measures in graphs, is captured by the distances between nodes in the vector space, and the topological and structural characteristics of a node are encoded into its embedding vector." (Cui et al, 2019). Several approaches to network embedding approaches have been proposed, among the others the ones based on factorization methods, random walks, and deep learning. A taxonomy of graph embedding methods is in Cai et a. 2018 and in Goyal and Ferrara (2018).

In this session, contributions focused on theoretical, methodological and empirical aspects related to network visualization, graph embedding and network factorization with examples of representative algorithms in each category and analysis of their performance on various tasks are welcome. Applications, which show the power of network visualization are equally welcome, with an emphasis on social research, organization, media among the others.

Words speaking in networks of connecting worlds

Michelangelo Misuraca and Giuseppe Giordano

Textual data analysis, Document clustering, Unsupervised topic detection

Many times, scholars with a very different scientific background share a common analytic language to investigate phenomena in a quantitative manner, but at the same time different disciplines use different terminologies. What happens is that powerful tools developed in a certain domain stand within a limited circle of users, or worse, different groups find quite similar solutions to a problem without sharing their experiences outside their community. In Text Mining as well as in scientific domains that exploit textual data to research purposes, network analytics are more and more used with the aim of revealing interesting patterns and trends. One of the keys of this trend is the sharing of common data structures. Data structures commonly used in text analysis and mining can be easily associated with those used in network analyses, so allowing their representation as graphs. From this viewpoint, different tasks can be accomplished in a more effective way. For instance, starting from a terms-by-terms adjacency matrix, it is possible to extract significant topics or concepts.

Such an approach is used in Bibliometrics to map the knowledge-base of a discipline by analysing the reference literature, but it is also used in Natural Language Processing to explore the syntactic and semantic structure of textual datasets. A similar approach can be performed on a documents-by-documents matrix aiming at grouping documents with similar contents, using a community detection approach or other graph-based clustering algorithms. In the two cases, looking at terms or looking at documents, several proposals have been presented and discussed in the years, focusing both on the organization of the data (looking at the different ways to weight nodes and edges, as well as taking in-to account multiple relations) and on the effective analytical steps (developing algorithms able to re-duce the complexity of a network, to decompose it in sub-structures, to study its evolution on a given time horizon, and so on).

The session aims at fostering a dialogue among scholars of different domains interested in the analysis of textual data with a network-based approach. We would like to guest interesting applicative studies as well as innovative methodological proposals, leveraging the experiences gained in different re-search fields.

YoungARS session

Viviana Amati, Anna Calissano and Maria Prosperina Vitale

Network analysis, Methods, Applications, Young scholars, ARS, YoungARS, Y-SIS

The YoungARS session is at its third edition and is part representative of the ARS'21. ARS is an international conference taking place in Italy every two-years to bring together network analysts to discuss methodological developments and innovative applications in network analysis.

The session is targeted at young scholars, such as PhD students and early-stage researchers. The purpose of the session is to gather early-career researchers and offer them a dedicated session to present their on-going research in front of the network community. The session has an interdisciplinary focus.

Thus, we welcome methodological, theoretical, and applied contributions from different disciplines. The discussion will help participants to establish potential collaborations as well as strengthen their network. All the presenters of the YoungARS session participate in the Young Researchers' Best Presentation supported by the non-profit Association "VADISTAT per Simona Balbi". The session is organised with the support and patronage of the y-SIS group of the Italian Statistical Society.

Analysing multilevel network dynamics using RSiena

Tom Snijders

Full-day *Multilevel networks, Network dynamics, RSiena, Statistical modelling, Random coefficients, Co-evolution*

Multilevel network analysis comes in two flavours: multilevel analysis of networks ('MAN') where the data consists of a set of multiple networks which are conceptually similar but have disjoint node sets and no connections between them, and regarded as independent replications with respect to the social processes investigated; and analysis of multilevel networks ('AMN') defined as multiple interdependent networks with several node sets, some of which are shared. The simplest example is a one-mode friendship network between individuals together with a two-mode network of the activities of the same set of individuals. Longitudinal analysis of both of these kinds of multilevel network structures will be treated in this workshop, using stochastic actor-oriented models and the RSiena package.

The first part of the workshop will focus on the first kind (MAN), in particular the random coefficient multilevel longitudinal network analysis implemented in the function sienaBayes in RSienaTest. The basic idea of this random coefficient model will be presented, with the approach taken by the analysis using sienaBayes. The use of this function will be explained, and guidance will be given for parameter interpretation.

For the second kind of analysis (AMN), the regular estimation function siena07 in RSiena can be used, with multivariate specification of the data set. The simplest case is the co-evolution of a one-mode and a two-mode network, with the question of selection versus influence: are actors influenced to have the same activities as their 'friends', or do they tend to select ties to those having the same activities. This will be elaborated in the second part of the workshop.

The workshop is intended for participants who have experience in working with RSiena.

Some background literature: Ripley, Ruth M., Tom A.B. Snijders, Zsofia Boda, András Vörös, and Paulina Preciado (2021). Manual for RSiena. URL: `https://www.stats.ox.ac.uk/~snijders/siena/RSiena_Manual.pdf` Tom A.B. Snijders (2016). The Multiple Flavours of Multilevel Issues for Networks. Chapter 2 in Emmanuel Lazega and Tom A.B. Snijders (eds.), Multilevel Network Analysis for the Social Sciences, Cham: Springer, 2016. SIENA website: `http://www.stats.ox.ac.uk/~snijders/siena`.

Bash scripting for big data

Yerali Gandica

Full-day *Bash-script tools, Social-networks, Real-data, NetworkX, Data visualization, Basic cleaning-data tool*

This tutorial focused on bash scripts, for the students to know how to explore the data before working with it. Those approaches make it possible to manage Big Data in a very efficient way. The Hands-on-session will be focused on downloading social-networks real-data. Students will be able to check the data using Bash-script tools before plotting it.

We will use NetworkX to visualize the data. The tutorial consists of the explanatory concepts and exercises with basic bash commands, loops in bash, grep, awk, sed. I have taught several tutorials in conferences and universities. In particular, I already gave this tutorial in a 2-days workshop at my university. However, 6 hours is Ok for the material. The material can be seen here: `https://github.com/yerali/bash_scripts_to_big_data`. The only requirement is a laptop and internet connection. I am going to explain concepts from scratch.

Topics covered by the workshop:

- Bash-script tools;

- social-networks real-data;

- NetworkX;

- Data visualization;

- Basic cleaning-data tool.

Analysis of longitudinal social network data using RSiena

Per Block, Isabel Raabe and Kieran Mepham

Full-day   *Network evolution, SAOM, RSiena*

This workshop is about analysing social networks panel data, understood here as two or more repeated observations of a directed graph on a given node set (usually between 20 and a few hundred nodes). The workshop teaches the statistical method to analyze such data, for which a tutorial is given in "Snijders, T.A.B., Steglich, C.E.G., and van de Bunt, G.G. (2010), Introduction to actor-based models for network dynamics (Social Networks, 32, 44-60)".

The method is implemented in RSiena, a package of the statistical system R. The workshop will demonstrate the basics of using RSiena. Attention will be paid to the underlying statistical methodology, to examples, and to the use of the software. The statistical model is the actor-oriented model where the nodes are actors whose choices determine the network evolution. This allows to include various network effects (reciprocity, transitivity, popularity, etc.), effects of individual covariates (covariates connected to the sender, the receiver, or the similarity between sender and receiver), and of dyadic covariates. An important extension is to have, in addition to the network, one or more actor variables that evolve in mutual dependence with the network; an example is a friendship network of adolescents where drinking behaviour is a relevant actor variable which influences, and is influenced by, the friendship network. This leads to models for the simultaneous dynamics ('co-evolution') of networks and behaviour, which are a special option in RSiena.

The first part of the workshop will focus on the intuitive understanding of the model and operation of the software. The second part will present models for the simultaneous dynamics of networks and behaviour and other more advanced topics such as model specification, multivariate networks, and goodness of fit checking. Further information about this method can be found at the SIENA website (http://www.stats.ox.ac.uk/ snijders/siena).

Prerequisites: Course participants should have a basic understanding of model-based statistical inference (say, logistic regression), some prior knowledge of social networks, and should have had some basic exposure to the R statistical software environment. They are expected to bring their own laptop to the course (Windows, Mac or Linux), with the R statistical software environment and the RSiena package pre-installed.

Participants for whom R is new are requested to learn the basics of R before the workshop: how to run R and how to give basic R commands. This is to reduce the amount of new material to digest at the workshop itself. The Siena website (RSiena tab) has some links which can be helpful for this purpose. Further instructions will be given before the conference starts.

Analysis of multiplex social networks (hands on with R)

Matteo Magnani and Luca Rossi

Half-day   *Multiplex networks, R software, Community detection, Measures analysis, Multinet*

A multiplex network is a network where actors are connected through different types of edges, such as individuals "working together", "being friend", etc. These different types of connections are also known as layers.

The workshop covers several topics in multiplex network analysis, including a selection of: community detection, layer comparison methods, actor measures, data exploration and network generation, depending on time and interest of the participants. For each topic, a quick presentation of the relevant theory and methods is followed by a practical application on a real pedagogical dataset. Part of the presented theory is covered in the book "Multilayer Social Networks" and in recent survey articles, such as "Community detection in multiplex networks" (forthcoming on ACM Computing Surveys) and "Quantifying layer similarity in multiplex networks: a systematic study" (`https://royalsocietypublishing.org/doi/full/10.1098/rsos.171747`), and in several research papers developed in different fields by different authors.

The short theoretical presentations are all meant to provide the necessary knowledge to perform practical exercises with network analysis software. This is an updated version of a workshop already given at previous conferences (including SunBelt), and differs from the workshop we are giving at the Networks conference this Summer, where we will use Python instead of R as a language.

In this workshop we will use the multinet library, available on the CRAN archive since 2017. Only limited knowledge of R is needed, as we will mainly use library functions. However, knowledge of R and igraph can be useful to understand some topics in more detail.

Analyzing the dynamics of networks and continuous behavior with RSiena

Nynke Niezink

Half-day   *Network dynamics, Network-behavior, Coevolution, Stochastic, Actor-oriented models, Stochastic differential equations, Longitudinal data, RSiena*

Stochastic actor-oriented models (SAOMs), implemented in the R package RSiena, are widely used to study social network dynamics and the processes governing the interdependent dynamics of networks and individual behavior, such as social selection and peer influence (also known as contagion or diffusion). In the original SAOM, individual behavior variables were assumed to be measured on an ordinal categorical scale. Continuous variables such as many performance and health-related measures had to be discretized to fit into the modeling framework.

This workshop introduces the recently developed SAOM for the dynamics of networks and continuous actor behaviour. In the workshop, we will first give an introduction to stochastic differential equations, the modelling framework used for dynamic continuous behaviour variables. We will also discuss parameter interpretation, explained variance and goodness-of-fit. The workshop combines a lecture with hands-on exercises using the RSiena package in R. Note: You need basic familiarity with R and SAOMs to benefit from this workshop. If you have not used RSiena before, consider taking the introductory workshop on SAOMs and RSiena.

Bayesian ERGMs with the Bergm package for R

Alberto Caimo

Half-day *Exponential random graph models, Bayesian analysis, Probabilistic modelling*

Bayesian analysis is a promising approach to social network analysis because it yields a rich fully probabilistic picture of uncertainty which is essential when dealing with relational data. Using a Bayesian framework for exponential random graph models (ERGMs) leads directly to the inclusion of prior information about the network effects and provides access to the uncertainties by evaluating the posterior distribution of the parameters. The growing interest in Bayesian ERGMs can be attributed to the development of very efficient computational tools developed over the last decade.

This hands-on workshop will provide participants with the opportunity to acquire essential knowledge of the main characteristics of Bayesian ERGMs using the Bergm package for R.

Topics will include

- Brief overview of ERGMs and Bayesian analysis;

- Model estimation and model selection;

- Approximate computation for large networks;

- Interpretation of posterior estimates;

- Missing data imputation;

- Goodness-of-fit procedures

The workshop will have a strong focus on the practical implementation of the package functions through the analysis of real network data. Interactive material will support the acquisition of concepts and understanding of the tutorial through code, scripts, and documentation.

Generalized blockmodeling in R using blockmodeling package

Aleš Žiberna and Marjan Cugmas

Half-day   *Blockmodeling, Clustering, Generalized blockmodeling*

The workshop will cover generalized blockmodeling (Doreian et al., 2005; Žiberna, 2007) of mainly one-mode binary and valued networks in R using "blockmodeling" package (Žiberna, 2021). Only basic knowledge of R and networks/graphs is required.

The workshop will cover matrix representation of the network, plotting of such matrices, and of course, clustering the units in the network, that is blockmodeling. Clustering units based on structural, regular and generalized equivalence will be covered. The later implies that also pre-specified blockmodeling will be covered.

All aspects of blockmodeling with the blockmodeling package from preparing the data through calling the optimization function (including setting appropriate parameters) to plotting and interpreting the results will be covered. In case of sufficient time and expressed interest, blockmodeling two-mode, multilevel, and linked networks can also discussed.

Some background literature: Doreian, P., Batagelj, V., Ferligoj, A., 2005. Generalized blockmodeling. Cambridge University Press, New York. Žiberna, A., 2021. blockmodeling 1.0.1: An R package for generalized and classical blockmodeling of valued networks. Žiberna, A., 2007. Generalized blockmodeling of valued networks. Social Networks 29, 105–126. https://doi.org/10.1016/j.socnet.2006.04.002

Handling missing network data

Robert Krause

Half-day   *Missing data, Multiple imputation, RSiena, SAOM, ERGM, BERGM*

In this workshop I will present advanced methods for handling missing network data. We will discuss both the theoretical foundations as well as how to apply these methods in practice, their assumptions and caveats. The workshop will teach participants how to obtain multiple imputations for missing tie variables (and nodal attributes) in cross-sectional and longitudinal network data, and how to proceed from there. The imputations can be used for any form of network analysis (e.g., ERGMs, SAOMs, Blockmodels, estimating descriptives). The imputation procedure makes use of (B)ERGM and SAOM models, thus familiarity with at least one of these model families will be very helpful in following the workshop.

Knowledge obtained in the introductory ERGM or SAOM workshops given at the Sunbelt is sufficient. The workshop will be in R and rudimentary knowledge of R is required for the application of the procedure. However, the workshop is explicitly open for all network researchers, who encounter missing tie variables (e.g., because of actor non-response).

Network visualizations in R using ggraph and graphlayouts

David Schoch

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Half-day *Network visualization, Rstats, Ggraph*

This workshop will cover network visualization in R, using the packages "ggraph", "graphlayouts" and the auxiliary package "snahelper". Some basic knowledge of R and networks is required.

The workshop will introduce the grammar of graphics for networks through series of examples where visualizations are built step-by-step. Besides standard network plots, the workshop will also cover some more advanced visualizations using dedicated layout algorithms implemented in the graphlayouts package. Finally, the snahelper package is introduced which facilitates and automates most of the coding required in the previous tasks.

The goldfish package in R

Christoph Stadtfeld, James Hollway, Alvaro Uzaheta and Marion Hoffman

Half-day   *Relational event models, Goldfish, DyNAM*

The Goldfish package in R is a software for the analysis of relational event data using a variety of models. In particular, it implements different types of Dynamic Network Actor Models (DyNAMs), a class of models that is tailored to the study of actor-oriented processes. Goldfish also implements different versions of tie-oriented relational event models.

Participants of the workshop will learn to describe relational event data in R, estimate different models with the goldfish package, inspect and interpret results, and will have the opportunity to discuss their own empirical projects with the course teachers.

More information about the package is available on Github: `https://github.com/snlab-ch/goldfish` and on the following website: `https://sn.ethz.ch/research/goldfish.html`.

Understanding social-ecological systems as social-ecological networks

Örjan Bodin and Lorien Jasny

Half-day   *Social-ecological networks, Social-ecological systems, Multilevel ERGM*

The network perspective has fairly recently been proposed as an analytical lens particularly suited for studying social-ecological systems (SES). The underlying rationale is that the network perspective as such is generic and allows the researcher to model any kind of systems as consisting of separate but interlinked components of different kinds. Hence, integrated social-ecological systems could be analyzed as social–ecological networks where interdependent ecological entities (e.g. species and habitat patches) and social entities (e.g. users, managers, agencies and NGOs) could be simultaneously incorporated in a common (network) model.

In this workshop, we will provide an overview of how this social-ecological network perspective has been used up till now. In doing so, we will describe and elaborate how social-ecological systems have been described and analysed as networks, and what kind of research questions have been addressed. Further, we will take stock in recent research that has identified different possibilities and barriers for further developments of this line of research.

Critical issues such as what are nodes and links in a social-ecological system, and how to accomplish some level of comparability across different study contexts, will be addressed. All these discussions will be related to published studies, thus discussions will be rooted in gained experiences in this emerging line of research.

We will also discuss the range of problems (design, data collection, methodological) that many have encountered when doing this kind of synthetic research. In addition, there will be practical hands-on exercises. Both exercises in terms of how to define a social-ecological system as a multilevel social-ecological network, but also how to understand analytical results deriving from multilevel ERGMs. This involves interpretations of how certain social-ecological configurations (cf. motifs) relate to assumptions about processes and outcomes.

All exercises and examples will be based on real data, and both patterns of social relations among actors as well as environmental interactions among biophysical components will be examined. The workshop includes the following elements: 1. Why a social-ecological network approach? What are the presumed benefits? 2. What is a node, and what is a link in a complex social-ecological system? 3. How to move beyond just describing a social-ecological system as a network to actually ask some challenging questions, and perhaps even get some answers? 4. Investigate how patterns of social- and social-ecological relations among resource users can be related to social- and environmental outcomes. 5. Gain exposure to commonly used software for studying multilevel social-ecological networks, i.e. multilevel ERGMs implemented in MPnet and discuss similar implementations in the R Statnet library.

Prerequisites Familiarity with the concept of networks (i.e. nodes and ties) as well as some experiences of network-centric analyses. Previous exposure to ERGM is valuable.

Using Matlab for social networks analysis

Carmela Bernardo, Francesco Vasca and Dora Ricci

Half-day *Social network analysis, Matlab, Local and global measures, Graphic visualization, Software tool*

The use of SNA is widespread not only in social sciences but also in engineering, mathematics, economics, and biology. As a result, several software tools have been proposed over the years to represent and analyse networks through this technique. Any software package dedicated to the simulation and the analysis of social networks cannot disregard the inclusion of efficient and handling tools for algebraic manipulations and graphical elaborations.

Many software which have a strong background on these two capabilities have recently proposed toolboxes dedicated to SNA. This is the case of Matlab, one of the most common software programs for the mathematical analysis of systems in information sciences, that in recent releases has included new features for networks analysis too. The name Matlab is an acronym for Matrix laboratory, highlighting the basis that underpins the structure of this programming environment.

The workshop entitled "Using Matlab for Social Networks Analysis" intends to introduce experts of SNA to the use of this software for the computation and the graphical visualization of networks represented by means of graphs. The presentation perspective is mainly for beginners of Matlab and no apriori knowledge of the package is required to the attendees. On the other hand, several suggestions for more advanced use of Matlab for SNA will be provided too, thus making the presentations of interest also for people who already know the tool. Beginners of Matlab who attend the workshop will come out with a general overview on the potentialities of using this software tool for SNA, while attendees who have already some experience on this package will get insights on how self-constructing programs for more advanced elaborations.

The half-day workshop is structured into three parts dedicated to the use of Matlab for creating, analyzing and visualizing social networks, respectively. The construction of a (direct or undirect) graph can be done starting from its adjacency matrix or edge list (possibly imported from files with standard format) and one can automatically transform each of these representations to the other. Moreover, nodes and links can be straightforwardly added or removed from the network after its construction. Once a graph has been defined, predefined Matlab commands can be directly used to obtain the typical (network and node) measures adopted in SNA, e.g. degree, density, distances, betweenness, closeness, hub, authorities. Nodes similarity can be evaluated by writing few lines of code in order to choose a desired set of indicators and dendrograms can be used to select a desired level of clustering.

In the last part of the workshop the networks graphic potentialities of Matlab are presented. It is shown how different types of representations can be chosen, nodes and edges can be set with color scale and sizes corresponding to their measures values, specific patterns can be highlighted. The pattern of the adjacency matrix can be plotted by using a dedicated command thus obtaining an intuitive representation which can be particularly useful for large networks.