# DySES 2018

## Dynamics of Socio Economic Systems

*Book of Presentation*
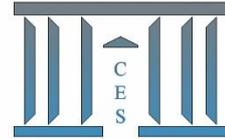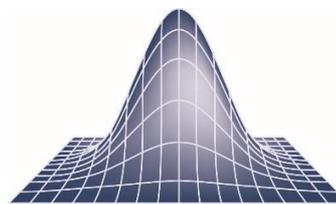
# October, the 9th

## 10:20-10:50

**Keynote: Mauro Gallegati** (Economics, Marche Polytechnic University, Italy) : <u>Liaisons dangereuses between firms and banks</u>

## 10:50-11:02

**Marcel Ausloos** (Economics, University of Leicester, UK) : <u>Risk control in peer-to-peer (P2P) e-lending</u>

This paper discusses the risk control in several P2P e-lending schemes. First, we compare different P2P e-business models and intrinsic risk control styles. We give cases for UK, USA, and PRChina. It is shown, as somewhat expected, that a successful and trustable P2P platform should have both good internal and external control. We find disadvantages in some PRChina case. Second, using a logistic regression analysis technique, we prove that some information on borrower could predict the default rate; the most important determinant is the credit grade. Moreover, there is a strong correlation between credit grade and interest rate. Finally, we discuss the credit rating system, finding that the (USA based) "Lending Club" platform would give a fixed interest rate for the different borrowers according to its credit grade. In fact, our quantitative analysis allows to conclude that the Lending Club uses a good internal control way to control credit risk. This allows us to suggest the most appropriate or optimized risk control schemes.

## 11:02-11:14

**Giulia Rotundo** (Mathematics, Sapienza Università di Roma, Italy) : <u>Portfolio overlapping and herding in mutual funds: threats to financial stability</u>

One of consequences of the financial crisis of the 2008 has been an increase of monitoring and regulation on the banks system. In turn, many investments that the banks don't perform any more are nowadays competences of mutual funds, where the regulation is quite less constraining than the one for the banks. Mutual funds can have an active style of investment; or a passive one, trying to replicate the benchmark. This implies quite an overlap of portfolios, beside strategic asset allocation. This work adopts a complex networks perspective for the analysis of the structure of the overlap, herding, which exposes the system to potential higher fluctuations.

## 11:14-11:26

**Mario Eboli** (Economics, Università degli studi "G. dÁnnunzio" Chieti-Pescara, Italy) : <u>Liquidity Flows in Interbank Networks</u>

This paper characterises the interbank deposit network as a flow network that is able to channel liquidity flows among banks. These flows are beneficial, allowing banks to cope with liquidity risk. First, we analyse the efficiency of three network structures--star-shaped, complete and incomplete--in transferring liquidity among banks. The star-shaped interbank network achieves the complete coverage of liquidity risk with the smallest amount of interbank deposits held by each bank. This result implies that the star-shaped network is most resilient to systemic risk. Second, we analyse the banks' decentralised interbank deposit decisions for a given network structure. We show that all network structures can generate an inefficiently low amount of interbank deposits. However, the star-shaped network induces banks to hold an amount of interbank deposits that is the closest to the efficient level. These results provide a rationale for consistent empirical evidence on sparse and centralized interbank networks.

## 11:26-11:38

**Jessica Riccioni** (Economics, University of Macerata, Italy) : <u>Rational expectations for systemic risk and stochastic systems</u>

This paper proposes a stochastic model for describing rational expectations in a context of systemic risk. We consider a system which is a united entity but is composed by individual

interconnected components. The components of the system and the system itself can fail. We assume that the failure of the system depends on the way its components fail. Components are weighted, to capture the different levels of relevance of them. We define the failure condition of the system and the rule of failure of its components. Once one has the failure of one of the components, then there is a reallocation rule reassigning to the survivors the weight of the failed component. Thus, the set of the components along with their weights is time dependent, and it is a configuration. Rational expectations are obtained by considering the expected time of failure of the system conditioned to each configuration. Extensive simulations support the theoretical setting.

## 13:00-13:12

**Akira Ishii** (Physics, Tottori University, Japan) : Opinion dynamics theory which adopted positive and negative trust relation

Opinion dynamics is important in analyzing social consensus formation and majority formation. Consensus formation will also be important in the sense of avoiding the social crisis. In this research we present new opinion dynamics theory. The characteristic of this new opinion dynamics theory is that the relationship between people and people has introduced trust and sluggishness in the trust relationship. In traditional opinion dynamics theory, it was a difference whether there was trust or not, so it was ignored. In our opinion dynamics theory, we assume that opinions of people who do not trust each other will become more and more distant from each other. Also, modeling of opinion is a discrete value such as +1 and 0, so that the appearance of opinion moving little by little as positive and negative real numbers also can be reflected. This theory is extremely versatile, it can deal not only with social consensus building but also problems such as division of society, isolation among groups, or rebellion against public relations by government and mass media.

## 13:12-13:24

**Yasuko Kawahata** (Physics, Gunma University, Japan) : Social risk prediction using search behavior analysis of people of society

In recent years, devices such as public networks and smartphones have spread all over the world. We were able to easily know the real-time weather and social situation. Likewise, in the case of a social crisis, many people hypothesized that there are increasing cases of conducting searches related to the crisis. We aim to quantitatively clarify the influence from media in search behavior by analyzing trends in the risk of social crisis by socio-physical method of search behavior. In this research, using a mathematical model of search behavior, we propose a method to analyze search behavior by using Google Trends data as search number. By using analysis of search behavior, it is possible to capture a sign of social crisis far more quickly than knowing its signs with blogs and Twitter's number of writes. In addition, it is possible to know the influence of writing of blog and Twitter on search behavior by mathematical model of search behavior.

## 13:24-13:36

**Serge Galam** (Physics, Centre de Recherches Politiques de Sciences Po, France) : Why bubbles form and eventually collapse ?

At odd with prevailing views questioning the validity of the neoclassical theory with respect to the repeated occurrence of bullish and perish dynamics I show how the basic concepts of invisible hand and rational agent produce a combination of bubbles and subsequent crashes. The underlining mechanism relies on a step by step aggregation of rational individual choices, which in turn reveals the existence of an elasticity in the market efficiency. While elasticity allows the rational formation of bubble, it also drives the bubble burst when reaching its limit, thus materialising the invisible hand at work.

**Keynote: Marcello Galeotti** (Economics, CISA, Italy) : From risk pricing to risk management : How an actuary can become a risk manager

The specific task of an actuary consists, in a broad sense, in giving a price to a risk. This task will be described through the following steps: definition of an economic risk, introduction of the risk aversion concept, computation of a financial risk premium and of an insurance policy price. To the same framework also the definition of a risk measure and the computation of a regulatory capital can be re-conducted. In particular, it will be shown how the computation of a Value-at-Risk and an Expected Shortfall measure, utilizing such instruments as the stress texts, requires, in a rigorous approach, the existence of a risk-neutral probability measure, i.e. of a market non-arbitrage assumption. The next step of the talk will deal with the related question: is it possible to help preventing or mitigating a risky event by issuing and therefore pricing insurance and financial tools? To this end a specific example and case study will be illustrated, that of financial tools a public administration could issue for mitigating flood risks. However, it will be clear how some of the underlining ideas can have a much broader application.

economies seem not to have started their acceleration processes (due to catching-up). This means that the scheme of the endogenous growth model fails in achieving its expected goal in the Eurozone. The failure of the desired convergence mechanism depends on the growing surplus of the balance of trade of the Central countries, accompanied by a decrease of the same balance in the peripheral countries, as Italy, Spain, Portugal, and Greece. In this situation, to guarantee, at least, the balance of payment of the peripheral countries in equilibrium, a positive flux of capitals would have to enter in these countries under the form of foreign investments deriving from the countries in advance. But This mechanism does not occur, and peripheral countries were forced to collocate their public debt securities abroad, thus produce a crowding out effect of private expense. The aim of this paper is to show that in the economic systems, the use of theoretical approaches where economics is considered an autonomous discipline respect to ethics and politics, one possible result is that market alone is not able to produce mechanism of cooperative competition able to produce the scope of well-living of men. On the contrary, in absence of politics able to stimulate a shared sentiment of Genovesian public confidence, the market tends to become predatory, acting as a a zero-sum game, where the self-national interest is in contrast with the interests of other competitors.

Guido Tortorella Esposito (Economics, University of Sannio, Italy) : Predatory market and the risk of economic divergence in the EU. A possible solution furnished by the Genovesian scheme of Civil Economy

Some econometric evidences show that the expected phenomenon of catching up, according to which the Southern Europe countries growth rate would have to achieve that of the Northern Europe ones, has never occur. In general, it can be observed that the States already present within EU before the entry of new States, probably being closer to their own steady state are slowing their GDP per capita growth rate, while the new member

Sarka Hoskova-Mayerova (Mathematics, University of Defence, Czech Republic) : The risk connected with accident in the transport of dangerous substances in the Czech Republic

Safety in an integral sense is a comprehensive tool by which the humans ensure the level of their security and the sustainable development of them and of other basic public assets in a given territory. In addition to individual parts of human system it is necessary to consider their mutual links and flows being among them. A transport of dangerous goods is one of problems of safety which requires constant

attention in the Czech Republic. Traffic accidents with dangerous goods have big impacts on goods and vicinity, i.e. humans and environment. They are accompanied by fire, explosion, leakage of dangerous substances, or combination of these phenomena. These facts have economic impacts on carriers (damage or destruction of goods) and as well as on protected assets at the accident site (damage to infrastructure, human health injury or loss of human lives of persons being in the vicinity, harms in environment). The aim of the paper is to analyse the traffic accidents involving dangerous substances on the motorways and main railway routes in the Czech Republic, to characterize their impacts, to judge response in case of accidents´ occurrences and on evaluation of real data to suggest the measures for increasing safety in the carriage of dangerous substances.The authors focused on the statistical evaluation of accidents and on analysis of accidents during the transport of dangerous substances from the perspective of the impacts on people and other public assets. Data on road accidents involving dangerous substances on the roads have been obtained directly from the Czech Republic Police and they have been supplemented from other sources during the Student grant competition. Information on accidents on the railway provided the largest national carrier, i.e. the ČD Cargo, a. s., and the SŽDS.

### 16:30-16:42

**Lucie Chytilova** (Engineering, VŠB - TU Ostrava, Czech Republic) : Data Envelopment Analysis under Risk in Banking
Nowadays, Data Envelopment Analysis (DEA) is widely used technique for evaluating the relative efficiency of a set of homogeneous Decision Making Units (DMU). Its empirical orientation and assumptions have resulted in many studies in a lots of areas. The hardest things in DEA is to choose the appropriate method and meaningful input and output parameters. In this article, banks from the Visegrad Group (VG) countries are analyzed. There are approaches for the selection of input and output variables in the analysis of banks. In

these approaches, the risk influence is missing. So, there is a lack of an important and today very discussed risk analysis. Therefore, in this article the new DEA model with the risk variable is defined and presented. Based on the data from the V4 coutries, the close analysis and comparison of this new model and the classical is done. The results have shown that the model with the risk variable provides more needed information then the basic and classical model of DEA.

### 16:42-16:54

**Fabio Baione** (Mathematics, Sapienza University, Italy) : A dynamic policyholder behavior model for lapse risk assessment in a participating life insurance portfolio
In the life insurance sector policyholders' behavior is a determining factor involving a wide-ranging of a life insurer activities: from pricing and reserving to financial reporting and solvency and, more in general, in the enterprise risk management. In this context, our aim is to consider the problem of estimating the dynamic of lapse rates, in a portfolio of participating life insurance policies composed by different policyholders' profiles, when conditions in the financial market change over time. As proposed in the literature we use a so called two-step model consisting in a first step based on the modelling of lapse rates by means of a Generalized Linear Model considering as explanatory variables the policyholder/contract features. In the second step we propose, as an alternative to the tradition model, a double sigmoid function dependent on the dynamic of a financial benchmark, in order to correct the lapse rates over time.

### 16:54-17:06

**Daniele Clementi** (Mathematics, Sapienza University, Italy) : Volatility in the stock market: a comparison between ANN and parametric models
Forecasting and adequately measuring stock volatility is crucial for portfolio selections and investor strategies. In this paper we compare the performance of various parametric and

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GARCH models to measure stock volatility in liquid and illiquid markets. The various models are used to compare the resulting estimates to the implied volatility of liquid stocks. An alternative ANN approach to estimate time varying volatility in the stock market is also presented. Our results suggest that the Heston model does not always result the most adeqate one, The EGARCH in most cases can correctly capture the market volatility. ANN in liquid markets provide a promising tool for volatility forecasting

<center>17:06-17:18</center>

Gian Paolo Clemente (Economics, Università Cattolica del Sacro Cuore, Italy) : Assessing safety loadings for policyholders clusters in non-life insurance pricing

In insurance context, the application of safety and expense loadings represent a keen step of the overall ratemaking process. Given the fair premiums, loadings are the extra amount of money that the insurer apply to the policyholders both to cover expenses and to guarantee a profit margin. On one hand, safety loadings represent an expected profit margin. the other hand, they assure a greater financial stability to the insurer by partially covering adverse fluctuation of aggregate claims. Alternative loading premium principles have been provided in the literature, mainly based on either a fixed coefficient of portfolio's fair premiums or risk-based criteria depending on the volatility of aggregate claim amount distribution. A calibration at portfolio level (or segment/product level) is usually applied by computing the expected total losses and then by applying the same loading factor to the overall portfolio. In this way, insurer is proportionally charging total loadings to the policyholders. Our aim is to present a different strategy that add further flexibility in the computation of the final premiums taking into account the risk profile of different policyholders. In particular, assume to estimate fair premiums by a parametric model. To each risk coefficient estimates we can associate a measure of dispersion (the standard deviation of the parameter estimator). Under standard asymptotic theory, the joint confidence region

of the estimates is approximately a hyperellipsoid. Given the overall amount of loadings, we may search within this region, the infinite combinations of parameters that allow to gather the total premiums. That means that we can add a "bias" to the risk estimate to include implicitly the computation of loadings. By an ex-post analysis, we are able to calibrate the risk coefficients so that, under the constraint of the overall premiums, the optimum of some objective functions is achieved. An example is the combination of risk parameters that allow the maximum (or, why not, the minimum) heterogeneity among classes of risks, or the unbalance of loadings in order to smooth in some sense the premium mean conditional to some categories. In this way, we are able to cluster data according to common risk profiles and to apply a customized safety loading related to the riskiness of each group.

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<center>October, the 10th</center>

<center>10:00-10:30</center>

Keynote: Luciano Pietronero (Physics, La Sapienza, Italy) : Economic Fitness and Complexity

Economic Fitness (EF) is a novel iteration of Complexity Science applied to Economics which evolves this approach into a systematic and mathematically sound and testable framework [1]. It i) forecasts long-term or structural growth better than the IMF WEO process; ii) characterizes diversification strategy better than existing measures; and iii) identifies complexity of goods and services helping governments and private sector understand constraints to sustainable growth, upgrading, and diversification. EF describes economics as evolutionary process of ecosystems made of industrial and financial technologies that are all globally interconnected. This offers new opportunities to constructively describe technological ecosystems, analyse their structures,

understand their internal dynamics, as well as to introduce new economic metrics. This approach provides a new paradigm for a fundamental economic science based on data and not on ideologies or interpretations. One characteristics is to go from the many parameters of the standard economic analysis to a new methodology with zero parameters. This dimensional reduction is essential for a novel approach to Big Data and for the analysis and forecasting beyond the standard regressions [1,2]. EF is a general algorithm. It has been applied to both export and import data (as a proxy for globally-consistent and comparable disaggregated production data) to understand the dynamics of economic growth - for example that many fast-growing countries have a sustained build-up of EF or accruing mutually-reinforcing capabilities prior to the fast growth stage [1,2]. When the fitness algorithm is applied to patents, it treats each patent as a bundle of technologies which provides information and indicators of innovation strategy and dynamics associated with future product development investment and likelihood of eventual global competitiveness. The Fitness algorithm when combined with machine learning has also characterized the interrelations between products, technologies and science allowing analysis of the core elements of the innovation process in a systematic and coherent way.

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Peter Mitic (Economics, Satander UK (SanUK), UK) : Systemic Shock Propagation in a Complex System

We study the effects of delivering a shock to a self-determining complex system where agents interact pairwise. We consider the characteristics of the system before and after shock and how long it takes the shock to affect the entire system. We use simulations in Mathematica. Principles of complexity (Rzevski 2014) are applied, embedded in the framework of Mitic (2018). Agents are modelled using Beta functions, where the expected value of a Beta function defines the agent's 'state'. Systemic risk arises only from the way in which pairs of agents interact. We incorporate a shock delivery feature which instantaneously changes an agent's state. Real example are the 2008 banking crisis and the VW emissions scandal. The shock scenarios used are: 1) A shock delivered to many agents simultaneously and is damped when transmitted; 2) A shock delivered to one agent, and is transmitted in full. This is the most severe type of systemic risk. A shock recovery process is proposed, where each agent tries to regain its pre-shock state through interaction with other agents. The process has a recovery target and a geometric state change model where the state change is biased in favour of the pre-shocked state. RESULTS 1) A single shocked agent gets an abrupt state change. 2) The state change for a shocked group is only significant if all group members receive it. 3) In the severe systemic case the state change for the group is fast, and only one agent needs to receive the shock. Even well protected agents cannot escape the systemic effect. 4) Convergence to a steady « recovered » state post-shock is slow, and faster convergence is associated with much greater state volatility. There are surprises in the results, such as increased state volatility in all cases and resiliance if only a few agents are shocked. Consequently, agents must shock-protect themselves well (Barclays bank did), or be protected externally, such as by Government action (e.g. the UK Treasury for RBS). Dynamic demonstrations of simulations will be presented. REFERENCES Mitic, P. (2018) A Complexity Framework for Consensus and Conflict. Int. J. Design & Nature & Ecodynamics, 13(2) Rzevski,G and Skobelev,P. (2014) Managing Complexity. WIT Press.

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Yuri Biondi (Economics, CNRS - IRISSO (University Paris Dauphine PSL), France) : Interbank Credit and the Money Manufacturing Process. A Systemic Perspective on Financial Stability

Interbank lending and borrowing occur when financial institutions seek to settle and refinance their mutual positions over time and circumstances. This interactive process involves money creation at the aggregate level.

Coordination mismatch on interbank credit may trigger systemic crises. This happened when, since summer 2007, interbank credit coordination did not longer work smoothly across financial institutions, eventually requiring exceptional monetary policies by central banks, and guarantee and bailout interventions by governments. Our article develops an interacting heterogeneous agents-based model of interbank credit coordination under minimal institutions. First, we explore the link between interbank credit coordination and the money generation process. Contrary to received understanding, interbank credit has the capacity to make the monetary system unbound. Second, we develop simulation analysis on imperfect interbank credit coordination, studying impact of interbank dynamics on financial stability and resilience at individual and aggregate levels. Systemically destabilizing forces prove to be related to the working of the banking system over time, especially interbank coordination conditions and circumstances.

10:54-11:06

**Bogdan Negrea** (Economics, Bucharest University, Romania) : The Winner's Curse Pricing Model and its Implications on Liquidity Measuring

I develop a valuation model for the winner's curse effect induced by a limit order submitted under informational asymmetry. Based on the winner's curse pricing model, I endogenously derive the price under perfect liquidity as a weighted average of the bid and ask prices. The weights are functions of the price volatility and the risk-free interest rate. The price under perfect liquidity is an alternative to the use of mid-quote in liquidity measuring. Thus, I derive the illiquidity premium based on the CAPM and an estimator of the bid-ask spread.

12:00-12:12

**Marie Shchepeleva** (Economics, National Research University Higher School of Economics, Russia) : Financial Stress Propagation in Russia through Balance-Sheet Channel

The global financial crisis 2007-2009 has refocused academicians' attention on financial sphere-real economy interactions. Special emphasis was placed on the role of asymmetric information in financial markets in propagating instability to broader economy. In this context central banks also attributed more importance to supplementary channels of monetary transmission (balance sheet channel and bank lending channel) connected with imperfections of financial markets. Balance sheet channel which is a part of the broad credit channel operates through the structure of the balance sheets of non-financial companies. It presumes that in case of tight monetary policy the value of assets held by companies tends to fall, thereby increasing the risk for a bank of not getting its funds back when it grants a loan. Therefore, changes in agents' wealth and income affect through imperfections in financial markets the willingness of financial institutions to lend which in its turn leads to a change in investment spending and output. This paper makes an attempt to assess the extent to which balance sheet channel has been at work over the last years in Russia. We formally test for the presence of this channel applying both micro- (panel dataset) and macroapproach (time series) using six variables: MIACR, price index of financial assets, a measure of net worth (total assets of non-financial companies), risk-premium, the volume of loans granted by the banks and investment spending. We use panel vector autoregression to analyze transmission mechanism for a dataset of the largest industrial companies and then construct Bayesian vector autoregression to check our results for aggregate time series. Our analysis gives evidence that there is a statistical link between price index of financial assets, balance sheets of non-financial companies and the

volume of loans granted by banks to the economy. Reaction of these variables on monetary policy tightening is rather small but statistically significant. Still we do not find empirical support for theoretical interrelation between loans and investment spending which can be due to noisy data on investment in Russia. Our results suggest that balance sheet channel can be a propagating mechanism of instability from the financial sector to real economy.

<div align="center">12:12-12:24</div>

Florian Ielpo (Economics, Université Paris1 Panthéon-Sorbonne,France) : Fundamental Bubbles in Equity Markets

We use a dynamic affine term structure framework to price equity and bonds jointly, and investigate how prices are related to a set of macro factors extracted from a large dataset of economic time series. We analyze the discrepancies between market and model implied equity prices and use them as a measure for bubbles. A bubble is diagnosed over a given period whenever the discrepancies are not stationary and impact the underlying economy consistently with the literature's findings, increasing over the shorter term economic activity before leading to a net loss in it. We perform the analysis over 3 major US and 3 major European equity indices over the 1990-2017 period and find bubbles only for two of the US equity indices, the S&P500 and the Dow Jones.

<div align="center">12:24-12:36</div>

Mikhail Stolbov (Economics, Moscow state institute of international relations, Russia) Do Economic Policy Uncertainty and Geopolitics Matter for Systemic Risk in Russia?

I investigate the relationship between systemic risk and two non-financial factors which can strongly affect financial stability ? economic policy uncertainty (EPU) and geopolitical risk (GR), proxied by the EPU index (Baker et al, 2016) and GR index (Caldara and Iacoviello, 2018), respectively. Russia appears a feasible natural lab to test for such linkages over the

past 10 years, since it has faced several episodes of acute financial stress and geopolitical tensions. With the aid of a dynamic factor model and independent component analysis, I derive two aggregate measures of systemic risk based on 12 individual indicators for March 2008-March 2018. The techniques provide more accurate metrics than conventional principal component analysis, as they are better suited to handle nonlinear and non-Gaussian data. The relationship between these measures and EPU and GR indices (global and national) is examined in the time series framework, conditional on global volatility (VIX index) and oil price dynamics. First, I specify a Bayesian VAR and derive impulse-response functions (IRFs) as well as forecast error variance decompositions to assess the relationship. Only the global EPU index is found to drive the two aggregate systemic risk measures, based on IRFs. Although this effect is statistically significant, it is not economically sizeable: the global EPU index accounts for about 4.5% of the systemic risk variance. The VIX index and oil prices by far outperform the EPU index, explaining up to 14 and 16.3% of the systemic risk variance. Second, I test the relationship, based on the local projections method (Jordá, 2005, 2009), which yields robust IRFs even if an underlying VAR is misspecified. This approach also underscores the prevailing role of the global EPU index. The national GR index matters less, while the national EPU index and global GR index do not appear to have any robust relation to Russian systemic risk. Finally, I dissect the relationship in the time-frequency domain by computing wavelet coherences and find that the impact of the global EPU index is pronounced in the short run and is mostly observed during the 2008-2009 period. The analysis reveals limited contribution of economic policy uncertainty and geopolitical situation to systemic risk in Russia in the presence of the VIX index and oil prices as its major determinants.

Hayette Gatfaoui (Economics, IESEG School of Management & Université Paris1 Panthéon-Sorbonne, France) : Flickering of Information Spreading As an Early Warning of Critical Transitions in Financial Systems

As many complex dynamical systems, financial markets exhibit sudden changes or tipping points that can turn into systemic risk. Therefore, regulators and investors express a urgent need for early warnings of critical transitions. Using a data-driven approach, we model European stock markets as a temporal financial network, in which nodes are connected by short-term causality. Before a tipping point occurs, nodes rapidly switch between 'being in' and 'out' the information diffusion process, and stock markets start to desynchronize. We build two early warning indicators based on the number of regime switches, and the time between two switches. We measure the predictive content of the indicators using receiver operating characteristic curves and areas under the curve, and show that we are able to predict a tipping point several months before it occurs. In particular, we can predict the Global Financial Crisis, and over a recent sample, we also capture, to a large extent, the 2016 turmoil of financial markets. Thus, flickering in information spreading convey information about a future transition. From a theoretical point of view, our results suggest that financial markets should be analyzed within the framework of excitable dynamical systems, in which transitions can be noise-induced.

15:00-15:30

Keynote: Colin A. Taylor (Earthquake Engineering, University of Bristol, UK) : Natural Hazard Resilience: A Collaborative Learning Challenge

Conventional engineering views on resilience tend to focus on restoring the functionality of the physical infrastructure assets and systems after they have been impacted by an event such as an earthquake, flood or storm.

However, this asset-centric mindset usually neglects the wider and highly collaborative and interdependent human behavioural responses that constitute resilience. Consequently, actions to rehabilitate affected physical infrastructure are not set in their full context and are likely to be at least sub-optimal, if not counter-productive, in restoring overall societal functionality. Whilst the types of impacts of a hazard can be anticipated, the exact nature, extent and consequences of such manifestations are unknowable until after the event. Once the event has happened, the imperative is to learn quickly what has actually happened and then to decide on the desired recovery outcomes and the next best actions to achieve them. The underpinning learning and creative actions are highly collaborative across the scales, from a home owner who has the most detailed picture of what has happened to their home to the national leaders who have the best overall picture, with many intermediate actors who have the best pictures at the scales between. Poor alignment of these pictures leads to inappropriate actions, delays and wasted effort and resources. Successful resilience depends on effective collaborative learning that builds a shared dependable systemic picture of what has happened and what needs to be done. This paper will explore how state-of-the-art learning theories and models can frame the resilience challenge, leading to systemic models that link resource flows and transformations, which enable people to choose and execute the best actions that will realise their desired outcomes. Analysis of these systemic models reveals the epistemic uncertainties, in terms of factual and procedural (ie capability and process) knowledge, from which risk can be assessed.

15:30-15:42

Raffaele De Risi (Engineering, University of Bristol, UK) : Risk-based seismic micro-zoning: a new urban policy tool

In the aftermath of a seismic event, the damage suffered by structures and infrastructures can be significantly different for nearby towns and often for nearby neighbours within the same city. The explanation of this

phenomenon is mainly related to the different vulnerability of the structures and to the different local behaviour of the soil, that can amplify or reduce the seismic waves on the earth surface. The classical seismic micro-zoning analysis is a geotechnical analysis that is used to study how the soil can affect seismic waves in their propagation from the seismogenic source to the earth surface, and more specifically in the uppermost tens of meters of soil underneath a structure. This study has been adopted by stakeholders and local policy-makers to improve their management capabilities of the built environment, to improve the design of new structures and infrastructures and to ameliorate emergency plans to be adopted in the aftermath of a seismic event. On the other hand, classical micro-zoning analysis is only hazard oriented and neglects the vulnerability component. In this study a new risk-based seismic micro-zoning methodology is proposed. The micro-zoning is carried out at risk level considering both hazard and vulnerability components. The main novelty of the methodology is the definition of a risk map that can help decision-makers in redistributing available financial resources in urban areas for the reduction of the seismic risk. The fundamental principle of the methodology is the creation of risk-homogeneous urban areas, that means that all citizens in an urban area, according to the principle of equality, share the same seismic risk. The proposed methodology has been applied to the city of Benevento, in Campania region, Italy. Benevento is an earthquake-prone city since it is very close to one of the most active seismogenic area in Italy. The building stock is composed by both masonry and reinforced concrete buildings. The seismic risk map is obtained convoluting the hazard curves provided by the Italian Institute of Geophysics and Volcanology (INGV), modified to consider the local seismic effects, with fragility curves from literature, that describe the structural vulnerability in a probabilistic manner. The output maps show where to prioritize future investments to reduce the urban seismic risk.

Norberto Rojas-Mercedes (Engineering, Instituto Tecnologico de Santo Domingo (INTEC), Dominican Republic) : Seismic risk of critical facilities in the Dominican Republic: Case study of school buildings

The island of Hispaniola, shared by the Dominican Republic and Haiti, is located in a subduction zone between the North American plate and the Caribbean plate. In addition, there are 13 geological faults in the interior of the island, some of which have shown the potential to generate earthquakes of magnitude 7.5 and higher. Thus, the whole island is considered to be a high seismic risk region. In the past 100 years, several earthquakes have affected both parts of the island. In the case of the Dominican Republic, two earthquakes stand out: a magnitude 8.1 earthquake on August 4, 1946, north of the Samaná province, which caused a tsunami, soil liquefaction phenomena, and the loss of about 100 lives; and a magnitude 6.5 earthquake on September 22, 2003, in the city of Puerto Plata, which caused great damages in infrastructures. Among the observed effects, the partial and total collapse of several school buildings stand out. In addition to the high seismic hazard, a large part of the country's infrastructures, designed according to the old seismic regulations active for about 32 years (from 1979 to 2011), may be highly vulnerable. During these three decades, thousands of structures were built throughout the entire country, including essential buildings such as hospitals and schools. Considering that the current student population in public schools in the Dominican Republic is over 2 million, with the majority attending buildings that were designed with the 1979 seismic code and which proved to be very vulnerable during the Puerto Plata earthquake, it is necessary to take measures that minimize potential earthquake damage and reduce the risk. In this context, the Technological Institute of Santo Domingo (INTEC) undertook a project whose main objective was to assess the seismic vulnerability of 22 schools located in the San

Cristóbal Province, in the south of the Dominican Republic, all built prior to the adoption of the current seismic code. This paper presents the results of this investigation, and some considerations on the countermeasures that could attenuate the seismic risk and consequent economic impact.

15:54-16:06

**Giuseppe Lucio Gaeta** (Economics, University of Naples L'Orientale, Italy) : Life after the storm: an analysis of earthquakes' effect on marriage

Natural disasters have severe effects on human well-beings. Alongside tragic immediate consequences for local economies, disasters have been proven to exert negative influence on citizens' health and human capital accumulation also in the long run (Caruso and Miller, 2015). Recent contributions highlight that disasters might also affect life transition decisions such as those concerning marriage (Ahmed, 2018; Cohan and Cole, 2002). This paper aims to add to this literature by studying the trend of marriages in Italy before and after the major earthquakes observed over last 20 years. Differently from previous contributions (Prati and Pierantoni, 2014), our analysis covers the entire national territory and embraces more than one single earthquake event; furthermore, it is based on municipality-level data.

16:06-16:18

**Oussama Raboun** (Mathematics, Université Paris-Dauphine, CNRS, France) : Risk Assessment of an Accidental Nuclear Release in the Marine Environment Using DRSA and ELECTRE TRI Multiple Criteria Classification Methods

This talk focuses on the impact assessment of an eventual accidental nuclear release in the marine environment taking place in the Bay of Toulon (in the Mediterranean coastal region of Southern France). Many studies have been conducted to simulate the concentration's evolution of a released radioactive substance on a given marine area. In this talk, we assume that the studied area is composed of a collection of elementary geographic units (called units for simplicity). Twelve possible nuclear release scenarios in the Bay of Toulon and four important criteria (Fishing, Fish Farming, Seagrass Posidonia and Tourism) have been considered. The objective is to assess the impact of a nuclear accident either over a unit or a subset of contagious units. For this aim, all the units have been assessed with respect to the four criteria using a predefined ordinal scale from 1 (no impact) to 5 (very important impact). The impact assessment of a nuclear accident over the studied area can be modeled as a multiple criteria classification problem. In this talk, we present, compare and discuss the first results of two well-known multiple criteria classification methods, namely DRSA and ELECTRE TRI. Both methods use as input a learning set, i.e., a set of assignment examples carefully identified by experts. The DRSA produces then a collection of ?if-then' decision rules. These rules can then be used to classify all the units of the studied area. In case of ELECTRE TRI, the assignment examples are first used, through a disaggregation /aggregation approach, to infer the different preference parameters. These parameters are then used in ELECTRE TRI approach to assign the units to the corresponding impact category. The comparative study will concern both practical aspects (e.g. definition of the learning set, support of missing information and uncertainty, specification of preference parameters, complexity, etc.) and final risk maps.

16:18-16:30

**Enrico Moretto** (Economics, University of Milano-Bicocca, Italy) : An attempt to apply risk measures to weather derivatives: managing meteorological risk through Expected Shortfall

In the last years, a growing concern about climate changes and risks related to extreme meteorological events has strongly entered into almost every world-wide government's agenda. In 2015, the United Nations Climate Change Conference, held in Paris, brought an agreement whose main aim is to limit global warming below the threshold of a 2 °C increase

with respect to pre-industrial levels. Even on the financial markets' side environmental topics are important: United Nations Environment Program Finance Initiative is pushing ?to bring about systematic change in finance to support a sustainable world? [www.unepfi.org] It is evident that damages due to climate changes are increasing in both frequency and severity of damages. This risk can be only partially mitigated using weather derivatives, traded financial contracts that pay-off cash-flows in case, for instance, temperatures and rainfalls end up being, in a given period, for a number of days above or below some predetermined level. Unfortunately these contracts are not, in a geographical sense, region-specific and might fail to offer proper hedges for activities that are localized in tiny areas. To cover such risks, tailor-made insurance contracts are more appropriate. The main drawback of insurance policies is that they are not, unlike weather derivatives, actively priced on a market with the consequence that their prices may be not fair. An attempt to mix together the two extremes is by proposing an insurance whose pay-off is based on a sufficiently long and accurate local meteorological data (so to prevent the main problem with weather derivatives) but whose price is obtained considering its claims as generated by a derivative. On top of this, such derivatives strike price is computed in terms of historical Expected Shortfall, a left-tail risk measure that has proved to be effective in managing extreme negative events that occur with very low probability but with huge impacts. This approach is capable of reducing stiffness in both the above mentioned standard methods to insure against meteorological risk, and, at the same time, provide a more specific hedge.

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Luca Raffaello Perfetti (Law, Università degli Studi di Bari, Italy) : Risk as a genetic element of the state and public functions
The modern State has been constituted and consolidated as a predominantly juridical instrument, which invests the political decision and translates it into a peculiar capacity of public law; at the origins of this path, which also involves the perception of Sovereignty, there is a kind of risk management, connected to internal and external securities. Progressively, the State has attracted to itself, taking it out from communities and societies, a series of activities aimed at preventing and tackling risks with various public organizations, charged to stable and properly public functions, and which therefore today generate different consequences also in terms of legal responsibilities. The work, therefore, intends to examine the evolution of this path, both on the theoretical level, highlighting the formulas and ambivalences of the Rule of Law, individual Rights, legal protections and the abilities of individuals and social groups, and on the organizational and functional sides, with specific aspects connected to the securitization, the progressive internationalization of the public organization directed to risk prevention and management, and the establishment of different administrative models from the traditional command-and-control one.

Annamaria Nifo (Economics, University of Sannio, Italy) : Rule of Law, Government Effectiveness and Firms' Productivity in the Regions of Europe
This paper focuses on the role of institutions in determining firms' TFP in Europe. To this end, we regress a measure of TFP for manufacturing firms located in seven European countries on a region-level index of institutional quality and its components accounting for formal dimensions of institutions, the rule of law and government effectiveness. The results are

twofold. First, better local institutions help firms to become more productive. Second, the impact of institutions is heterogeneous, according to the operating sector (stronger for technologically less advanced industries) and firms' TFP (stronger for less productive firms).

Julien Salin (Economics, Université Paris Nanterre, France) : The Impact of Legal Framework on Bank Loan Portfolio: An implementation to the European Stress Test Exercise

The economic crisis put financial and banking sector on the viewfinder of regulators and policymakers across EU and more widely across the world. Indeed, the improvement of the quality of banks' balance sheet has proved crucial for economic stability and growth. In this paper, we use several panel specifications to provide an innovative viewpoint of the impact of insolvency regimes and macroeconomic factors on quality of banks loans portfolio. Our results about macroeconomic factors are consistent with the related literature and show that a better insolvency framework is associated with a higher quality of bank loan portfolio.

Francesco Caruso (Law, Italian Emeritus Ambassador, Italy) : Risk Management in the prevention, protection, tutelage of tangible and intangible cultural assets: a global issue

Some concepts related to the Risk / Culture theme should be overturned: Natural, environmental, human Risks should not to protected (also) the Cultural Heritage, but Cultural Heritage should be exalted as a tool also for protection from risks. The effort for the implementation of projects to safeguard cultural heritage must therefore be included in local development projects as an element of prevention. This appears to be a determining factor for natural hazards in relation, for example, to cultural landscapes: the maintenance and development of traditional techniques for the protection of soils, the wise use of water resources, the governed management of peripheral buildings, etc. can be elements for the conservation and sustainable tourist use of cultural landscapes, also and above all elements for the prevention of natural and environmental disasters. It is evident that such good practices related to soils are more easily achieved in the Management Plans for the protection and enhancement of Cultural Heritage (such as those included in the UNESCO World Heritage List) compared to less culturally significant sites. Moreover, the realization of the good practices often finds an impediment in the high costs, due to the prevalence of technically qualified human work and to the scarce immediate profitability in the short and medium term. The result is the abandonment of the necessary maintenance operations and the consequent depletion of entire areas that end up being more exposed to natural hazards. It is therefore necessary to implement integrated management plans at regional, interregional and international levels, and the Italian Ministry for Culture has recently encouraged the development of an integrated national system of the Management Plans of the UNESCO Sites of our Country. The high costs and the long time required for the implementation of such integrated systems therefore require intervention and the desirable coordination not only at national level but also and above all of international organizations (EU, EIB, UNESCO, BANK WORLDWIDE etc.) Since the second half of the twentieth century, the commitment of the international community has been increasing in the prevention and repression of threats to cultural heritage, deriving from human activities and the management of risks connected to natural phenomena; alongside a progressive expansion of the notion of cultural heritage (which contemplates the relationship between cultural and natural heritage, and between tangible and intangible heritage), in fact, there is a tendency towards a unified approach to the international protection of cultural heritage ("UNESCO system ", which in international or interstate forms extends to the identification, protection, management and even prevention of illicit trafficking in cultural goods), an international criminal jurisprudence

which considers a" constitutional "protection of cultural heritage as a" fundamental value "of the international community, and also the establishment of a system of "enhanced protection" of immovable cultural heritage in the event of armed conflict (1954 Hague Convention, with the 1999 Protocol). For some time, however, the risks to cultural heritage deriving from environmental impact, from natural disasters, climate changes, or from large urban projects to cultural heritage protection, also based on the promotion of the cultural diversity of peoples, are also discussed; and on the use of non-state actors in the protection of immovable property of exceptional universal value. Therefore, the varied forms of protection of cultural heritage in the world have recently become an instrument of peacekeeping, a political and security necessity. Responding to the UN appeal, Italy has assumed a strong world leadership to mobilize and coordinate the efforts of the international community and, on the Italian proposal, in 2015 UNESCO approved a resolution to ?strengthen the protection of culture and the promotion of cultural pluralism in the event of armed conflict?, with a strategy based on two fundamental elements: 1) the incorporation of a cultural component in peacekeeping activities; 2) the creation of national task forces specifically dedicated to the protection of cultural heritage. On 16 February 2016, an agreement was signed between UNESCO and the Italian Government for the formation of the first national task force called « Unite4 Heritage », the recent G7 of Culture of Florence reiterated the distinctive role of culture as an instrument of dialogue between peoples and the need for a cultural mandate in security and peacekeeping missions, and on 24 March 2017 the UN Security Council approved an Italian-French resolution, no. 2437, which provides for the possible use of a cultural component in peacekeeping missions. The Italian task force was established, with a significant contribution from the Carabinieri Command for the Protection of Cultural Heritage, internationally recognized as the most effective police in the world in the protection of artistic heritage, flanked by a civil component made up of archaeologists, restorers and historians of art

and prestigious Institutes of the Ministry of Heritage and Cultural Activities and Tourism: the Istituto Superiore per la Conservazione e il Restauro, the Opificio delle Pietre Dure in Florence, the Istituto Centrale per la Conservazione e il Restauro del Patrimonio Archivistico e Librario and the Istituto Centrale per il Catalogo e la Documentazione. It may intervene, upon the request of a Member State that is facing a crisis or is struck by a natural disaster, to estimate damage to Cultural Heritage, plan operations for safeguard measures, provide technical supervision and training to assist local restorers in actions protection, assist in the safe transport of movable cultural assets, counter the looting and illicit trafficking of cultural heritage.

## October, the 11th

### 10:00-10:30

**Keynote: Didier Sornette** (Poly-fields, ETH Zürich, Switzerland) : A General Framework Reconciling Rational with Inefficient Financial Bubbles

### 10:30-10:42

**Paolo Silvestrini** (Physics, Università della Campania, Italy) : A quantum physics paradigm in view of analyzing technology development and social diffusion of new ideas

Is it possible to measure the probability of success, the duration and the time evolution of the impact and popularity of a scientific innovation? Scientific innovation is linked to several factors such as the emergence of new ideas, scientific research, proper communication of scientific knowledge for their development, engineering and production of marketable technologies, marketing strategy and community interest in humans' use of new technologies, the availability of renewable sources, and in general everything that has an impact on quality of life. These concepts are often discussed in a qualitative way. The theoretical understanding of Gartner's « hype curve » is an

interesting open question in deciding the strategic actions to adopt in presence of an incoming technology. In order to describe the hype behavior quantitatively, we propose a mathematical approach based on a rate equation, similar to that used to describe quantum level transitions. The model is able to describe the hype curve evolution in many relevant conditions, which can be associated to various market parameters. Different hype curves, describing the time evolution of a new technology market penetration, are then obtained within a single coherent mathematical approach. We have also used our theoretical model to describe the time evolution of the number of scientific publications in different fields of scientific research. Data are well described by our model, so we present a statistical analysis and forecasting potentiality of our approach. We note that the hype peak of inflated expectations is very smooth in the case of scientific publications, probably due to the high level of awareness and the deep preliminary understanding which is necessary to carry on a research project. Our model is anyway flexible enough to describe many patterns of increasing interest on a new idea, leading to a hype behavior or other time evolution.

10:42-10:54

Antonio Di Nola (Mathematics, University of Salerno, Italy) : Generalized events

We show how a theory of "generalized event" can help in developing an analysis of economic and social systems.

10:54-11:06

Michael Campbell (Physics, Veritone, USA) : Statistical Mechanics of Boundedly-Rational Economics and Control Theory

In many systems there are two sets of variables with the property that one set of variables changes much more quickly than the other set. We will assume that the « fast » set of variables are adjusted to optimize some objective function, and that the process of adjustment is « boundedly-rational » ? that is, agents adjust fast variables using a « rational » process to maximize the objective function which is perturbed by random error. Under certain assumptions, the fast-dynamics will equilibrate to the Gibbs measure from statistical mechanics. Applications of resulting phase transitions to economics give a model with a market crash, and to control theory give a model with simplified reduced dynamics which may be bifurcated.

12:00-12:12

Alessandra Cornaro (Mathematics, Università Cattolica del Sacro Cuore, Italy) : Robustness assessment in complex networks based on the Kirchhoff index

Systemic risk refers to the possibility of an entire system breaking down, due to attacks or failures in the networks. In this regard, it is crucial for a network to be able to continue performing well when it is subject to such challenges. It is noteworthy that the identification of a measure suitable to capture the robustness properties can be desirable in order to assess the vulnerability, reduce risks and enhance network resilience. To this aim we focus on spectral graph theory where robustness is measured by means of a graph invariant called Kirchhoff index, expressed in terms of eigenvalues of the Laplacian matrix associated to a graph. The Kirchhoff index (also known as effective graph resistance) can be alternatively defined as the accumulated effective resistance between all pairs of vertices. This index can be highly informative as a robustness indicator, showing the ability of a network to maintain its total throughput under node and link removal. In fact, the pairwise effective resistance measures the vulnerability of a connection between a pair of vertices and quantifies the impact of failures on the functionality of the network. A small value of the effective graph resistance therefore indicates a robust network. Since the direct calculation of the Kirchhoff Index is computationally intensive, we provide some new and tighter bounds of this graph invariant when edges are added or removed. These limitations take advantage of real analysis

techniques, based on majorization theory and optimization of functions which preserve the majorization order, the so-called Schur-convex functions. Applications to both simulated and real data show the effectiveness of our bounds, also in providing meaningful insights to fast and reliably assess network's vulnerability.

12:12-12:24

Rosanna Grassi (Mathematics, University of Milano Bicocca, Italy) : Systemic risk assessment through higher order clustering coefficient

Global financial markets can be seen as part of a strongly interconnected system, so modelling them by means of a network tool can be useful to understand how systemic risk rises and how shocks propagate, thus preventing future financial crises. This work moves from this premise and proposes a novel measure of systemic risk in the context of financial networks. To this aim, we provide a definition of systemic risk based on the structure of neighbours around the nodes of the network. In the literature of financial networks, there are several measures of systemic risk based on clustering coefficient. Indeed, being formally constructed on the number of triangles a node belongs to, these local coefficients generate a synthetic global indicators that well includes the interconnections between elements of the system. However, classic clustering coefficient takes into account only the neighbours if a node. Our aim is to consider the interconnections of the entire network simultaneously, opening the view beyond the adjacents. To this end, we introduce the concept of local l-adjacency clustering coeficient of a node i as an opportunely weighted mean of the clustering coefficients of the nodes at geodesic distance l from i. Then, we define a global adjacency clustering coefficient of i as the mean of the l-local adjacency clustering coefficients of i and we explore its properties in terms of systemic risk assessment. Empirical experiments on the time-varying global banking network show the effectiveness of the presented systemic risk measure and provide insights on how systemic

risk has changed over the last years, also in the light of the recent financial crisis.

12:26-12:38

Fabrizio Lillo (Physics, Università di Bologna, Italy) When panic makes you blind : A chaotic route to systemic risk

We present an analytical model to study the role of expectation feedbacks and overlapping portfolios on systemic stability of financial systems. Building on [Corsi et al., 2016], we model a set of financial institutions having Value at Risk capital requirements and investing in a portfolio of risky assets, whose prices evolves stochastically in time and are endogenously driven by the trading decisions of financial institutions. Assuming that they use adaptive expectations of risk, we show that the evolution of the system is described by a slow-fast random dynamical system, which can be studied analytically in some regimes. The model shows how the risk expectations play a central role in determining the systemic stability of the financial system and how wrong risk expectations may create panic-induced reduction or over-optimistic expansion of balance sheets. Specifically, when investors are myopic in estimating the risk, the fixed point equilibrium of the system breaks into leverage cycles and financial variables display a bifurcation cascade eventually leading to chaos. We discuss the role of financial policy and the effects of some market frictions, as the cost of diversification and financial transaction taxes, in determining the stability of the system in the presence of adaptive expectations of risk. Mazzarisi, P., Lillo, F., & Marmi, S. (2018).

12:38-12:50

Cécile Bastidon (Economics, Toulon University, France) : MIFID, French equity markets fragmentation and intraday volatilities: a network analysis

The implementation of the MiFID Directive in November 2007 results in the end of monopolies of European stock exchanges. Thus it introduces trades fragmentation: listed securities are no longer solely traded in the market which first listed them, but also in

other stock exchanges or trading platforms. We propose an empirical study of the relationship between trades fragmentation and the intraday volatilities of the stocks of the CAC40 index, using a network analysis. The relationships between the volatilities of the stocks are measured by topological indicators from the econophysics literature, with three superiods: prior to the introduction of competition (2000/01-2007/11), during the transitory period of rising fragmentation (2007/12-2010/01), and after the stabilization (2010/02-2015/06). Fragmentation is measured by the reference index of FIDESSA. In accordance with the market microstructure literature stating that fragmentation affects volatility at the individual stock level, we show that fragmentation also affects the structure of the system. In particular, the intraday volatilities of the stocks of the CAC40 are all the more connected to the rest of the network that their level of fragmentation is high and stable. In addition, financial stocks volatilites show both an increasing intra-sectoral integration and a decreasing inter-sectoral integration, which does not allow for straightforward bail-in recommendations as regards policy choices in the context of crises resolution.

## 12:50-13:02

**Roy Cerqueti** (Mathematics, University of Macerata, Italy) : Communities and systemic risk

The analysis of the resilience of a network is of key relevance in the systemic risk analysis, mainly in the socio-economic context. This paper deals with this topic by advancing theoretical proposals for measuring the resilience of a weighted network. The followed approaches are related to the weighted paths of the network and to the existing community structures. In particular, shocks propagation is assumed to become faster as the connectedness of the network becomes more evident. Empirical experiments on real world data support the theoretical framework.

## 15:00-15:30

**Keynote: Monica Billio** (Economics, University Cà Foscari, Italy) : Bayesian Markov Switching Tensor Regression for Time-varying Networks

We propose a new Bayesian Markov switching regression model for multi-dimensional arrays (tensors) of binary time series. We assume a zero-inflated logit dynamics with time-varying parameters and apply it to multi-layer temporal networks. The original contribution is threefold. First, in order to avoid over-fitting we propose a parsimonious parametrization of the model, based on a low-rank decomposition of the tensor of regression coefficients. Second, the parameters of the tensor model are driven by a hidden Markov chain, thus allowing for structural changes. The regimes are identified through prior constraints on the mixing probability of the zero-inflated model. Finally, we model the jointly dynamics of the network and of a set of variables of interest. We follow a Bayesian approach to inference, exploiting the Polya-Gamma data augmentation scheme for logit models in order to provide an efficient Gibbs sampler for posterior approximation. We show the effectiveness of the sampler on simulated datasets of medium-big sizes, finally we apply the methodology to a real dataset of financial networks

## 15:30-15:42

**Raffaele Giammetti** (Economics, Marche Polytechnic University, Italy) : The economic impact of tariffs, trade diversion and import substitution within the World Input-Output Network: the case of Brexit

In this paper we employ the World Input-Output Database (WIOD) to simulate the economic impact of Brexit. In contrast to the traditional trade models which relies on direct gross exports between bilateral trade patterns we consider (1) the global production network and the linkages with global and domestic demand, (2) bilateral tariffs that affect

intermediate production and final consumption, (3) the case of import substitution. We first analyse the properties of the UK-EU production network from a global, regional and local perspective. We find that at a global level, industries are highly but asymmetrically connected, which implies that micro shocks can lead to macro fluctuations. At regional level, we find that UK-EU production is still operated nationally or at most regionally as the communities detected are either individual economies or geographically well-defined regions. Further, we enrich the traditional key sectors investigation employing network-based centrality measures such as PageRank centrality. Descriptive analyses based on network measures suggest that both regions UK and EU are exposed to Brexit. In the second stage of the analysis, based on partial extraction techniques we develop two scenarios to forecast the impact of Brexit on UK and EU. In the first scenario, we follow the literature and consider the Brexit as a trade shock. The introduction of tariffs and trade restrictions hit bilateral intermediate and final exchanges between UK and EU. This direct distortion spread indirectly all along the value chain. The first scenario suggests that UK will lose more than EU. Nevertheless, our results are less pessimistic than other recent findings (Dinghara et al. 2017, Chen et al. 2017). In the second scenario, we refer to the so-called Thirlwall law and we analyse the Brexit as a current account rebalancing case. We develop a computing method to determine the impact of the substitution of imports by domestically produced goods. If we introduce the hypothesis of import substitution results are different. The evidence suggests that UK could tolerate the Brexit with moderate losses only in some sectors.

15:42-15:54

Giada Bruni (Economics, University of Macerata, Italy) : Using a Robust CVaR Optimization Selection Model to assess the fair risk-return level of a Fund

In this paper we use a robust, in the sense of Robust Optimization, bi-criteria Portfolio Selection Model based on the use of the CVaR as risk measure to verify (evaluate) if the performance of a Fund traded on the market is actually linked with the fair (declared) associated risk level. Indeed, stating the same risk level, if it is possible to obtain best results in returns terms by selecting the same Fund's assets alternatively, then the team managers have to reconsider their selection models almost eventually choosing a more efficient one. We start showing that theoretically the robust CVaR approach is preferable compared with the others because at the same time it is able to take account of investors' asymmetric preferences in profit and losses together with the goal of having solution less depending on the parameter uncertainty. The implementation of this selection model on the prices of the assets that compose the considered Fund clearly seems to indicate that its performance during the time is not actually related to the fair risk (level). We think that the results obtained by our approach could have very interesting applications in the field of the asset management industry.

15:54-16:06

Janina Engel (Economics, European Commission - Joint Research Centre, Italy) A block-structured model for the reconstructing of financial networks of multiple countries

The global financial crisis of 2007-2008, highlighted the need for a more detailed understanding of our financial markets and an accurate assessment of systemic risk. Since then, many well-defined contagion mechanisms and systemic risk measures have been proposed. In order to explore the full scope of these models and allowing reliable conclusions on the stability of actual financial networks, realistic network reconstruction methods are needed. This however, remains a challenging task, because of the very limited data availability. To fill this gap, we developed a block-structured model for the reconstruction of financial networks spanning multiple countries in a directed and weighted network. In a first step, link-probability matrices are derived via a fitness model that is calibrated to reproduce a desired

density and reciprocity for each block (i.e. country and cross-border sub-matrix). The resulting probability matrix allows fast simulation throughindependent bivariate Bernoulli trials. In a second step, the sampled adjacency matrices are weighted through an exponential random graph model (ERGM) which is conditioned on the row, column and block weights. This model is analytically tractable, calibrated only on scarce publicly available data and closely reconstructs known network characteristics of financial markets. This is demonstrated by reconstructing the European interbank market. In addition, an algorithm for the parameter estimation of the ERGM is presented. Our network reconstruction model, enables the application of the proposed contagion mechanisms and systemic risk measures to more realistic and transnational financial networks. We expect the outcomes to shed new light and new understanding on systemic risk and its monitoring. Furthermore, this analysis can also pave the way for further improvement on contagion models and systemic risk measures, as well as support the aim of policy-makers to stabilize financial markets.

16:06-16:18

**Giacomo Tizzanini** (Economics, Financial Markets and Intermediaries, Prometeia SpA, Italy) : GDP-Network CoVaR: a tool for assessing Growth-at-Risk

We propose a tool to predict risks to economic growth and international business cycles spillovers: the GDP-Network CoVaR. Our methodology to assess Growth-at-Risk is composed by two building blocks. First, we apply the network-based NETS methodology by Barigozzi and Brownlees to identify significant linkages between neighbour countries. Second, applying the CoVaR methodology by Adrian and Brunnermeier, and exploiting international statistics on trade flows and GDPs, we derive the entire distribution of Economic Growth Spillover exposures at the bilateral, country and global level for different quantiles of tail events on economic growth. We find that Economic Growth Spillover probability distribution is

time-varying, left-skewed and in some cases bi- or even multi-modal. Second, as in the previous contributions, we find that spillover risks are more severe during financial turmoil. Third, Global exposure to economic growth tail events is decreasing over time. Finally, we prove that our two-step approach outperforms alternative one-step quantile regression models in predicting risks to economic growth.

17:00-17:12

**Roberto Jannelli** (Risk Management, University of Sannio, Italy) : Integrated approach to Risk Management for Enterprises

17:12-17:24

**Matteo Foglia** (Economics, University of Pescara, Italy) : Tail Risk Spillover in CDS bank markets

In the last decade, the concept of systemic risk is back in the limelight. In fact, the crisis has shown the fast propensity of a shock for financial institution-specific risk to spill over to other. These dependencies in extreme (event, crisis) risks are more relevant and implying an attention to connections between, time-varying tails risks. This article aims to analyse this tail dependence between Eurozone banks credit default swap (CDS). The idea is to study the intra-banks contagions and its spillover. We refer to contagion as the spread of CDS changes from one crashing economy to others. To measure bank tail risk, we use a powerful tool, such as extreme value theory (EVT), used to measure the related to the unconditional distribution of extreme CDS ?return?. We compute the dynamic tail shape a là Zhang and Schwaab (2016), by the score of the predictive log-likelihood - Generalized Autoregressive Score model (GAS) model (see Creal et al (2013)). Estimated the banks tail risk, we want to explore the tail-spillover effect building the Spillover Index from Diebold and Yilmaz (2009; 2012) which measures the co-movement in tail risk across banks. More in deep, we proceed in our network analysis by constructing connectedness measures for idiosyncratic CDS tail components using the vector auto-

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regression (VAR) approach, in order to examine the measures of aggregate and banks-specific network connectedness to provide supervisory insights on the current state of the financial risk of the banking system. In fact, the banking network links are determinant factors when measuring systemic risk (see Glasserman and Young, 2016). Our results confirm that defining spillovers based on proximity between core and no core banks' countries is a key issue to have a complete picture of the transmission mechanism in a union characterized by a high level of heterogeneity (Draghi, 2014). Through our findings, we can study, how a credit event in one bank spreads a credit event in another and which banks/countries are more exposed to credit events than others. This suggests that the risk of default of in one Eurozone banks can depend on perceived developments in other countries (banks).

17:24-17:36

Maria Incoronata Fredella (Environmental Risk, EMSO ERIC, Italy) : Risk Management Systems to underpin enterprise performance. Innovative methodologies in management of European Research Infrastructures (RIs). Case study on the EMSO ERIC

The implications for combining three essential management elements (Risk Management System, Internal Control Process and Management Accounting) to strengthen the process of achieving strategic objectives in the management of a Research Infrastructure are discussed in this paper. Background. The Organization for Economic Co-operation and Development (OECD) describes Research Infrastructures (RIs) as "long-term enterprises", so RIs need to identify policies and procedures to increase their effectiveness and sustainability. To date, recent studies made by leading players (OECD GSF, ESFRI, etc.) confirm that the above-mentioned objectives are the main challenges facing RI administration, its funders and their host, participants and their stakeholders. This is because RIs represent long-term strategic investments needed to facilitate and promote research in different scientific domains and often have greater socio-economic impact. In a large Distributed Research Infrastructure, such as EMSO ERIC, the achievement of relevant socio-economic objectives is considered as strategic 'enterprise' objectives. For this reason, we focused a notable effort towards its achievement. As EMSO ERIC is characterized by a multifaceted and multiparametric nature, the integration of distinct but complementary functions is crucial to design and operate sustainable control activities throughout its life cycle, as well to define best practices to improve sustainability and efficiency. Methodology and results. In our case, an operative risk is considered and it is totally linked to the hazard of missing the goal. So, defining risk means establishing at the beginning the event 'causative of the loss ' and then the probability of that event. As the risk is also multifaceted in nature, the contribution of the multicriteria approach, based on methods as Analytical Hierarchy Process (AHP) or AHP sort, to the risk analysis is necessary. We can identify the 'loss-causing' events related to the activities to achieve a relevant socioeconomic impact. This study is also focused to analyze the difficulty of controlling caused by a great numbers of performance indicators connected to the socioeconomic impact. In this way, we are merging the functions of Risk Management with the Internal Control Process and Management control system, so we can monitor the task performances through the evaluation and risk assessment, intervening, if necessary, with risk mitigation actions, increasing the probability of success. It is important to consider that to evaluate the socio-economic impact of EMSO ERIC we have adopted the tool that assesses the achievement of relevant socio-economic objectives provided by OECD GSF in the "Expert group meeting on reference framework for assessing the socio-economic impact on RIs" in March 2018. This standard indicators list is related to the common strategic objectives reported for the European RIs. Conclusion. It is fundamental to point out that RIs are marked by their own performances that must be evaluated in a specific method and a different method according to the classic enterprise but also different in each RI.

The methodologies we are proposing help RIs in achieving the main objectives and sustain and improve performance, by embracing different elements in the management process. Additionally, it takes care of spatial (comparison of common strategic objectives among different Research Infrastructures - by picking the tool provided by OECD) and temporal (internal control and monitoring) elements, but also of the peculiarity of our RI, in the risk assessment. Citations and references. Cited from the OECD Global Science Forum reports (2008-2010) "Research infrastructures are long-term enterprises. They are increasingly diverse in nature, may operate under very different models of governance and financing, and within diverse and evolving financial and political contexts. They represent strategic investments which are indispensable for enabling and developing research in all scientific domains and also often have broader socio-economic impacts"

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17:36-17:48

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**Paolo Emilio Mistrulli** (Economics, Bank of Italy, Italy) : Multiple lending, credit lines and financial contagion

Multiple lending has been widely investigated from both an empirical and a theoretical perspective. Nevertheless, the implications of multiple lending for the stability of the banking system still need to be understood. By lending to a common set of borrowers, banks are interconnected and then exposed to financial contagion phenomena, even if not directly. In this paper, we investigate a specific type of externality that originates from those borrowers that obtain liquidity from more than one bank. In this case, contagion may occur if a bank hit by a liquidity shock calls in some loans and borrowers then pay them back by drawing money from other banks. We show that, under certain circumstances that make other sources of liquidity unavailable or too costly, multiple lending might be responsible for a large liquidity shortage.

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October, the 12th

10:00-10:30

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**Keynote: Andrzej Nowak**, (Psychology, University of Warsaw, Poland) : Non-linear patterns in social and economic transition

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10:30-10:42

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**Gerarda Fattoruso** (Mathematics, University of Sannio, Italy) : Electre Methods for analyzing the behaviour of economic agents

The systemic risk represents the risk of a profound mutation of the structure of an economic and / or financial system that occurs, through a chain reaction, after the manifestation of a triggering event (De Bandt and Hartmann, 2000; Hunter and Marshall, 1999). The dynamics of company crises, particularly the pathological company crisis. By translating the concept of systemic risk to company dynamics, it is possible to approach it to the dynamics affecting the company crisis. In the economic-business sciences, it is possible to identify the risk of the business crisis through predictive models, such as the Z-Score (Altman, 1968, 1977, 2000), defined using a multivariate approach based on the consideration and the analysis of several factors deemed significant in determining the health of a company. The objective of the paper is to create a function that has a predictive character in the definition of the company crisis. This function will be defined starting from the identification, the mapping and the coverage of the risk. In particular, during the mapping and risk coverage phase, MCDM will be used to identify the impact of risk on company dynamics.

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10:42-10:54

Gaetano Vitale (Mathematics, University of Salerno, Italy) : Social Preferences through Riesz Spaces

We propose Riesz spaces as general framework in the context of pairwise comparison matrices, to deal with definable properties, real situations and aggregation of preferences. Some significant examples are presented to describe how properties of Riesz spaces can be used to express preferences. Riesz spaces allow us to combine the advantages of many approaches. We also provide a characterization of collective choice rules which satisfy some classical criteria in social choice theory and an abstract approach to social welfare functions.

10:54-11:06

Alessio Emanuele Biondo (Economics, University of Catania, Italy) : Reputation vs Information in imitation-driven financial markets

This paper presents an agent-based model of the financial market, in which a truly operative order book, managed by a market maker, drives the matching of orders submitted by heterogeneous traders. Such a transactions-driven framework is augmented by an opinion dynamics model simulating the consequences of reputational effects among investors. Imitation among traders is designed as the behavioral attitude of modifying own individual decisions when signals form other market participants are trusted more than the personal attitude in action. Traders have been designed as nodes of a directed endogenously-dynamic network, in which the edges represent, at each time step, the imitation. In the community, some members can reach a certain level of success, thus playing the role of influencer for the market. The credibility of influencers is assessed by each trader according to different criteria - wealth, luck/expertise, number of followers-thus inducing different individual preferential attachment rules. Imitation will occur with a probability directly proportional to the score reported by the chosen criterion. As described, links among agents matter in two respects: opinion dynamics and transactions. Therefore, it can correctly be said that the presented community is a multiplex, since the nodes are identically correspondent between the two layers, representing ? each ? the same trader on both. Three topologies will be tested for the opinion dynamics, i.e., random graph, small-world, and scale-free. The layer for transactions is a star network, where each trader may exchange with others through the order-book managed by the market maker, which operates as the central hub. The model is preliminary tested to show its compliance with the most relevant stylized facts of financial markets. Then, the model is used to asses the efficacy of specific policies, aimed to reduce market volatility, specially against the emergent herding caused by imitation.

11:06-11:18

Alessia Donato (Economics, University of Messina, Italy) : Risk Management of Global Food Production Scarcity: a Coopetititve Game Approach

In this paper, we face the problem of global food production scarcity and feeding sustainability, caused by environmental issues and climate change. Specifically, our risk management approach considers food producers and sellers of vegan and non-vegan food. We propose possible economic agreements among complementary food producers, in order to develop a sustainable food production for human population sustainability - characterized by low impact on the planet - by using coopetition and game theory together. Our game coopetitive approach proposes an easier entry in global market of vegan food producers, obtaining a more sustainable food production (less pollution, less greenhouse emissions. etc.). Meanwhile, the model could allow big producers/sellers of non-vegan food a smooth rapid transaction to more sustainable production/supply. In particular, we propose an exemplary complex agreement among global food sellers and small (but strongly sustainable and innovative) vegan food producers. We show how to adopt normal-form games in coopetition studies, in order to address climate change catastrophic risk and hunger in the world, by reducing the risk of

global food production scarcity and shocks. The results of the mathematical study suggest win-win solutions for global economy and world environment, while improving human population sustainability and climate change effects.

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12:00-12:12

Hugh Cameron (Economics, University of Manchester, UK) : An Alternative Sailing Ship Effect

The 'Sailing Ship Effect' is well known in innovation theory, describing improvement in performance of an apparently mature technology as a general response to the assault by a new technology. Many authors (e.g. De Liso & Filatrella, 2008) cite Gilfillan (1935) as the source of this concept. However, Gilfillan also pointed out a conceptually distinct possibility, that the incumbent technology could incorporate the new technology and thereby improve mature product performance and competitiveness, prolonging its life and even defeating the assault. The improvement in performance of market incumbents is responsible for many (perhaps most) of the market failures of new products. This paper will present a theoretical framework to explain this important concept including design and engineering choices, and will illustrate this with a remarkable case study that has been neglected in technological and business literature. The 'progress ideology' (e.g. Schatzberg, 1994) of the past half century has assumed that digital technologies will always displace analogue technologies. The case of repeated failure by technologically excellent digital products in the field of mass market physical recordable sound formats will be described, and the persistence of the old incumbent analogue audio cassette explained, using the new concept.

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12:12-12:24

Nicola De Liso (Law, University of Salento [Lecce], Italy) : On the "unexpected" survival of old technologies

Old and new technologies providing similar products and services sometimes coexist for a longer-than-expected time. In this paper we provide a review of the forces which are at work, which tend to prolong the life of incumbent technologies beyond « reasonable » limits. A non-exhaustive list of these forces is: learning-by-doing à la Smith, learning-by-doing à la Arrow, learning-by-using à la Rosenberg, stretching à la Coe-Aylen, formal R&D, old-technology's reliability, sunk costs, systemic characteristics of the technology, presence of tributary technologies, institutional rigidities, management and labour resistance to technical change, consumers' preferences. Some of these forces may act jointly, while some may be technology-specific.

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12:24-12:36

Giovanni Filatrella (Physics, University of Sannio, Italy) : Systemic technologies and slackened technological progress: the sailing-ship effect

The role of technology in our societies can hardly be overestimated, and the way in which technological progress takes place is a fundamental issue. Sometimes we face a situation in which a new technology, capable of superseding an existing one, is developed, and the incumbent technology fights back improving its performance ? the latter process is the so-called sailing-ship effect. The more a technology is widely used, the more investment decisions on whether to fully develop and adopt a new one is risky, one fundamental reason being the sailing-ship effect which may significantly delay the returns on the investment in the new technology. In this presentation we build on our previous works and further develop a mathematical model capable of explaining the development path of the old and the new technology according to the resources devoted to their improvement, learning-by-doing and stochastic effects. Put it in another way, we study the race between two technologies, and the conditions which affect the timing of the

overtaking of the new over the old technology. The sailing-ship effect, though, may be so powerful so that overtaking is impossible. We will show two cases of technological competition. In the first case, despite the occurrence of the sailing-ship effect, the new technology displaces the old one. In the second case, the sailing-ship effect is so strong that the incumbent technology actually inhibits the new one from prevailing. Without pretence to historical accuracy, the first could be the case of steam-ships vs. sail-ships, while the second could be that of semi-conductors vs. super-conductors in the computer industry.

12:36-12:48

Sandro Mendonça (Economics, ANACOM, Portugal) : Sunset industry in search of a sunrise: The postal sector decline and tentative letter-package switch-over

Post is an ancient for of communication. As a sector it only took off after the mid-19th century after institutional reform (uniform price, payment by sender) and technological change in the transport systems (railways, steamships). It nonetheless suffered challenges with the telegraph and the telephone in the 20th century. Even if it benifitted from the First and Second Inudistrial Revolutions, the Third one seems to be killing it. This article explores the story of the postal sector, as it undergoes a mix of structural transformations: the pro-market wave of institutional modernisation (liberalisation, privatisation) and information revolution (digitisation). It assesses the prospects of a rebound effect through its capitalisation on logistics cabalities in the era of e-commerce in the 21st century(a sailing ship effect?). Some comments are produced concerning the role of regulatory intervention.

15:00-15:30

Keynote: Alessio Ishizaka (Decision Analysis, University of Portsmouth, UK) : Classification of London boroughs according to their safety levels with Analytic Hierarchy Process-Fuzzy Sorting

Multi-Criteria Decision Analysis (MCDA) is the field that facilitates decision-making among different alternatives evaluated for several conflicting criteria. MCDA has been mainly applied to ranking and choice problems. Recently, the Analytic Hierarchy Process (AHP) method has been extended to sorting problems with AHPSort, by using crisp class-assignment to alternatives. This, however, sometimes implies the necessity of a fine-tuning process due to the lack of flexibility inherent in this approach. This presentation aims at making the class assignment process in AHPSort more flexible by using fuzzy sets theory, which facilitates soft transitions between classes and provides additional information about the membership of alternatives in each class that can be used to fine tune actions beyond the sorting process. Finally, the applicability of the proposed approach is exhibited in a case study that regards the classification of London boroughs according to their safety levels based on crime related criteria.

15:30-15:42

Gabriella Duca (Engineering, Insitute for Sustainable Society and Innovation (ISSNOVA), Italy) : Human behaviour modelling for the improvement of Air Traffic Management performances

Air Traffic Management (ATM) is a complex socio-technical system, whose behaviour depends on a combination of various subsystems of different nature: societal, technical, and human; it is difficult to understand which could be the part to be changed in order to improve performances, or which is the impact of a change on the overall performances. This paper focuses on how human behaviours in ATM can be analysed and modelled in order to deliver an innovative process to perform the change management by combining the agent-based paradigms with evolutionary computing and sensitivity

analysis. The human behaviour works as an elective adaptive system, by which we reply to needs, keep our balance, live in our environment. The chosen approach for the proposes work combines the human activity theory addressed by Leont'ev [1], the Hierarchical Task Analysis (HTA) [2] and the recent studies on the complexity in work environment [3]. Moreover, quantified variables on behavioral, cognitive (Visual search, Trust, Problem solving, Decision making, Judgement on take actions, Prioritization Situation awareness) and socio-cultural aspects (Group behavior, verbal coordination, Shared situation awareness, Negotiation) are provided [4]. The complexity aspects such as Distributed systems, Hazardous system, Automation, etc. are under consideration too. This work has received funding from the SESAR Joint Undertaking with grant agreement No 783189 (EVOAtm project) under European Union's Horizon 2020 research and innovation programme. [1] Leont'ev, A.N. 1978. Activity, Consciousness, and Personality. Prentice-Hall [2] Eurocontrol 1998. Integrated Task and Job Analysis of Air Traffic Controllers, Phase 1. Development of Methods [3] [Stroeve, S., Bosse, T., Blom, H.A.P., Sharpanskykh, A., Everdij, M., Agent-Based Modelling for Analysis of Resilience on ATM. Proceedings of the SESAR Innovation Days, 2013 [4] Hilburn, B. Cognitive Complexity. In: Air Traffic Control: A Literature Review. CHPR, 2004

15:42-15:54

Lamba Harbir (Mathematics, George Mason University, USA) : Analytic Solutions for Cascading Processes on Networks of Prandtl-Ishlinskii Nodes

Prandtl-Ishlinskii (PI) operators are a class of rate-independent operators with perhaps the two best-known being the play and stop operators. Each PI operator is defined by a monotonic Primary Response (PR) function which is just its response to a monotonically increasing input. PI operators have a remarkable composition property [1,2], namely that even when connected on an arbitrary network (under mild technical conditions) the aggregate network response is itself a PI operator, albeit with a more complicated PR function. Once the PR function of the network is identified, either analytically or empirically, the response of the system to arbitrary continuous inputs is completely determined. Discontinuities in this PR function correspond to the possibility of, say, cascading failures within the network and so the form of the PR function is key to understanding the robustness of the network as a whole. As an example, in [1] it was shown that basic momentum trading strategies in a financial market correspond to particular PI operators. Thus a network of momentum traders, all influenced by both the asset price and their neighbours' states, fits into the above framework. Analysis of the aggregate PR function then proved that significant crashes, due to the positive feedbacks between momentum traders, are inevitable once the total influence of momentum traders on the market as a whole exceeds some critical value. More generally, PI operators are well-suited to capturing threshold effects and sudden changes in the actions or states of individual nodes on a network. And so we conclude by discussing other applications of PI networks and the reduction in computational complexity that results from the composition property. [1] P. Krej?í, H. Lamba, S. Melnik and D. Rachinskii, "Analytical solution of a class of network dynamics with mechanical and financial applications", Phys Rev E 90, 032822 (2014). [2] P. Krej?í, H. Lamba, G. Antunes Monteiro and D. Rachinskii, Kurzweil integral in financial market modeling", Mathematica Bohemica 141,pp 261-286 (2016).

16 :48-17 :00

Enrico Ciavolino (Psycometrics, University of Salento), Mario Angelelli, (Physics, University of Salento) : Sequential Entropy for Streaming data

Maximum entropy approaches have proved useful in several situations where new information has to be included in a given model. Generalized Cross Entropy (GCE) has been applied to regression models to provide accurate estimations of the parameters, even

in the presence of multicollinearity, thus overcoming difficulties of ill-posed problems. We propose a method based on generalized cross entropy for cases in which the information flows as a stream of data. Starting from a first estimation obtained from a batch of initial data, at each step the parameters of the model are estimated on the basis of the prior knowledge and the new observation, or a block of observations. This allows to extend the maximum entropy technique to a dynamical setting, distinguishing between entropic contributions of the signal and the error. Furthermore, it gives a suitable approximation of standard GME problems when exact solutions are hard to evaluate. We test this method performing numerical simulations at different sizes of the sample and dimension of the batch. Moreover, we explore intermediate cases between streaming-GCE and standard-GCE, namely, when the update of estimations involves blocks of observations of different sizes. We include dynamical weights between the entropies relative to parameters and errors and collinearity effects. Finally, we discuss the results to highlight the main characteristics of this method, the range of application, and future perspectives.

## 17:00-17:12

**Claudiu Herteliu** (Statistics, Bucharest University of Economic Studies, Romania) : Day of the Week Effect among Peer Reviewed Journals

It is widely acknowledged that there is a lack of direct connection between number of days in a week and any natural characteristics. Even so, there are enough evidences that sometimes a specific day of the week, when an event is recorded, counts. Following a very recent finding, the present paper confirms the occurrence of a positive Tuesday-Wednesday effect and a negative Week-End effect in papers which have been published within several top peer reviewed journals. The papers' sample on which this paper rely is wide (more than 170 000) while journals being investigated (Nature, Cell, PLOS ONE, Physica A) are broadly recognized to maintain an accurate and detailed history of their papers.

## 17:12-17:24

**Violetta Simonacci** (Engineering, University of Naples "L'Orientale", Italy) : Improving PARAFAC-ALS performance by initialization

The CANDECOMP/PARAFAC (CP) model (Carroll and Chang, 1970; Harshman, 1970) is a trilinear decomposition which provides a low rank approximation of a three-way array in a manner that preserves the multi-mode structure of the data. This is achieved by estimating three sets of parameters, one for each dimension of the array, namely observation units, variables and occasions. The CP model, however, due to an elevated number of degrees of freedom, can be quite challenging to estimate. The most commonly used algorithm to fit this model to the data is PARAFAC-ALS. Comparative studies (Tomasi and Bro, 2006) have shown that this procedure is, in general, more reliable and accurate than other algorithms proposed in the literature. Nonetheless, it presents some non-trivial issues: it can be slow at converging and may run into over-factoring and bad initialization degeneracies. With respect to these setbacks, some of the alternative estimating procedures are able to perform better than ALS, specifically the Alternating Trilinear Decomposition (ATLD) and Self-weighted Alternating Trilin-ear Decomposition (SWATLD) proposed by Wu et al. (1998) and Chen et al. (2000) respectively. These algorithms are faster and less likely to be affected by over-factoring and bad initial values. They present, however, difficulties connected to their non-least squares objective functions and for this reason they are seldom used in practice. In this work it is suggested that a successful way to improve on ALS performance with respect to the presented drawbacks is to initialize it with either ATLD or SWATLD steps, obtaining two integrated ALS procedures. The effectiveness of this methodology is demonstrated by comparing the results of standard ALS with the ones of the proposed integrated ALS variants in an extensive simulation design.

## 17:24-17:36

T. Sripriya (Statistics, University of Madras, India) : Detection of Outliers in Categorical Data using Model Based Diagnostics

Detection of outliers is an important and interesting problem in data analysis. However, detecting outliers in categorical data poses additional diculties due to polarization of cell counts. The structure and nature of cell counts in a contingency table play an important role in the data analysis with the cell counts ranging from zero to very high frequencies. Thus the nature and location of frequency in cells could create polarization posing an additional challenge in the detection of outliers. The present study considers model based approach to detect outliers in an I x J contingency table. The procedure deals with tting a Poisson Log-Linear Model for the count data and examine different types of residuals supplemented by boxplot in identifying the outlying cells. The robustness of the model is investigated through a simulation study along with applications to real datasets.

17:36-17:48

Fabrizio Maturo (Mathematics, University of Chieti-Pescara, Italy) : Measuring impatience, inconsistency, and magnitude effect with functional data analysis

This manuscript aims to measure the impulsivity shown in intertemporal choice by using the functional data analysis approach with implications on inconsistency and the possible existence of magnitude effect. Traditionally, the level of impatience exhibited in intertemporal choices has been assessed by means of the k-parameter (discount rate) of a hyperbolic discount function: $SIR=(LDR)/(1+kd)$, $k>0$, where SIR is the smaller, immediate reward, LDR is the larger, delayed reward, and d is the delay associated with LDR. Our objective is to derive a new family of discount functions able to more accurately fit the obtained choices. For this purpose, we have used the 27-item monetary choice questionnaire developed by Kirby et al. (1999). There are three levels of reward size: small (from \$25 to \$35), medium (from \$50 to \$60), and large (from \$75 to \$85). It is thereby possible to calculate for each participant a

separate k value for small, medium, and large delayed rewards. Therefore, the magnitude effect, which implies higher discount rates for smaller than for larger amounts, can be assessed.

17:48-18:00

Michele Gallo (Statistics, University of Naples L'Orientale, Italy) : A robustification of the Parafac model for high dimensional outliers

Three-way data pertain to measurements organised in three entities (modes) in which repeated observations are collected for the same variables on several occasions (conditions, times, locations). For the exploratory analysis of three-way data set, the Parafac model, independently proposed by Carroll and Chang (1970) and Harshman (1970), is particularly suitable. The model defines a best low rank approximation of the original data through the alternating least squares algorithm (ALS), obtaining interpretable results, the uniqueness of the solution under mild conditions and keeping separate the variability of each mode. The widespread of the interest in the three-mode techniques results in a further evolution of three-way algorithms aimed at stemming problems occurring when outliers arise in data. In fact, the ALS estimation procedure is extremely sensitive to anomalous observations, in the sense that the influence of deviating points could articially increase the variance or shift the mean distorting the analysis and reproducing flaw results. High dimensionality indeed increases the possibility to run into atypical observations due to the huge amount of data to process. In order to keep the complex structure of data while preserving the information content, a robustication of the Parafac model is here proposed using a fast robust algorithm defined as COMedian-Parafac. The procedure, taking advantage of some interesting studies of Falk (1997) on the Co-median estimator properties, it is simple in its robustification process, able to identify extreme points after few iterations, full informative in parameters estimation, robust when the fraction of outliers increases and incredibly fast in high dimensional data. The

algorithm proposed is compared, in a simulation study, to the well known Parafac via ROBPCA algorithm (ROB-Parafac) (Engelen et al., 2009; Engelen and Hubert, 2011), demonstrating less affected and incredibly accurate estimates. It is also applied to different real case studies.

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## POSTER SESSIONS

Luigi Di Sarno (Engineering, University of Sannio, Italy) : Commonly Used Intensity Measures for the Structural Assessment of Gas Pipelines Subjected to Seismic Ground Shaking

Natural gas pipelines constitute a critical means of energy transportation, playing a crucial role in the economic development of modern societies. Along these lines, a simple, yet efficient, structural assessment prior or after extreme natural hazards, such as severe earthquakes, is of great importance. However, the structural assessment of this type of lifelines, against severe seismic ground shaking, is not a straightforward task. The typology of the pipeline (e.g. material, diameter, thickness) and the existence and the quality of connections (e.g. between the pipeline parts or between the pipeline and other structural elements, such as metering or regulating stations), as well as the significant differences on the geotechnical conditions and the seismic hazard along its length, are among the parameters that affect the seismic behavior and hence the seismic vulnerability of gas pipelines. In practice, the seismic vulnerability assessment of gas pipelines is performed, by implementing fragility functions, derived mainly from empirical post-earthquake observations. The existing fragility functions consider a variety of seismic Intensity Measures (IM) for the description of the seismic hazard, which range from simple ones, such as the Modified Mercalli Intesity (MMI) that can be derived from Macro-seismic intensity maps, and the Peak Ground Acceleration (PGA), or the Peak Ground Velocity (PGV), which can be obtained from recorded data (in cases of instrumented sites) or from Ground Motion Prediction Equations

(GMPEs) and shakemaps, to more complex IM, such as the Peak Ground Strain (PGS), or a combination of IM, for example the PGV2/PGA. This paper summarizes a thorough literature review on the seismic IM commonly used in the seismic vulnerability of gas pipelines. The efficiency of the various IM to be estimated or measured in the field, describe critical characteristics of the seismic hazard, and more importantly to correlate with structural damages on gas pipelines, is highlighted and discussed. The correlation between the IM and structural damages is examined on the basis of examples of damaged pipelines during past severe earthquakes (e.g. San Fernando, 1971, Northridge, 1994, Chi-Chi, 1999, Tohuku, 2011).

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Luigi Di Sarno (Engineering, University of Sannio, Italy) : Seismic Fragility Analysis of Gas Pipelines

The assessment of seismic safety of gas pipelines is of utmost importance for modern resilient communities. Earthquake risk evaluation should consider emergency conditions with particularly risky consequences on human life, class of living, financial and cultural activities. Adequate mitigation remedies should be adopted, where appropriate, for the reduction of the earthquake losses. Detailed seismic hazard evaluation of gas pipelines requires the formulation of reliable fragility analysis. Fragility curves express the probability of attaining a certain damage state when the element at risk, e.g. the pipe component and/or pipe network, is subjected to a strong motion demand. The derivation of fragility curves is linked with the parameters of strong-motion shaking or permanent ground deformations, especially when trans-fault passing of pipes are considered. The earthquake impact on pipelines may result in releases of risky materials and major accidents leading to injuries and losses to people in the nearby area. Most major oil and gas pipelines usually run underground: though they are less exposed to the inertial forces than the

above?ground pipelines, the seismic response of pipelines is dominated by soil deformations; as a result vulnerability assessment strongly depends on the ground-pipeline interaction. The present paper intends to provide a literature review of earthquake severity measures utilized for performing fragility analysis of gas pipelines. A thorough assessment of the existing methods employed to derive seismic fragility curves is also provided. A detailed review of existing analytical and empirical models is presented and possible future research needs are emphasized.

Armando Simonelli (Engineering, University of Sannio, Italy) : Seismic Response in Near-Fault Conditions. Impacts on the Seismic Risk Assessment for Urban areas along the Appennine

In the last years several earthquakes hit Central Italy regions, heavily damaging towns and villages located very close to the fault surfaces (e.g. Lioni, Teora, Caposele, Conza della Campania in 1980, San Giuliano di Puglia in 2002, L'Aquila in 2009, Amatrice, Accumoli and Norcia in 2016). Unfortunately this is a typical condition for the Appenninic region, where many historical centres lay on or very close to active fault patterns. Hence it is very important to study the local seismic response of sites in the so-called near-fault condition, where actual seismic actions are very different from those traditionally accomplished in national seismic design code. From the analysis of seismic data, it is clear that: - near-fault seismic motions are characterised by significant values of vertical accelerations, sometimes even higher than the horizontal ones; - vertical and horizontal motions are characterised by the same main frequency content; - the time delay between the start of the vertical and the horizontal motion is negligible (while it became noticeable as the distance from the fault increases). A recent research is focusing on subsoil response in near fault condition, and preliminary analyses have been performed on the simultaneous propagation of vertical and horizontal seismic waves for different subsoil conditions. In this paper, some interesting results of these analyses will be illustrated, and typical features of surface seismic motion in near-fault area will be discussed.

Augusto Penna (Engineering, University of Sannio, Italy) : Seismic risk assessment of the L'Aquila gas network

Natural gas pipelines constitute a critical means of energy transportation, playing a crucial role in the economic development of modern societies. The paper analyses the effects of the 6th April 2009 L'Aquila earthquake, in Italy, on the local gas network, by applying a simplified multi hazard loss estimation methodology, following the layout of HAZUS project (FEMA, 2003). Key factors of the methodology are the inventory, the typology and the specific characteristics of the pipelines that help to define the fragility functions for the elements composing the network, as well as the seismic scenarios (seismic hazard) and the geological and the geotechnical characterization that allow to define the susceptibility of the area to landslide and liquefaction that, together with ground shaking, cause major damage on pipelines network. All the available data related to the local gas network and to the geological and geotechnical characterization of the L'Aquila basin have been collected in a GIS environment. Seismic hazard has been evaluated taking into account for both transient ground deformation caused by the seismic waves propagation (ground shaking) and permanent ground deformation (PGD) related to landslides. The loss estimation has been evaluated in terms of repairs per unit length of pipe associated to the seismic demand expressed in terms of peak ground velocity, PGV and permanent ground deformation, PGD, relevant to the 6th April 2009 earthquake event. The produced hazard scenario has been finally used to compare the data of the damage inventory collected in a narrow area by the organization managing the gas distribution network in L'Aquila, with the fragility curves adopted to predict the damage scenario.

**Carlos Javier** (Engineering, Univesidad Autonoma de Santo Domingo (UASD), Dominican Republic) : <u>Seismic risk in the Dominican Republic: Seismic hazard, local effects and vulnerability of structures</u>

The Hispaniola Island is located on the northern edge of the Caribbean plate, which interacts with the plate of North America, originating a system capable of generating large magnitude earthquakes. These earthquakes caused significant damage to the entire infrastructure of the island. As an example for the earthquake that occurred on December 2, 1562, an intensity degree of IX was estimated, according to MCS scale. This earthquake destroyed the city of La Vega Real, located about 120km from Santo Domingo, where several severe liquefaction phenomena occurred, forcing the colonial government to move it to another place. In addition cortical faults in the interior of the island, among which is the so-called Septentrional (SFZ), have accumulated energy for approximately 800 years, according to measurements made by Mann et al., 1988. In this paper the results of several recent hazard studies, e.g. by SODOSISMA (Sociedad Dominicana de Ingegeneria Sismica), Frankel et al. and Javier are briefly illustrated. Hence the typical constructive typologies of buildings, generally located in areas with different soil and topographic conditions, are presented too. A probabilistic procedure for estimating the expected damage and the probability of their collapse under earthquakes is proposed, with the aim of evaluating replacement costs of infrastructures.

**Ekaterina Seryakova** (Economics, Moscow state institute of international relations, Russia) : <u>Cross - border transmission of systemic risks of banking sectors of G7 and BRICS-countries</u>

The paper deals with cross-border transmission of systemic risks of banking sector. Database consists of 10 countries: G7 (USA, Germany, UK, Italy, France, Canada) and BRICS (except SAR). The analysis spreads over the period from 01.01.2006 till 01.01.2018 and is conducted on the quarterly basis. The research aims at defining countries- donors and countries-acceptors of systemic risk which also influences real economy sector. The research bases on : the characteristic of systemic risk to spread not only across the national banking sector, but also through other countries banking sectors and thus define probability of global systemic banking crises uprise; the fact that systemically important banks are the main source of uprise and spread of systemic risks of banking sector. EPS (Earnings per share) is used for the analysis as the indicator showing how much banks net profit less dividends on privileged shares falls on their one share. EPS is considered to be key indicator of investment potential on international level. National banking systems with high average EPS are expected to be financially sound and are less exposed to originate systemic risks. The research results in getting the matrix of connectedness. Its elements dij (i-j show, how much of i-indicator variance can be explained with variance of residuals of j-indicator, so the higher dij -s are, the more impact j has on i. The following is pointed out as the result of the conducted research: -countries which are net-acceptors of systemic banking risks are defined: Russia, China, Italy. Brazil. India. -countries net-donors of systemic banking risks are defined: USA,UK, Canada, Germany, France. USA, China, Brazil and Russia are less exposed to exogenous shocks, which is due to uprise of systemic risks in their national banking sectors, but not to cross-border injection. References: 1. Does economic policy lead systemic risk? A Comparative Analysis of selected European countries, XIX Quantitative Finance Workshop 2018, University Roma Tre, January 2018. 2. Systemic risk of financial sector: assessment and regulation: monography/A. Karminsky, M.Stolbov, M. Shepeleva. M.: Nauchnaya biblioteka, 2017. - 284 p. 3. A. Leonidov Systemic Risks in Financial Markets, Global Markets and Financial Engineering, ? 2 (2015), 2-15 ?.?.

Jay Emmanuelle (Economics, University of Paris1, France) : Improving portfolios global performance using a cleaned and robust covariance matrix estimate

This paper presents how the most recent improvements made on covariance matrix estimation and model order selection can be applied to the portfolio optimisation problems, through examples on the global minimum variance and the maximum variety (or most diversified) portfolios (resp. GMVP and VarMax or MDP). The frequently used covariance estimator is the Sample Covariance Matrix (SCM), that is optimal under the Normal assumption. Financial time series of returns often exhibit abnormal returns implying the SCM to be mis-adapted for such a series. Robust estimation methods [1] are therefore useful to deal with such cases. Combined with regularization or shrinkage approaches when the size of observations is insufficient regarding the number of assets leads to robust hybrid methods [2]. Another way to mitigate covariance matrix estimation errors is to filter the noisy part of the data. Several empirical evidences militate in favour of the existence of multiple sources of risks challenging the CAPM single market factor assumption. Estimating the number of factors is a challenging problem and Random Matrix Theory (RMT) may help in finding a solution, even for filtering noise [3]. But the described cleaning method generally leads to estimate only a single market factor that is not completely satisfactory. We propose here to mix several approaches: the assets returns are modelled as a multi-factor model embedded in correlated elliptical and symmetric noise; we make use of the RMT results to identify the noisy part of the data [4]; then we derive a cleaned covariance matrix estimate. Preliminary results [5] were obtained for the VarMax portfolio, considering the assets universe as a whole. The present paper extends these latter results: the assets are grouped according to their returns distribution before being whitened, and the process is applied also for the GMPV. Considering homogeneous groups inside the universe leads to further improvements whatever is the allocation process.

Muja Aranit (Economics, AFSA, Albania), Extreme Value of Intraday Returns

Natural disasters have severe effects on human well-beings. Alongside tragic immediate consequences for local economies, disasters have been proven to exert negative influence on citizens' health and human capital accumulation also in the long run (Caruso and Miller, 2015). Recent contributions highlight that disasters might also affect life transition decisions such as those concerning marriage (Ahmed, 2018; Cohan and Cole, 2002). This paper aims to add to this literature by studying the trend of marriages in Italy before and after the major earthquakes observed over last 20 years. Differently from previous contributions (Prati and Pierantoni, 2014), our analysis covers the entire national territory and embraces more than one single earthquake event; furthermore, it is based on municipality-level data.

Maria Grazia Olivieri (Mathematics, University of Sannio, Italy) : An experimental approach for comparing inconsistency of multiplicative, additive and fuzzy approaches

Pairwise comparisons matrices (PCMs) have been long used in psychophysical research to judge and compare sensory intensities; this technique has also gained popularity in decision analysis. In the literature, different types of PCMs are considered, e.g. multiplicative, additive and fuzzy, and several techniques have also been proposed to derive the priorities from a PCM. Unfortunately, a priority makes sense only if the decision maker has a minimum level of coherence. It has never been studied for which type of PCM the decision makers are more coherent when they express their preferences; thus, this paper aims at filling this gap. In particular, we perform an experiment in order to measure the coherence of the participants when they express their subjective preferences by means of additive, multiplicative and fuzzy PCMs. Although multiplicative, additive and fuzzy PCMs share the same algebraic structure (i.e. Abelian linearly ordered group), the experiment shows that when expressing "preference ratios"(i.e.

multiplicative preferences) or "preference degrees"(i.e. fuzzy preferences), the participants are more coherent than when they express "preference differences"(i.e. additive preferences). This research shows that Behavioral Operations Research is an interesting field when human behavior needs to be examined and taken into consideration.

Gabriella Marcarelli (Mathematics, University of Sannio, Italy) : A group-AHP based approach for selecting the best public tender

The selection of the best tender is an important step during the public procurement process. According to European Union (Directives 2014/23/EU, 2014/24/EU, and 2014/25/EU) and Italian (Legislative Decree 50/2016, as amended and supplemented by Legislative Decree 56/2017) rules on public procurement, the Most Economic Advantageous Tender (MEAT) may be considered the standard criterion for tender selection. Decisions, provided by a group of experts, are complex because they require the evaluation of a number of tenders by taking several qualitative and quantitative criteria into account; furthermore, they must comply with the principles safeguarding transparency in the allocation of public resources, equal treatment and competiveness among bidders. The choice of analytical methods and scoring rules for evaluating public tenders assume a crucial importance due to the interconnections between the rules on public contracts and those aimed to tackle corruption. Public officers could favor a certain bidder by assigning a high weight to a criterion that only the bidder would meet fully; furthermore, some analytical methods and formulas, usually used to evaluate tender, pose the risk of collusive agreements between competitors. Many other risks are connected to the public tender process. In order to improve the process of selecting the best public tender, by preventing some of the above risks, this paper proposes a unified group-AHP based approach which synthesizes, by a unique priority vector, the evaluations corresponding to qualitative and quantitative criteria. This approach may reduce the risk of corruption, by decreasing the randomness and subjectivity and increasing the objectivity and the rationality in the procedures, ensuring transparency of public choice. By preventing the lobby from influencing the competition even through collusive agreements, a multicriteria method may ensure both the discretion of public authorities in the choice of bidders and a fair and transparent procedure that allows the public opinion to be able to control the goodness of decision processes and responsiveness to public interest. Finally, adequately estimated weights may reduce the possibility of abuse and fraud in the public procurement system.

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