Abstracts:

Invited

Oral

Poster SOCIO

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Arkadiusz Orłowski, SGGW

Author(s):
Arkadiusz Orłowski

Abstract title:
Applications of machine learning in complex systems

Abstract:

We Various methods and techniques of machine learning are presented and critically evaluated in the context of possible applications in complex systems. In particular, a class imbalanced classification learning problem is discussed. This is a well-known big issue in real-world applications as dealing with data exhibiting imbalanced class distribution is both very important and very hard task. Some of existing methods in this area are presented and applied to complex systems, including (a) extreme learning machine (ELM), being a competitive machine learning technique (b) weighted extreme learning machine (WELM) and (c) weighted support vector machine (WSVM). If time permits, also nontrivial applications of random forest (RF), being an ensemble supervised machine learning technique, will be given.

Dariusz Grech

Author(s):
Dariusz Grech

Abstract title:
Identification of the base currency in analysis of complexity on Forex market.

Abstract:

We search for various properties of Minimal Spanning Tree (MST) network constructed from FOREX market exchange rate data in the period 2009-2016. Different lag-time for returns are investigated from interday to intraday data. The economically based conditions related to network features which have to be satisfied by so called base currency are proposed. Finally, the hierarchy of leading world currencies is constructed which takes into account both the scale free propertes of the network as well as its stability. The economic interpretation of this result is proposed.

Fabrizio Lillo, Università di Bologna

Author(s):

Fabrizio Lillo, Università di Bologna

Abstract title:

Reconstruction of lead-lag (trading) networks via the Kinetic Ising Model

Abstract:

Using the test of Granger-causality in tail of Hong et al. (2009), we define and construct Granger-causality tail risk networks between 33 systemically important banks (G-SIBs) and 36 sovereign bonds worldwide. Our purpose is to exploit the structure of the Granger-causality tail risk networks to identify periods of distress in financial markets and possible channels of systemic risk propagation. Combining measures of connectedness of these networks with the ratings of the sovereign bonds, we propose a flight-to-quality indicator to identify periods of turbulence in the market. Our measure clearly peaks at the onset of the European sovereign debt crisis, signaling the instability of the financial system. Finally, we use the connectedness measures of the networks to forecast the quality of sovereign bonds. We find that connectedness is a significant predictor of the cross-section of bond quality.

Janusz Hołyst, Center of Excellence for Complex Systems Research, Faculty of Physics, Warsaw University of Technology, Koszykowa 75, 00-662 Warsaw, Poland

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Abstract title:

How to find spread source in complex networks?

Abstract:

Spread over complex networks is a ubiquitous process with increasingly wide applications. Locating spread sources is often important, e.g. _nding the patient one in epidemics, or source of rumor spreading in social network. Here we explore the problem of complexity of currently known methods as well as we investigate the validity of the assumption that information spreads only via the shortest paths.

Pinto, Thiran and Vetterli introduced an algorithm (PTVA) to solve the problem of source detection in which a limited set of nodes act as observers and report times at which the spread reached them. PTVA uses all observers to _nd a solution and assumes the information travels via a single, shortest path, which by assumption is the fastest way. Here we propose a new approach in which observers with low quality information (i.e. with large spread encounter times) are ignored and potential sources are selected based on the likelihood gradient from high quality observers. The original complexity of PTVA is O(N_), where _ 2 (3; 4) depends on the network topology and number of observers (N denotes the number of nodes in the network). Our Gradient Maximum Likelihood Algorithm (GMLA) reduces this complexity to O(N2 log(N)) without reduction of the detection accuracy.

We also show that assumption that information spreads only via the shortest paths leads to

the overestimation of propagation time for synthetic and real networks, where multiple shortest paths as well as longer paths between vertices exist. We propose a new method of source

estimation based on maximum likelihood principle, that takes into account existence multiple shortest paths. It shows up to 1:6 times higher accuracy in synthetic and real networks.

Acknowledgements

The work was partially supported as RENOIR Project by the European Union Horizon 2020 research and innovation programme under the Marie Sk lodowska-Curie grant agreement No 691152 and by Ministry of Science and Higher Education (Poland), grant Nos. W34/H2020/2016, 329025/PnH /2016. and National Science Centre, Poland Grant No. 2015/19/B/ST6/02612. J.A.H. was partially supported by the Russian Scienti_c Foundation, Agreement #17-71-30029 with co-_nancing of Bank Saint Petersburg. X.L. and B.K.S. were partially supported by

the Army Research Laboratory under Cooperative Agreement Number W911NF-09-2-0053 (the ARL Network Science CTA) and by the Army Research O_ce grant W911NF-16-1-0524. B.K.S was partially supported by the National Science Centre, Poland, project no. 2016/21/B/ST6/01463. This research was also supported in part by PLGrid Infrastructure.

Katarzyna Sznjad-Weron

Author(s):
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Abstract title:
Think then act or act then think?

Abstract:

There is a common belief, verbalized by Ralph Waldo Emerson in his Essays from 1841, that ``The ancestor of every action is a thought''. On the other hand, as noted by social psychologist David Myers: ``If social psychology has taught us anything during the last 25 years, it is that we are likely not only to think ourselves into a way of acting but also to act ourselves into a way of thinking.''. Indeed, it has been shown in many social experiments that attitudes are frequently poor predictors of behaviors, and it is often that behaviors determine attitudes. This startling conclusion inspired us to introduce a new agent-based model of opinion dynamics in which binary opinions of each agent can be measured and described regarding both pre- and post-influence at both of two levels, public and private, vis-à-vis the influence source. The model combines ideas introduced within the q-voter model with noise, proposed by physicists, with the descriptive, four-dimensional model of social response, formulated by social psychologists. We investigate two versions of the same model that differ only by the updating order: an opinion on the public level is updated before an opinion on the private level or vice versa. We show how the results on the macroscopic scale depend on this order. The main finding of this paper is that both models produce the same outcome if one looks only at such a macroscopic variable as the total number of the individuals with positive opinions. However, if also the level of internal harmony (viz., dissonance) is measured, then significant, qualitative differences are seen between these two versions of the model. All results were obtained simultaneously within Monte Carlo simulations and analytical calculations. We discuss the importance of our studies and findings from three points of view: the theory of phase transitions, agent-based modeling of social systems, and social psychology. Literature:

[1] A. Jędrzejewski, G. Marcjasz, P. R. Nail and K. Sznajd-Weron (2018) Think then act or act then think?, PLoS ONE 13(11): e0206166, https://doi.org/10.1371/journal.pone.0206166

[2] A. Jędrzejewski and K. Sznajd-Weron (2019) Statistical Physics Of Opinion Formation: Is it a SPOOF?, Comptes Rendus Physique, Special issue: From statistical physics to social sciences, https://doi.org/10.1016/j.crhy.2019.05.002

Krzysztof Kułakowski, AGH University of Science and Technology, Cracow

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Małgorzata J. Krawczyk , Maciej Wołoszyn , Piotr Gronek , Krzysztof Kułakowski, Janusz Mucha AGH University of Science and Technology, Cracow, Poland

Abstract title:

The Heider balance and the looking-glass self

Abstract:

We consider the dynamics of interpersonal relations which leads to balanced states in a fully connected network. Here this approach is applied to directed networks with asymmetric relations, and it is generalized to include self-evaluation of actors, according to the 'looking-glass self' theory. A new index of self-acceptance is proposed: the relation of an actor to him/herself is positive, if the majority of his/her positive relations to others are reciprocated. Sets of stable configurations of relations are obtained under the dynamics, where the self-evaluation of some actors is negative. Within each set all configurations have the same structure. For details see arXiv:1903.12464.

Ladislav Kristoufek, Czech Academy of Sciences (IITA)

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Ladislav Kristoufek, Charles University Prague

Abstract title:

Bitcoin and its mining on the equilibrium path

Abstract:

Bitcoin as a major cryptocurrency has come up as a shooting star of the 2017 and 2018 headlines. After exploding its price twenty times just in the twelve months of 2017, the tone has changed dramatically in 2018 after major price corrections and increasing concerns about its mining power consumption and overall sustainability. The dynamics and interaction between Bitcoin price and its mining costs have become of major interest. Here we show that these two quantities are tightly interconnected and they tend to a common long-term equilibrium. Mining costs adjust to the cryptocurrency price with the adjustment time of several months up to a year.

We contribute to the discussion on the relationship between Bitcoin mining and its price formation by finding an equilibrium relationship between the two and showing that mining costs are driven (in addition to the technical factors such as electricity price, mining efficiency, and mining network power consumption) by Bitcoin price but not vice versa forming a hysteresis-like dynamics when a (possibly bubble/speculation induced) price increases are being caught up by increasing mining costs which then form a new support level for potential future price increases. Current developments suggest that we have arrived at a new era of Bitcoin mining where marginal (electricity) costs and mining efficiency play the prime role. Presented results open new avenues towards interpreting past and predicting future developments of the Bitcoin mining framework.

Magdalena Wojcieszak, University of California Davis, University of Amsterdam

Author(s)

Magdalena Wojcieszak

Abstract title

Exposure to diverse views and polarization: What can we learn from social science, data science, and physics?

Abstract

Public observers worry that the fragmented media environment facilitates exposure to like-minded information, reinforcing prior attitudes and political polarization. In this presentation, I first outline these fears and review recent work to show that the concerns regarding ike-minded exposure and online echo-chambers may be exaggerated. I later argue that extant concerns and prior research neglect the fact that citizens encounter dissimilar information that is shared by like-minded partisans with their opinionated commentary. I present evidence from two projects that combine diverse methodological approaches. The first project focuses on exposure to counter-attitudinal messages filtered through one's partisan ingroup (ingroup filtering). (a) I rely on Twitter behavioral data to establish that ingroup filtering indeed takes place: users share information from across the political aisle with negative commentary. (b) I also present experimental evidence that although ingroup filtering has no direct effects on two consequential outcomes, polarization and participation, it does increase both through decreased ambivalence. The second project attends to different messages encountered during political discussions or partisan media. (a) Agent-Based Model first shows that discussions that criticize the outgroup (party bashing) lead to polarization relative to discussions focused on policies themselves (cognitive messages). (b) An experiment additionally shows that messages that praise one's political ingroup (party praise) polarize attitudes more than opposition bashing and cognitive messages. In conclusion, I argue that a combination of social science, data science, and physics can accurately explain various social and political processes occurring in contemporary societies.

Marcel Ausloos, School of Business, University of Leicester and Department of Statistics and Econometrics, Bucharest University of Economic Studies

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- Marcel Ausloos, School of Business, University of Leicester and Department of Statistics and Econometrics, Bucharest University of Economic Studies

Abstract title:

Non stationarity of high order return distribution moments and the Irrational Fractional Brownian Motion modelling

Abstract:

A discussion of financial indices is presented in the spirit of behavioral finance. Thus, a new methodology", or rather "hypothesis" is presented. Results on the forecast of the numerical value of the fat tail(s) in asset price distributions obtained from stock market indices are to be discussed. Using the Irrational fractional Brownian Motion (IFBM) model, instead of the Geometric Brownian Motion (GBM) mapping a log normal random walk, is outlined. This is in accordance with the hypothesis that investors are so called rational, supporting the efficient market hypothesis, subsequently leading to normally distributed distributions of returns, however empirically not observed. Indeed distributions of returns of assets are found to be leptokurtic, showing fat tails. The origin, value and range of the fat tails are the source of arguments in favor of a IFBM behavior of investors.

Mateusz Pipień, Uniwersytet Ekonomiczny w Krakowie

Author(s):
Błażej Mazur, Mateusz Pipień

Abstract title:

A family of non-standard bivariate distributions with applications to unconditional modelling in empirical finance

Abstract:

We develop a class of parametric bivariate distributions that are capable of accounting for non-standard empirical properties that are evident in some financial time series. We aim at creating a parametric framework that allows for serious divergences from the multivariate Gaussian case both in terms of properties of marginal distributions and in terms of the dependence pattern. We are particularly interested in obtaining a multivariate construct that allows for considerable degree of heterogeneity in marginal properties of its components (like

tail thickness and asymmetry). Moreover, we consider non-standard dependence patterns that go beyond a linear correlation-type relationship while maintaining simplicity, obtained by introducing rotations. We make use of marginal distributions that belong to generalized asymmetric t class analysed by Harvey and Lange (2017), allowing not only for skewness but also for asymmetric tail thickness. We illustrate flexibility of the resulting bivariate distribution and investigate its empirical performance examining unconditional properties of bivariate daily financial series representing dynamics of stock price indices and the related FUTURES contracts.

Paweł Oświęcimka, Polish Academy of Sciences, Institute of Nuclear Physics, Kraków

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Abstract title:

Agent-based modelling of stock market stylized facts

Abstract:

Agent-based modelling (ABM) is a powerful technique of complex systems simulation. The ABM's main advantage over other statistical methods is its ability to reproduce emergent phenomena, which reflect a collective behavior of individual entities in a system. Indeed, through the microscopic modelling, not only do we recreate the complex behavior patterns of the system as a whole, but also we explain many of these phenomena.

In this contribution we develop a generalization of the Bornholdt model, which involves mechanism of local herd behavior as well as elements of minority game. We focus on the agents organization leading to reproduce set of "the stylized facts" observed in the financial time series. In particular, we study the mechanism of creation of the multifractal organization in the time series which is still poorly recognized. In this perspective, it seems natural to apply the idea of ABM to understand how the microscopic organization of the entities leads to the complicated patterns on the macroscopic level of the system.

Peter Richmond, School of Physics, Trinity College, Dublin

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Abstract title:

Unravelling mortality

Abstract:

The ‘bath tub’ curve appears universal in its application to mortality in humans, animals as well as assemblies of inanimate objects. The curve exhibits different characteristics during the early and later stages of life. The later

stage of life for humans follows the law proposed on empirical grounds by Benjamin Gompertz in 1825. We show how a simple toy model based on basic biology ideas can predict the law of Gompertz.

Is life finite or could we live for ever? We explore what existing data has to say about this question.

We re-examine using modern data the Farr and Bertillon conjecture that says that for all age-groups, the death-rate of married people is less than the death-rate of non-married be they single, widowed & divorced. Never established with great accuracy, the conjecture has been considered by many to be a statistical artefact. This leads to a more general conjecture (Richmond and Roehner Physica A 450(2016) 768-784) that any abrupt change in living or social conditions generates a mortality spike which acts as a type of selection process. The conjecture will be illustrated using a few examples from prison inmates to fish. Even birth we show may be described as a shock to the foetus and data for early life is used to illustrate how the character of the mortality curve in early life differs both qualitatively and quantitatively from the later Gompertz phase.

From considerations of causes of death in early life we show how diseases may be differentiated into two types characteristic of early and later life. This allows us to highlight the dominant impact of medical advances during the 20th century years and point to the challenges ahead.

Rafał Weron, Wrocław University of Science and Technology

Author(s):
Rafał Weron

Abstract title:
Recent advances in electricity price forecasting: A 2019 perspective

Abstract:

Electricity price forecasting (EPF) is a branch of energy forecasting on the interface between econometrics/statistics and engineering, which focuses on predicting the spot and forward prices in wholesale electricity markets. Over the last 25 years, a variety of methods and ideas have been tried for EPF, with varying degrees of success. In this talk I will review recent developments in this fascinating area, including (but not limited to) probabilistic forecasting, combining forecasts and deep learning.

Rosario N. Mantegna, University of Palermo

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- Federico Musciotto, Central European University, Budapest, Hungary
- Luca Marotta, Palermo University, Palermo, Italy
- Jyrki Piilo, Turku University, Turku, Finland
- Rosario N. Mantegna, Palermo University, Palermo, Italy

Abstract title:
Trading Networks in Financial Markets

Abstract:

We construct and analyze trading networks of market members acting at some venues of Nasdaq European markets. Our analysis is performed on time intervals as long as one calendar month for a period of 23 months. By performing an information filtering approach based on the tool of statistically validated network we are able to detect a networked structure of the trading relations occurring among highly heterogeneous market members. Specifically, our results show that some market members specialize with respect to their liquidity profile by acting primarily as liquidity providers or liquidity takers. This specialization can last for a period of time as long as the time interval of almost two years (2010-2011) available for our analysis. The aspect of price information discovery is also considered from the perspective of complex network construction, time dynamics, analysis and modeling.

Shlomo Havlin, Bar-Ilan University

Author(s):

Shlomo Havlin, Bar-Ilan University

Abstract title:

Applications of network science to socio-economic, climate and infrastructure systems

Abstract:

Network science has been applied in many world-wide systems and processes. These include economics [1,2], social systems, physiology, traffic, climate, pollution, epidemics, and infrastructures [5]. I will show some examples of how one can distinguish between fake news and real news and how to predict failures of financial companies or banks using network features. I will also show some properties of phase transitions that can be observed and applied in traffic systems [3,4,6]. Also, it will be shown, how switching between topics of scientists evolve during their career over the past 100 years [7].

Sitabhara Sinha, The Institute of Mathematical Sciences, Chennai

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- Sitabhra Sinha, The Institute of Mathematical Sciences, Chennai, India

Abstract title:

How representative is our democracy ? Relating wealth and electoral performance in recent Indian general elections

Abstract:

Using open databases (publicly available on the Web) of assets declarations made by candidates contesting in the Indian general elections held over the last decade, we show that the distribution of their wealth follows a universal scaling form which is independent of the year, as well as, the different regions of the country, and, most surprisingly, even the political parties to which the candidates belong. Using an entropy measure, we propose a novel method for identifying the intensity of electoral contest in a constituency (i.e., how many cornered contest it was). We also observe that the set of winners, as well as, that of the “serious candidates” (contenders) have asset distributions which deviate significantly from those of the remaining candidates. This is a worrying aspect given the supposedly representative nature of electoral democracies, particularly in light of the recent worldwide rise to power of xenophobic populism.

Tobias Preis

Author(s):

Tobias Preis

Abstract title:

Sensing human behaviour with novel data sources

Abstract:

Mammoth amounts of data are now being generated through society’s extensive interactions with technological systems, automatically documenting collective human behaviour in a previously unimaginable fashion. In this talk, I will outline recent results of our research programme at the Data Science Lab in which we investigate whether data from sources including Google, Wikipedia, Twitter, Flickr and Instagram can be used to reduce delays in measurement of human behaviour, measure behaviour which previously could not be measured and improve predictions of future behaviour.

Vygintas Gontis, Vilnius University

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Abstract title:

Non-extensive birth-death processes as an origin of spurious long-range memory birth-death processes as an origin of spurious long-range memory.

Abstract:

Models of the population or opinion dynamics often are introduced as the continuous time Markov chains. A macroscopic dynamics in such models usually results in non-linear stochastic differential equations (SDEs) exhibiting spurious long-range memory. This category of models is as an alternative to the models built using fractional Brownian motion (fBm) and exhibiting real long-range memory property. We propose a general form for probability density function (PDF) of return time applicable to the continuous time birth-death processes. This PDF might be used to discriminate between spurious memory and real long-range memory in various non-equilibrium systems.

Zbigniew Struzik, The University of Tokyo

Author(s):

Zbigniew R. Struzik

Abstract title:

Nothing

Abstract:

The concept of nothingness has profound philosophical connotations and is restricted only to the most daring speculations. Meanwhile, mathematics and natural science are at the very most capable of dealing with the concept of 'absence' such as the notion of 'zero'. In recent decades absence in these contexts has attracted significant interest, for example, such as in fractal and strange attractors, where it is sometimes characterised in terms of 'lacunarity'. I will review the contexts of absence which overlap with my interests, in particular in complex dynamical systems. There, the inter-event silence is at least as meaningful as the event itself.

Oral

Aleksejus Kononovicius, Institute of Theoretical Physics and Astronomy, Vilnius University

Author(s):
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Abstract title:
Compartmental voter model

Abstract:

In this contribution we consider an opinion dynamics model inspired by the well-known Voter model and the Kawasaki interpretation of the Ising model. In the Kawasaki interpretation global magnetization is conserved (the spins of the particles are fixed), but local magnetization changes as particles swap their spins (alternatively, the particles swap their places). Here we translate this assumption to the subject of opinion dynamics. Namely, in our model agents reside in compartments (which we assume to represent neighborhoods belonging to a certain polling station). Agents can change the compartment they reside in, but the opinions of the agents themselves remain fixed. Agents change the compartments based on the rules inspired by the Voter model. There are multiple ways to implement these rules, but they all boil down to a simple homophily principle: the more agents with opinion $ S $ reside in the compartment, the more it is likely to attract more agents with opinion $ S $. We examine couple of possible implementations of these rules and show the impact of the slight differences between them. We provide empirical context to these theoretical developments by using Lithuanian parliamentary election data (see exploration of this data set by us [1, 2]) and Brexit referendum / UK census data (see exploration by a different group [3]).

[1] A. Kononovicius, Complexity 2017: 7354642 (2017). doi: 10.1155/2017/7354642. arXiv: 1704.02101 [physics.soc-ph].

[2] A. Kononovicius, APPA 133 (6): 1450 (2018). doi: 10.12693/APhysPolA.133.1450. arXiv: 1709.07655 [physics.soc-ph].

[3] T. Fenner et al., Int. J. Mod. Phys. C 2017 (28): 1750132 (2017). doi: 10.1142/S0129183117501327. arXiv: 1703.10548 [physics.soc-ph].

Bartłomiej Nowak , Politechnika Wrocławska; Katedra Fizyki Teoretycznej

Author(s):

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- Katarzyna Sznajd-Weron, Department of Theoretical Physics, Wrocław University of Science and Technology

Abstract title:
Homogeneous Symmetrical Threshold Model with Nonconformity: Independence versus Anticonformity

Abstract:

We study two variants of the modified Watts threshold model with a noise (with nonconformity, in the terminology of social psychology) on a complete graph and a random regular graph. Within the first version, a noise is introduced via so-called independence, whereas in the second version anticonformity plays the role of a noise, which destroys the order. The modified Watts threshold model, studied here, is homogeneous and possesses an up-down symmetry, which makes it similar to other binary opinion models with a single-flip dynamics, such as the majority-vote and the q-voter models. Because within the majority-vote model with

independence only continuous phase transitions are observed, whereas within the q-voter model with independence also discontinuous phase transitions are possible, we ask the question about the factor, which could be responsible for discontinuity of the order parameter. We investigate the model via the mean-field approach, which gives the exact result in the case of a complete graph, as well as via Monte Carlo simulations. Additionally, we provide a heuristic reasoning, which explains observed phenomena. We show that indeed if the threshold r = 0.5, which corresponds to the majority-vote model, an order-disorder transition is continuous. Moreover, results obtained for both versions of the model (one with independence and the second one with anticonformity) give the same results, only rescaled by the factor of 2. However, for r > 0.5 the jump of the order parameter and the hysteresis is observed for the model with independence, and both versions of the model give qualitatively different results. We check also if discontinuous phase transition can be visible in model without independence, and how above results presents on random regular graph.

Czesław Mesjasz , Uniwersytet Ekonomiczny w Krakowie

Author(s):
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Abstract title:
Complexity of Social Systems and Awareness of Ignorance

Abstract:

Applications of the ideas related to complexity and chaos allow for presenting the hypothesis that every use of the those utterances reflects ignorance of the observer/participant. This hypothesis relates to all attempts to define complexity – quantitative and qualitative. This observation was made by several authors, e.g. Simon and by Gell-Mann and Lloyd 2004 who define mathematical sense of ignorance in systems complexity. This definition means that the less we understand about how social system behaves, the more complex is the phenomenon. The aim of the paper is to extend the meaning of quantitative and qualitative definitions of complexity of social systems. A draft version of extension of definitions is proposed: Complexity of social system can be defined as awareness of the observer/participant of limitations of possibility to identify the system's properties ("awareness of ignorance") essential for its description, identifying causal links and prediction. It may result both from insufficient amount of measurable information and also from increasing amount of measurable information available for observer/participant. Complexity can be either the result of insufficient measurable information or the result of increasing amount of measurable information available for the observer/participant. Paradoxically, in some cases complexity can be better understood by rejection of information. This paradox can be partly solved by understanding of ignorance. It means that the participant/observer has to be able to assess his/her capability to deal with knowledge and ignorance about his/her ignorance (I do not know what I do not know), and to decide about a relevant process of eliminating information or searching for information when defining complexity of social system.

Ewa M. Syczewska, Warsaw School of Economics

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- Zbigniew R. Struzik, The University of Tokyo (Tokyo)

Abstract title:
Granger causality, transfer entropy for financial time series – role of crises

Abstract:

In our earlier research causal relationship between financial variables has been shown for returns of bilateral exchange rates and stock indices (see Syczewska and Struzik (2014)). The possible Granger causality was tested

with use of both linear and nonlinear Dicks-Panchenko method, showing differences in causality direction for subperiods covering the last crisis (2007-2010) and earlier periods of the same length.

The causality tests are applied to extended time series, to check if similar effect exists for other financial crises. The linear Granger test, the nonlinear test and transfer entropy method (introduced by Schreiber (2000), Barnett et al. (2009) and generalized by Hlavackova (2011)) are applied to returns and to financial series prefiltered with the ARMA-GARCH models, in order to check possible causality between conditional variance (risk measure) of the financial instruments.

Fischer Stefan , Escola de Engenharia de Minas Gerais - EMGE and Skema Business School

Author(s):

- Fischer Stefan, Escola de Engenharia de Minas Gerais-EMGE and Skema Business School
- Allbens Atman, Centro Federal de Educação Tecnologica de Minas Gerais – CEFET-MG

Abstract title:

Behavioral Finance has become a challenge to the scientific community. Based on the assumption that behavioral aspects of investors may explain some features of the Stock Market, we propose an agent based model to study quantitatively this relationship. In order to approximate the simulated market to the complexity of real markets, we consider that the investors are connected between them through a small world network; each one has its own psychological profile (Imitation, Anti- Imitation, Random)...

Abstract:

Behavioral Finance has become a challenge to the scientific community. Based on the assumption that behavioral aspects of investors may explain some features of the Stock Market, we propose an agent based model to study quantitatively this relationship. In order to approximate the simulated market to the complexity of real markets, we consider that the investors are connected between them through a small world network; each one has its own psychological profile (Imitation, Anti-Imitation, Random); two different strategies for decision making: one of them is based on the trust neighborhood of the investor and the other on considers a technical analysis, the momentum of the market index technique. We analyze the market index fluctuations, the wealth distribution of the investors according to their psychological profiles and the rate of return distribution. Besides, we analyze the influence of changing the psychological profile of the hub of the network and report interesting results which show how and when anti-imitation become the more profitable strategy for investment. Moreover, an intriguing asymmetry of the return rate distribution is explained considering the behavioral aspect of the investors. This asymmetry is quite robust and it has been observed when even a completely different algorithm to calculate the decision make of the investors was applied to it.

Grzegorz Siudem , Warsaw University of Technology

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- Agata Fronczak, Faculty of Physics Warsaw University of Technology
- Piotr Fronczak, Faculty of Physics Warsaw University of Technology
- Grzegorz Siudem, Faculty of Physics Warsaw University of Technology
- Mike Thelwall, Statistical Cybermetrics Research Group, School of Mathematics and Computing, University of Wolverhampton

Abstract title:

Scaling of fluctuations in Internet - the state states perspective

Abstract:

Taylor’s law of fluctuation scaling is a power-law relationship between a variance and a mean. It

has been observed in a wide range of disciplines, ranging from population dynamics through the Internet to the stock market. To explain origins of the law, a number of theoretical approaches have been proposed. Here, we discuss applicability of one of them, the maximum entropy-based formalism, to non-equilibrium stationary states. In addition to analyzing several real time series, we show that a simple model of transport of packets in communication networks also exhibits Taylor's law and could serve as a good testbed for verification of the formalism. We draw attention of the complex system community to the Bell polynomials that turn out to be very well suited for studying systems that exhibit Taylor's law.

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Abstract title:

Fluctuation scaling residuals reflect reporting style of online news outlets

Abstract:

It is known that activity (number of published articles) of online news outlets follows the temporal fluctuation scaling (FS) law. Given publication timestamps list of all articles from all sources and a time window size, one can define a correction (residual) to retrieved FS for each source – we call it reactivity. Interestingly, a dependence of reactivity on a time window size seems to be following few patterns which allows to detect erroneous activity timeseries (caused by e.g. a crawler malfunction). Here we present a novel measure of a news outlet reporting style based on its aggregated corrections to FS in different timescales – mean reactivity. A high mean reactivity means that activity fluctuations were larger than expected by a fitted fluctuation scaling law, thus bursty reporting style, and a low mean reactivity value – fluctuations lower than expected, thus a stable reporting style. We consider activity of nearly 8,000 news outlets in 34 topics in a year 2018; data for the study comes from the Event Registry (eventregistry.org). We calculated reactivity of each source towards each topic and aggregated the results over geographical (country, continent) and political (political bias from mediabiasfactcheck.com) features. Analyzing distributions of mean reactivity by country, we see non-trivial spatial dependencies; additionally, considering a political bias shows that mean reactivity is not its direct reflection. We present results for selected countries and topics and discuss them in details. One of open questions is a relation between a pair of sources' similarities in a reactivity dependence on time window size and correlation of their activity timeseries. We believe that results can be applied to other systems following the temporal fluctuation scaling.

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Abstract title:

Entropy of globalizing world. The macroeconomic time series analysis.

Abstract:

Globalization is a process that reduces the distance between societies on different levels.

This process was initiated by inventions facilitating transport and communication. It has transformed the evolution of societies from a local phenomenon to a global phenomenon by strengthening long-range interactions.

The standard globalization measures are based on a designated feature considered as the characteristic of the globalization. In the present study a different approach is proposed. The measure is constructed, such that it would be possible to investigate various aspects of globalization by the same measure.

At present, the flow of information is the most dominating factor determining globalization. Thus, the measures related to the analysis of information seem to be the most promising and it seems that the proper measure of globalization should be based on the entropy, in particular, information entropy, which characterizes the degree of noise/determinism in given data sets. The main difficulty in directly using Shannon information entropy is the

limitation of the available data. In the present study the approach based on permutation entropy is proposed which is focused on patterns rather on the probability distribution function. This makes it possible to apply in the analysis of short time series.

The presented study shows that globalization measure might be based on the permutation entropy. This measure was applied to the various sets of macroeconomy time series showing the evolution of the globalization process. The very important feature of the proposed measure is its universality - the same measure can be applied to various aspects of human activity giving the opportunity to measure it quantitatively and point out the areas the of globalization.

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- Tomasz Gubiec, University of Warsaw, Faculty of Physics

Abstract title:

Continuous-time random walk model for correlated inter-trade times

Abstract:

Over 50 years ago, two physicists Montroll and Weiss in the physical context of dispersive transport and diffusion introduced stochastic process, named Continuous-Time Random Walk (CTRW). The trajectory of such a process is created by elementary events ‘spatial’ jumps of the stochastic process preceded by waiting (or interevent or pausing) time. Since introduction, CTRW found innumerable application in different fields [1] including high-frequency finance [2]. In recent years numerous extended CTRW model with memory were introduced [3] focusing on the dependence between successive ‘spatial’ jumps. Our latest results [4] suggest that dependencies between waiting times are the key element to explain long-term memory in financial time-series. We introduce the new CTRW model with long-term memory in waiting times, able to successfully describe power-law decay decaying time autocorrelation of the absolute values of price changes. We compare our model to the financial data from the Polish stock market.

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[3] Gubiec, T., & Kutner, R. (2017). Continuous-Time Random Walk with multi-step memory: an application to market dynamics. The European Physical Journal B, 90(11), 228

[4] Klamut, J. & Gubiec, T., (2019). Directed continuous-time random walk with memory. The European Physical Journal B 92:69.

Joanna Landmesser , Szkoła Główna Gospodarstwa Wiejskiego w Warszawie

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Abstract title:

Exploring the gender pay gap across the income distribution: an empirical analysis for EU countries

Abstract:

The goal of the paper is to compare personal income distributions for men and women in countries of the European Union and to discuss whether there exists a significant diversity in this respect across the countries. First, we examine the income inequalities in each country using the Oaxaca-Blinder decomposition procedure. Second, we extended the decomposition procedure to different quantile points along the whole income distribution. To describe differences between the incomes of men and women we construct the counterfactual distribution using the recentered influence function approach (RIF-approach). As explanatory variables, the individual people's characteristics are used, e.g. age, education level, marital status, number of years spent in paid work, type of contract, position at the local unit. We expect that the gender pay gap exhibits a remarkable heterogeneity across European countries. Therefore, after assessing the gender pay gap for the countries, an attempt will be made to group them using hierarchical clustering method. The nearest neighbors algorithm for agglomerative clustering with Euclidean distance will be applied.

The data from EU-SILC (Statistics on Income and Living Conditions) will be used.

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Abstract title:

Analysis of air pollution in Poland and locating the sources based on data from sensor network.

Abstract:

The aim of this research was to find the method to locate pollution sources in Poland.

Assumption was made that diffusion of pollution can be described by the diffusion equation with sources. In this paper air pollution sensors were treated as a graph. The measurers were marked as nodes. Each vertex was connected to every other sensor in radius of 5 kilometres. On this graph divergence of concentration of pollution was approximated. In this way probable sources were pinned down.

Also, Pearson correlation coefficient of neighbouring measurers was taken into consideration. By making coefficients' distribution, it was observed that we can categorize measurers into classes depending on their characteristics of hourly pollution intensity. For example: suburbs of towns are more polluted in the evening.

Finally, average quality of air in Poland was analysed, by drawing average daily pollution concentrations distributions.

Research covers PM10 and PM2.5 pollution data shared by Airly collected from 9 October 2018 until 19 January 2019.

Katarzyna Bień-Barkowska , Institute of Econometrics, Warsaw School of Economics

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Abstract title:
Forecasting the timing and size of extreme returns in stock markets

Abstract:

Forecasting the occurrence of extreme returns is at the forefront of modern financial econometrics and allows for effective management of market risk. Adequate econometric tools describing such extreme losses should account for their tendency to cluster in time. We use dynamic extensions of the peaks-over-threshold (POT) model for predicting both the timing and the size of extreme events in stock markets. The random times when magnitudes of negative financial returns exceed given large threshold are modeled in line within the marked point process theory, where the marks correspond to the sizes of extreme losses. In this framework, the conditional intensity of extreme negative returns is not constant but possess the self-exciting property, because it can instantaneously rise, and later slowly decay, in reaction to large negative returns observed in the past. We apply different specifications of the dynamic observation-driven models to jointly depict both (1) the time-varying conditional intensity function, and hence, the arrival rate of extreme events over time and (2) the magnitudes of negative returns exceeding large threshold. The latter are depicted with the generalized Pareto distribution with the time-varying scale parameter that can capture serial correlation in the sizes of extreme losses. We apply the dynamic POT models to forecast market risk with the value-at-risk (VaR) measures calculated for different quantile levels. In-sample and out-of-sample validity of the dynamic POT models applied to different stock indexes is assessed with the probability integral transforms and the coverage tests designed to evaluate the accuracy of obtained VaR estimates.

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Abstract title:
Paradox of integration---Cellular automata approach

Abstract:

According to Peter M. Blau \cite{Blau}, the process of integration of a newly formed group has a paradoxical aspect: most attractive individuals are rejected because they raise fear of rejection. Often, their solution is to apply a self-deprecating strategy, which artificially raises the social statuses of their opponents. Recently we have introduced a two-dimensional space of status, real and surface one ($A $ and B), and we have demonstrated that with this setup, the self-deprecating strategy efficiently prevents the rejection \cite{KK}.

There, the process of reducing the conflict was described by master equations, i.e. a set of differential equations describing evolution of density $v(A,B)$ of actors of status (A,B).

Here we reformulate the problem in terms of probabilistic asynchronous cellular automata.

The obtained results for number $n(A,B)$ of actors of status (A,B) are qualitatively the same as in the previous approach.
Namely, an enhancement of the surface status compensates a deficiency of the real one.

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\bibitem{KK} K. Malarz, K. Ku{\l}akowski, Paradox of integration---Dynamics of two-dimensional status, arXiv:1903.04291 [physics.soc-ph], to appear in Int. J. Mod. Phys. C. \end{thebibliography}

Levan Efremidze , Pepperdine Graziadio Business School

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Abstract title:
Entropy Model for Asset Rotation

Abstract:

This study develops an entropy based methodology and tests its effectiveness for asset and sector rotation investment management strategies. Entropy based investment methods have been developed for market timing and currency prediction models with relatively positive results. Specific entropy metric used in this paper is called sample entropy. It is one of the ways that complex systems' statistical properties can be studied and is heavily used in physics, materials science, astronomy, medicine, biology, and other fields. We test the algorithm on the data of Standard and Poor's 500 index sectors (using 9 SPDR Sector ETFs) and bond index for the period of 1999-2016. We conduct testing of several possible sector rotation strategies for various rebalancing periods. Most strategies we test outperform a buy and hold strategy of the S&P 500 index.

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Abstract title:
Cryptocurrency market evolution

Abstract:

Since the beginning of 2017, Bitcoin price has increased from 1000$ to 20,000$. This striking, possibly unprecedented, rapidity of market capitalization ended on 16.12.2017, when the market experienced a spectacular trend reversal, from strongly increasing to sharply decreasing, both large trends being accompanied by well-evident, smaller-scale oscillations. These events motivated us to compare BTC/USD fluctuation properties to the stylized facts of mature world markets. While early trading was affected by system-specific irregularities, it is found that over the months preceding Apr 2018 all these statistical indicators approach the features hallmarking maturity. It also appears that the maturity of the Bitcoin has cascaded onto other cryptocurrencies, leading to the emergence of a seemingly-independent world cryptocurrency market, akin to the foreign exchange. Based on high-frequency (10s) trade recordings on the Kraken cryptocurrency exchange, we show that, remarkably, the cryptocurrencies have already started developing multifractal cross-correlations, even when traded directly among themselves. The analysis of the detrended cross-correlation coefficients reveals a dependence on the time scales which may be caused by large arbitrage opportunities that occurred in the past. By the end of 2018, these opportunities have decreased significantly, making the cryptocurrency market more synchronized.

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Abstract title:
Macroscopic Structures in Financial Networks

Abstract:

In the last decade, financial networks became an extremely important subject, both for researchers and regulators. One of the most crucial elements of such research is to be able to identify macroscopic structures,

such as core-periphery, which is considered to be common in the financial world. We will show how the Stochastic Block Model can be used in order to easily distinguish between different network structures.

It was already observed in [1] that using different network representation can lead to different macrostructures. We extend this idea by looking at broader space of models, taking into account directions, weights and different number of groups. Moreover, we will analyse real data from the e-MID interbank market in order to find which factors cause the emergence of various network structures. Even when limiting our model to only two groups, we could already observe how a core-periphery structure, observed in the undirected version, changes into bipartite when taking into account directions.

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Abstract title:

Social network analysis in second language acquisition

Abstract:

Network analysis has proved to be a useful tool for linguistic enquiry, e.g. in natural language processing to represent the structure of language, or in stylometry to analyse various stylistic similarities between texts in order to determine authorship, detect plagiarism, or find close relations between authors. It has also been successfully applied in research on language acquisition. However, until now there has been no research that would rigorously analyse students' interactions, and their influence on second language (L2) acquisition.

We present a study investigating the influence of peer interaction dynamics and social graph topology on measurable outcomes in L2 acquisition among participants in an intensive summer course of language and culture in Poland (n=181). To comprehensively characterise the structure of the learner networks, egocentric networks were collected via surveys, permitting the recreation of directed weighted graphs. The topological data were then overlaid over independently collected personal motivation profiles and learning outcomes in order to carry out multi-faceted analyses of the mutual influence of individual on social factors and vice versa. To determine how these were associated with performance, we performed multiple linear regression with over 100 independent variables.

Analyses of various standard centrality measures vis-à-vis performance in a pilot study reveal that the best (statistically significant) predictors of both self-reported and independently measured progress are closeness and degree centrality, while betweenness and PageRank fail to correlate. Additionally, we observed slightly negative predictors in incoming centralities, which means that being popular among other students is not always good for one's outcomes.

Mikołaj Koszowski , Warsaw University of Technology

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Abstract title:

Predicting cryptocurrencies prices using sentiment analysis of social media.

Abstract:

Behavioral economics in contrast to classical economic theory allows the possibility of predicting the future value of financial instruments. Today's price is often more strongly correlated with the belief of value rather than

production costs of the asset. Social media are an inherently noisy source of data, nevertheless, studies show they contain a substantial amount of useful information. Finding methods of extracting relevant indicators to approximate collective sentiment was the main goal of this work.

A low cost system for collecting information with needed time resolution was created. Due to the strong crypto community on Twitter, this platform was chosen as the data source. Obtained tweets were filtered for containing the word 'bitcoin' in the text body. Data was collected between 1st Oct and 4th Dec 2018, with a 5 min resolution, which sums up to 4M tweets.

Prepossessing of gathered data assumed inertia in the emotional state of the public, which is an added value of this study. It was accomplished through a moving average function, which window size became another dimension of the conducted analysis. Standard machine learning classifiers like LDA and SVM were used for up or down trend prediction with specified time shift. What differentiates this work, is an extensive analysis in the time shift horizon dimension, which ranged up to 7 days with a 2-hour resolution. Prediction models were trained only on social media data and tested with the use of Out-of-Sample testing schema.

Finally, a toy model of investment strategy was proposed which indicated the possibility of profits for real implementation. Maximum of prediction accuracy was observed for a 3-day time shift horizon which is consistent with similar studies.

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Abstract title:

Transition to a structurally balanced paradise state in the system with agents possessing opinions

Abstract:

Research over structural balance of a system with Heider dynamics usually assumes the dynamics of links and triads. One example of such model is local triad dynamics (LTD) introduced by Antal et al. in 2005, where a phase transition from a quasi-stationary unbalanced state to a structurally balanced paradise state with no negative links was observed. Here, we propose a model with dynamics similar to the LTD. The main difference is that in the LTD the dynamics is based on states of links, whereas in our model states of links are defined using states of nodes (called attributes) and the attributes are modified during simulation updates. Using Random Walk approximation and Fokker-Planck equations we have obtained analytical solutions fitting well data from numerical simulations. Our main findings are that the outcome from these models are equivalent (or at least similar) only when the number of attributes G is much larger than the number of agents N. In other words, in the presence of agents' attributes the phase transition observed by Antal takes place only when $G>O(N ^2)$, $N\rightarrow\infty$. If this condition is not fulfilled then the transition to a paradise state does not take place. We do not contradict the conclusions obtained for the LTD. However, our analysis indicates that applying LTD for systems where the states of links depend on the states of nodes may lead to erroneous results. Especially, when the number of the attributes is small which, we believe, is the most realistic case.

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Abstract title:

Crucial factors determining the popularity of scientific articles.

Abstract:

The single most important bibliometric criterion for judging the impact of scientific papers is the number of citations received, commonly known as "citation count". However, due to the discipline dependence, this metric is unreliable. Sentiment analysis is the field of study that reflects people's opinions, attitudes, and emotions from written language. Not only the citation impact but sentiment around citation may be an essential metric. Finding the criterions describing the popularity of scientific papers and also determining the popularity threshold was the major objective of this work.

Around 140k journals were gathered from PLoS ONE database. Additionally, a dataset with the number of views of a given scientific article was created. The simple features such as counts of words in the title and abstract and more complex like Gunning fog index, valence and arousal was calculated to ascertain the crucial factors of popularity. The components were used to build machine learning models (Support Vector Machines, Random Forests) and examined the concept of the threshold of popularity. Furthermore, the main part of the paper was

divided into sections. In each part, the number of citation and sentiment were computed. Binary classifiers were built using these features. The models were measured of its quality with the Matthews correlation coefficient and F1 score. Moreover, it has been observed that dimensionality reduction (PCA) had a small influence if the results.

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- Takayuki Mizuno, National Institute of Informatics
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Abstract title:

Using two-dimensional Kolmogorov-Smirnov statistics to characterize allometric scaling between population and number of facilities

Abstract:

We empirically investigate the allometric scaling relation between population size and number of facilities in all municipalities across Japan observed in corporate telephone directory data. This data contains address, latitude and longitude, and industrial information of facilities. The industrial sector is divided into 39 categories. Each category is further divided into 735 subcategories. A wide variety of companies from large to small businesses are recorded, enabling the identification of geospatial and industrial information from nearly all facilities nationwide (approximately seven million). It has been demonstrated that number of facilities Y is proportional to N^b, where N and b are population size of a municipality and the scaling exponent. We find that exponent b is dependent on the type of industrial sector; for example, if the population doubles, the number of dermatology clinics also doubles, but dental clinics multiply by 2.1 (b>1: super-linear scaling), and obstetrician clinics by 1.8 (b<1: sub-linear scaling). Nontrivial relations exist between the population and number of facilities in various industries. In order to analyze scaling relation in more detail, the two-dimensional Kolmogorov-Smirnov tests are used to compare the scatter plots of the population size of and the number of facilities between any two industries. Distance between any two industries is defined by the value of Kolmogorov-Smirnov statistic. To classify industries into groups, we perform a cluster analysis with Ward's method. The obtained dendrogram

corresponds closely to the industrial sector. But obtained groups are not the same as industrial classification. Extracted the taxonomy of industries provide a valuable insight into urban properties and economic function.

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Abstract title:

Coevolving nonlinear voter model with triadic closure

Abstract:

Network dynamics often refers to the dynamics of the network creation or evolution, but also to the dynamics on the network, where the dynamics of the states of the nodes is affected by the topological structure of a fixed underlying network. However, the structure of the network among interacting agents evolves dynamically in response to the state of the nodes. Therefore, dynamics of and on the network are dynamically coupled processes occurring in comparable time scales. The coupling of these processes has been referred to as coevolution of node states and network structure. Coevolution has been applied in a variety of different fields

ranging form classical spin models, opinion formation, game theory and epidemic spreading, to cultural dynamics, and ecological interactions. A prototype model is the coevolving voter model combining the voter dynamics and the change of a network by rewiring links. Here, we study a nonlinear coevolving voter model with triadic closure local rewiring. We find three phases with different topological properties and configuration in the steady state: absorbing consensus phase with a single component, absorbing fragmented phase with two components in opposite consensus states, and a dynamically active shattered phase with many isolated nodes This shattered phase, which does not exist for a coevolving model with global rewiring, has a lifetime that scale exponentially with system size. We characterize the transitions between these phases in terms of the size of the largest cluster, the number of clusters, and the magnetization. Our analysis provides a possible solution to reproduce isolated parts in adaptive networks and high clustering widely observed in social systems.

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Abstract title:

Predicting language diversity with complex networks

Abstract:

Evolution and propagation of the world's languages is a complex phenomenon, driven, to a large extent, by social interactions. Society can be seen as a system of interacting agents, where the interaction leads to a modification of the language spoken by the individuals [1]. Two people can reach the state of full linguistic compatibility due to the positive interactions. But, on the other hand, if they speak entirely different languages, they will separate from each other. These simple observations make the network science the most suitable framework to describe the dynamics of language change. Although many mechanisms have been explained [2], we lack a qualitative description of the scaling behavior for different sizes of a population. We analyze the model of social interactions with coevolution of the topology and states of the nodes [3,4]. This model can be interpreted as a model of language change. We propose different rewiring mechanisms and perform numerical simulations for each. Obtained results are compared with the empirical data gathered from two online databases

and anthropological study of Solomon Islands. We study the behavior of the number of languages for different system sizes and we find that only local rewiring, i.e. triadic closure, is capable of reproducing results for the empirical data in a qualitative manner. Furthermore, we cancel the contradiction between previous models and the Solomon Islands case. Our results demonstrate the importance of the topology of the network, and the rewiring mechanism in the process of language change.

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Abstract title:

Application of Machine Learning Methods under IFRS 9 Approach to Credit Risk.

Abstract:

The concept of ECL (Expected Credit Loss) introduced in 2018 under IFRS 9 standards has an enormous impact on risk management models. One has to take into account a decline of credit rating since the contract date. Therefore there are baskets of asserts (related to three stages) distinguished. Depending on the stage assigned to the instrument the expected loss is calculated either in the given horizon or over its entire lifetime.

From the supervisor's perspective, such an approach allows for evaluating relevant financial reserves that include financial risk for all transactions in a given basket. Supervising regulations allow for application of both methods, based on statistical and machine learning algorithms. Unfortunately, due to the lack of experience in machine learning applications to credit risk estimation as described in IFRS 9 regulations, machine learning methods are seldom used. Analysis of Goodness-of-Fit (GOF) type measures in machine learning models and their comparison with classical approach such as logistic regression can be a convincing argument to apply them.

The research done by authors is of great importance for undertaking practical application of machine learning (allowed in IFRS 9). In the paper the authors consider models of the main of three risk components, Loss Given Default (LGD). Supervising regulations indicate that for many exposures one has to apply either survival curves or Markov chain models. We propose an approach based on machine learning. Also new measures of GOF allowing for comparison of statistical and machine learning approach will be given. Calculations will be done on real data.

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Abstract title:

The fair distribution of conflict territory between alternative opponents

Abstract:

We discuss the problem of fair distribution of conflict territory (natural resources, social energy or power,...) between finite many alternative opponent sides. We assume the existence of starting conflict intersections of living interests and seek the universal law for getting of the fair distribution of considered territory during the

time evolution. Actually, the real law of conflict interaction is always unknown "a thing in itself" . What is why we develop the probabilistic approach. We correspond at starting moment of time to each alternative side some density of his distribution along a conflict territory. These densities are usually various for different sides. Then we include the conflict dynamical system with discrete time generated by the formula of conditional probability of Bayes type.

We state the existence of the limiting division of whole space into separated fair regions where one only opponent stays.

The computer simulations confirm this result and show that for each opponent side there appears the concentration of his densities in some region, own for everyone. Besides, the result admits an explicit illustration. If we put in correspondence the own color for each opponent, then the starting picture with mixed colors transformed with time into the geographical type map with separated colors. The limit picture gives the exact fair distribution in the following sense: each opponent leaves all places where he was at starting moment in minority and occupies the regions defined by his maximal starting priority with respect to all other sides.
The density concentrations

inside the fixed color regions are not uniform and their forms may have even the fractal structure.

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Abstract title:
Income distribution in a new perspective

Abstract:

Nowadays many exhaustive, and electronically accessible data are available for studying experimentally the income distribution in different societies. According to the experimental data, the probability density function of income decays exponentially in the low and middle income classes, and in form of a power -law in the high income limit [1]. Starting from a newly proposed master equation containing only local growth and reset terms [2], we elaborate a simple and realistic model to reproduce the universal character of the income distribution. The model leads to a compact analytical form for the probability density function, that is successfull for fitting the whole data range. The dynamical assumptions of the model (growth and reset rates) are experimentally tested on a ten year exhaustive social-security data-set [3] from Cluj county (Romania). Work supported by the UEFISCDI grant: PN-III-P4-ID-PCCF-2016-0084.

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Poster SOCIO

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Abstract title:

Duration of diffusion of innovations to developing areas after the removal of the state border between the Federal Republic of Germany and the East Germany

Abstract:

The flow of investments and innovations, similarly as the circulation of goods and services, may encounter barriers resulting from the existence of state borders. The barriers may be of complex nature, which is caused by the outflow of various economic, sociological, legal and cultural phenomena. In this respect, states conduct an economic policy that can range from autarky to relatively full openness. Autarky is the opposite of the international division of labor and usually causes a reduction in economic efficiency. European economic integration, on the other hand, leads to gradual removal of barriers of foreign trade, which facilitates convergation and diffusion of investments and innovations from the more developed to the less developed areas. The period of natural spreading of new technologies and innovations after removal of state borders is a research problem that has been relatively unconsidered so far. In this respect, a natural experiment like the unification of Germany on October 3, 1990 seems to be a particularly interesting case. Such a time scale is an excellent starting point to study duration of diffusion of technologies and innovations from developed to developing areas. The research results can be predictive and shed some light on the potential economic effects of similar unification movements that could occur in the future. Such simulation could apply to North Korea and South Korea, if such integration would ever take place.

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Abstract title:

The models of the propagation of confidential information

Abstract:

Insider trading, being one of the symptoms of information asymmetry in stock exchange trading, is defined as a transaction carried out on the stock exchange on the basis of confidential information.

In the relatively short history of the existence of the Warsaw Stock Exchange, there are few cases of convictions for insider trading, that is for the disclosure and use of confidential information to perform a stock exchange transaction. In October 2018, one of several convictions for this crime has been passed (from the very beginning of the Warsaw Stock Exchange) for a crime which took place in October and November 2010.

The description of the insider trading case in this case has received wide coverage in the press and revealed one of the mechanisms

of insider trading. From the point of view of modeling the propagation of information, this case provides a valuable lesson in as many as 3 various examples from a similar period of time. The convergence of the method

of operation allows for the preparation of a model of propagation of information and a short-term increase in the share price and then the transition to the equilibrium price.

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Abstract title:

Verification of information flow and decision making models classified by types of confidential information in insider trading

Abstract:

Insider trading may be defined as a transaction carried out on the stock exchange based on confidential information. Insider trading is a punishable offence and in most countries of the world it is punishable by fine or imprisonment. The data on the actual insider trading are, to a large extent, impossible to obtain. Very often, however, insider trading is suspected.

Two simulation models were used to simulate the dissemination of confidential information. The first of said models examines the use of confidential information with the assumption of an infinitely long time of use. The second of the models assumes that confidential information will be used immediately (on the day of its receipt). The simulation results were referenced to the stock exchange data of selected companies from the sWIG80 index from 01/01/2010 – 31/12/2014. As a result of the research, we pointed out that the more likely model for the use of confidential information for small investors is the model consisting of immediate use of the received confidential information.

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Abstract title:

Ferromagnetic and spin-glass-like transitions in the majority vote model on random graphs with repulsive interactions

Abstract:

Majority-vote model on random graphs is investigated in which a fraction p of

edges corresponds to repulsive (antiferromagnetic) interactions between agents. The agents update their opinions
following with probability $1-q$ ($0 < q < 1/2$) the majority rule, and

otherwise acting independently. If the interactions between agents are symmetric the model can be treated as a nonequilibrium counterpart of the

dilute spin glass model. In general, the interactions need not be symmetric, e.g., a fraction of the agents can be anticonformists, with only repulsive interactions with their neighbors. By means of Monte Carlo simulations and using the Binder cumulants method phase diagrams in the (p,q) plane are obtained for different variants of the model. For small p and with decreasing q the model undergoes ferromagnetic transition at

a critical value $q=q_c$ decreasing with $ p$, which agrees well with that evaluated in the mean-field approximation. For large p and with decreasing q the model undergoes transition to a spin-glass-like state, characterized by a non-zero value of the spin-glass order parameter measuring the overlap of agents$^{\prime} $ opinions in two replicas of the system, and simultaneously by the magnetization close

to zero. In the case of symmetric interactions between agents the phase diagram resembles qualitatively that for dilute spin glass models and a tricritical point occurs where the paramagnetic, ferromagnetic and spin-glass-like phases coexist. In the case of generally asymmetric interactions for intermediate values of p there is no phase transition with decreasing q and only the disordered phase is observed.

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Abstract title:

Possible effect on border fencing and animal corridors blocking on African Swine Fever (ASF) Virus propagation in Poland

Abstract:

We analyze 3487 ASF notification in Poland from February 2014 to April 2019 (50 out of 380 poviats have been affected and due to restrictions, almost 90% of farms in affected area stopped pig production) comprising event time, longitude and latitude (within the administrative unit of poviat), where at least one house swine or wild boar case was reported. We choose a pseudo gravity propagation model for future projection of disease spread taking into account: pig abundance (pork production chain), disease vectors (wild boar) density, and human failures to restrictions. We propose a multilayer approach to heuristic analysis of these 3 layers of networks related to disease propagation.

To verify a possible effect of the fence, we quantify the difference in transmission dynamics between regions at the country border (immigration hypothesis) and in the interior regions (endemicity hypothesis) and no significant difference between border and interior countries was observed. Additionally, we test a scenario in which all border poviats are disconnected on wild boars network layer. There is only a small difference in the arrival time to “Polish swine hot spot”, because most of the dynamics is currently happening on the West of the border counties.

To verify a possible effect of blocking animal corridors, we test a scenario in which all poviats on A1 motorway are disconnected on the outgoing wild boars layer. There is an important difference in the arrival time to “Polish swine hot spot”. This estimation seems to be in agreement with observed propagation in Baltic States (e.g. via Baltica and A1 in Lithuania).

It is important to mention, that our methodology capture only the upper limit of a theoretically perfect barrier and more analysis in realistic scenario is required.

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Abstract title:

Is independence necessary for a social hysteresis within the q-voter model?

Abstract:

We investigate the q-voter model, a metaphorical agent-based model (ABM), of opinion dynamics on a complete graph with two types of response to social influence: conformity and anticonformity. We ask a question if a discontinuous phase transition and the related social hysteresis is possible within the model with anticonformity. Previously it was claimed that within the q-voter model social hysteresis can emerge only because of an independent behaviour. However, this claim was derived for models with the same size of the influence groups for each type of responses to social influence. Now we abandon this assumption and we introduce a generalised model, in which the size of the group needed for conformity q_c and the size of the group for anticonformity q_a are independent variables, and in general $q _c \neq q_a$. We show that such modification of the model displays both types of phase transitions depending on parameters q_c and q_a.

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Abstract title:

Modelling of information pathways changes in social network

Abstract:

We present a study of structural changes in a social network based on the Twitter users network. The pathways change due to the new information occurrence. Those changes depend on the similarity between users. Similar users move closer to each other, while the mean distance in the network increases. There is a model which is able to reproduce this result. Based on its simulations more similar users are always closer to each other than dissimilar one. Tests on the Twitter network with real similarities show the same changes as observed in the data. The same results are preserved for specific parameters on a synthetic network.

We can observe the dependence of the mean distance behaviour on parameters. The presented model is complemented by analytical calculations.

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Abstract title:

Avalanches of aggression in a Bethe lattice

Abstract:

According to the Collins English Dictionary, „a troll is someone who posts unkind or offensive messages on social media sites, and often tries to start arguments with other users” [1]. This kind of behavior, if initiated persistently, raises frustration of contributors of online discussions and can be imitated by some of them [2]. Here we propose a simple description of the process of nonstationary spreading of aggressive behavior in a directed Bethe lattice. The frustration is released by an aggressive act, at the cost of receivers. The approach is motivated by the theory of self-organized criticality [3]. The obtained avalanche size distribution P(s) is proportional to 1/s.

[1] Collins English Dictionary, retrieved 20 May 2019.

[2] Cyberemotions. Collective Emotions in Cyberspace, J. A. Hołyst (Ed.), Springer 2017.

[3] G. Pruessner, Self-Organized Criticality. Theory, Models and Characterisation, Cambridge UP, Cambridge 2012.

Maciej Pawlik, Wydział Fizyki PW

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Abstract title:

Analysis and modeling of the hierarchical structure of a team sport league

Abstract:

In sports most of the time there is a group of teams that stand out above others in a league. On the other hand different group may never or rarely reach the top. This may be the consequence of some hierarchy existing within the league. The motivation of this research is to prove the existence of this hierarchical division.

A model based on Bonabeau's work was proposed to simulate a simple sports league. A sport is described by the parameter of determinism \(\beta\) (outcome of a match is more dependent of strength of a team as the parameter increases). First, a pool of players with their strength \(h \in \left \langle 0 ; 1 \right \rangle\) and from them teams are created via draft selection. Their strength is a sum of strengths of its players. In a season each team plays every other at least once. Draws are forbidden. Final rankings are made based on number of wins. At the end of each season every team has a chance to swap some number of its players with those, who are currently not signed by any team. Then the strength of every player changes by a random, small value.

Analysis of data gathered from simulations shows a phase transition between teams ranking being random and changing less if they rank at the top or bottom. The transition occurs for \(\beta\) in range of 0,2 to 1 for basic model. Comparing real data with the model shows that real sports should have the value of parameter of determinism in mentioned range.

Patryk Bojarski,

will be announced later

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Abstract title:

Efficient observers for source detection in complex networks for spread with high transmission variance

Abstract:

Detection of spread source in complex network is an important problem which has received a lot of attention in recent years. The spread is a ubiquitous process and may apply to epidemics, rumors or fake news. The most effective methods for source localization are based on observers which play the role of the detectors and provide the information about the time at which they received the infection. We investigate the problem of the optimal placement of the observers in complex networks and propose new graph measure called Collective Betweenness which we compare against four other metrics. The tests are performed for different types of complex networks (Erdos-Renyi, Barabasi-Albert, Configuration Model with power law degree distribution, Random Regular Graphs), for wide range of the density of observers and for wide range of the transmission variance. The results confirm that popular methods for observers placement work best in their favorite regimes and there is no unambiguous winner. However, we show that in case of spread with high transmission variance, which is the most difficult scenario for the source localization, usually the most efficient is the set of observers which maximize Collective Betweenness.

Tomasz Bałdyga, WUT

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Abstract title:

Urban road network analysis based on data from navigation system

Abstract:

Purpose of this research was to collect and analyze data of urban road networks and car traffic in selected cities in Poland and to compare the results of the analysis. The data was collected using Directions API which is a part

of Google Maps Platform. The collected data describes street networks in the following cities: Olsztyn, Lublin, Kraków, Wrocław and Warsaw, were collected. The nodes of above networks

were selected using the proposed square point randomization algorithm. Moreover, for Wrocław and Warsaw we created two additional networks, where nodes represented public transport bus stops. Directed, weighted full graphs are formed using the collected data. The graphs represent urban road networks. The distribution of edge weights such as speeds, travel times and distances are plotted. A distribution describing inter-node distances in the network has been proposed. The

analytical form of this distribution is invariant due to the metric. Measures describing differences in network topology depending on the metric have been introduced. A method for estimating travel times depending on the time of a day has been proposed. The occurrence of percolation phase transitions during transformation of graphs has been found. In such a case the travel time is used as the control parameter. Percolations depend vastly on the way of selected nodes. A city quasi-metric has been described statistically, depicting it as Minkowski's generalized metric. It has been shown that distributions of direction coefficients of the examined networks are power law distributions. The results of analyzes vary depending on the selection of vertices.

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Abstract title:

Efficiency of stylometry based on statistics of words and punctuation in linguistic networks

Abstract:

Complex networks can represent natural language on many levels of its structure. Word-adjacency networks illustrate the mutual co-occurrence of words, and, although simple and intuitive in construction, can capture useful information concerning certain statistical properties of given language sample. By studying the characteristics of such networks we were able to perform authorship attribution for narrative texts in English and Polish and to observe some structural differences among these languages. Adding network representation to elementary methods of authorship attribution led to a siginificant improvement of the distinguishability of different authors. Furthermore, the characteristics

of word-adjacency networks suggested that punctuation marks, previously often disregarded in statistical analysis of texts, are to a large extents sharing the properties of usual words. This manifested even more clearly in rank-frequency plots, which, originally described by Zipf-Mandelbrot law, tend to restore the purely power-law Zipf distribution when punctuation marks are included. This effect, although to a varying degree, was observed in all of six studied languages and therefore was considered as quite general and possibly helpful in understanding the role of punctuation in written language. Punctuation also appears to play a crucial role in improving efficiency of the stylometric methods.

References:

1. Stanisz, T., Kwapień, J., Drożdż, S. (2019). Linguistic data mining with complex networks: A stylometric-oriented approach. Information Sciences, 482. doi: 10.1016/j.ins.2019.01.040

2. Kulig, A., Kwapień, J., Stanisz, T., Drożdż, S. (2017). In narrative texts punctuation marks obey the same statistics as words. Information Sciences, 375. doi: 10.1016/j.ins.2016.09.051

Poster ECONO

Alekdander Jakimowicz, Institute of Economics, Polish Academy of Sciences, Pl. Deölad 1, Warsaw, Poland

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Abstract title:
Macroeconomic Effects of Swiss-franc Loans on the Polish Economy

Abstract:

Mortgage loans indexed to Swiss Francs appeared in the Polish economy on a massive scale in the years 2006–2008, as they accounted for the vast majority of loans granted to consumers for the purchase of residential property at that time. Initially, they were advertised as more advantageous than loans granted in domestic currency due to their relatively lower interest rate. This resulted in the interest of a large number of consumers in Swiss-franc loans, as a result of which the total number of such loans is estimated at nearly one million. However, it quickly became apparent that consumers who had taken out such loans were exposed to unlimited foreign exchange risk. This was caused by a significant depreciation of the Polish zloty against the Swiss franc. The economic situation of consumers was also aggravated by the fact that they were charged for the bid-ask spread, the amount of which was freely determined by the banks. Since these loans were granted for several decades, their economic impact will be felt by at least several generations of consumers. In this context, the strong and long-term impact of these loans on the Keynesian consumption function is evident. The significance of these loans for the Polish economy was examined using the model by P.A. Samuelson, winner of the 1970 Nobel Prize in Economics. As it turns out, solving the problem of Swiss-franc loans requires systemic changes as provided for in the Council Directive 93/13/EEC of 5 April 1993 on unfair terms in consumer contracts, whereas government assistance in this area in the form of increased expenditure may prove ineffective.

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Abstract title:
New Measure of Economic Development Based on the Four-Colour Theorem

Abstract:

The location quotient is one of the basic quantitative tools for identifying the regional poles and the turnpikes of economic growth in spatial economy. The disadvantage of this traditional measure is the limited scope of economic information contained in it. The new measure of economic development proposed in the article encompasses a complex spectrum of phenomena in one number, as it takes into account the influence of the public administration sector, as well as peak technology in the form of ICT and its practical business models. It also takes into account the digital prosumption and the platforms

for participation. The participation platforms in the public administration sector are the websites of municipal public administration offices. A cluster analysis was used to distinguish four quality classes of these websites. These classes were assigned four different colours, which were then used to draw up a map of the selected province. Each municipality is marked with a colour that corresponds to the quality class of the website of the state administration office operating on its territory. The colour system resulting from the four-colour assumption and the corresponding dual graph play the role of a reference system in relation to each empirical colour distribution and another dual graph related to it. The measure of the economic development of a region

is the degree of reduction of the dual graph corresponding to the empirical distribution of colours, which identifies the actual growth poles and determines the routes of growth. The presented indicator better and more precisely identifies poles and routes of economic growth than the traditional location quotient.

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Abstract title:

Diversification of the Innovation Strategy of Polish Industrial Processing Companies

Abstract:

This article aims to define the innovation strategy of industrial enterprises in the period 2012–2014 with emphasis on the effects of the exogenous shock caused by the global financial crisis. The diversification of the innovation strategy is studied in relation to the size of the enterprise, i.e. depending on whether it is small, medium or large. This categorisation is based on staffing limits and financial criteria, such as annual turnover and/or annual balance sheet total. In doing so, consideration is given to the supply of the factors of production, i.e. labour and capital. The research included such variables as the geographical scope of markets, types of innovative activity of enterprises, enterprises' decisions regarding forms of introduced innovations, ways of developing product and process innovations, types of eco-innovations most frequently encountered in industrial processing and innovation barriers. The correspondence analysis was chosen as the research method, because of the large number of variables and the need to specify the relationship between them. The results were ambivalent. On the one hand, industrial processing enterprises showed a low propensity for innovation, which could have resulted from the persistence of exogenous shock effects while, on the other hand, they also exhibited a growing interest in eco-innovation. This indicates the need to initiate a pro-innovation policy focused on eco-innovation, which may contribute to overcoming the negative effects of external shock in the form of psychological reluctance to innovation, manifested by excessive caution in their planning and commercialisation.

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Abstract title:

Piecewise Linear Representation of Economic Time Series

Abstract:

A method of calculation based on piecewise linear representation for estimation of fractal properties is presented. The piecewise linear representation has the adventage of being straightforward and simple. The method is based on calculating local maxima and minima in time series. The representation is tested with many data sets. In addition, we identify fractal regimes in different data samples. The mathematical procedure is used in different econophysics models [1,2].

[1] H. Cruz, Proc. 13th Econophysics Colloquium (EC) and 9th Symposium of Physics in Economy and Social Sciences (FENS), 2017.

[2] H. Cruz, Acta Physica Polonica A 133, 1347 (2018).

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- Janusz Szwabiński, Politechnika Wrocławska

Abstract title:
Best Portfolio Management Strategies For Synthetic and Real Assets

Abstract:

Managing investment portfolios is an old and well know problem in financial mathematics and engineering as well as in econometrics. We analysed various strategies of building such portfolios in different market

conditions. A special attention was given to several realisations of a so called balanced portfolio, which is rooted in the natural "buy-low-sell-high" principle. Results show that there is no universal strategy, because they perform differently in different circumstances (e.g. for varying transaction costs). Moreover, the planned time of investment may also have a significant impact on the profitability of certain strategies. All methods have been tested with both simulated trajectories and real data from the Polish stock market.

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Abstract title:
Measuring a strength of detected correlations between incomes of spouses

Abstract:

This paper studies possible correlations between the women and men incomes in the USA. In our previous paper, when we proposed a two-parameter model of spouses income distribution, we observed that the separate incomes of women and men could be correlated. In this paper we prove the such correlations do exist, by computing the standard |Pearson correlation coefficient. It is interesting to note that these correlations are more pronounced for incomes greater than the specific threshold. Using the simulation methods we estimate the expected incomes of the family members, resemble the empirical data.

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Abstract title:
A new approach to application of Markov models in credit risk estimation

Abstract:

The concept of ECL (Expected Credit Loss) introduced in 2018 under IFRS 9 standards has an enormous impact on risk management models. One has to take into account a decline of credit rating since the contract date. Therefore there are baskets of asserts (related to three stages) distinguished. Depending on the stage assigned to the instrument the expected loss is calculated either in the given horizon or over its entire lifetime.

From the supervisor's perspective, such an approach allows for evaluating relevant financial reserves that include financial risk for all transactions in a given basket. Supervising regulations allow for application of both methods, based on statistical and machine learning algorithms. Unfortunately, due to the lack of experience in machine learning applications to credit risk estimation as described in IFRS 9 regulations, machine learning methods are seldom used. Analysis of Goodness-of-Fit (GOF) type measures in machine learning models and their comparison with classical approach such as logistic regression can be a convincing argument to apply them.

The research done by authors is of great importance for undertaking practical application of machine learning (allowed in IFRS 9). In the paper the authors consider models of the main of three risk components, Loss Given Default (LGD). Supervising regulations indicate that for many exposures one has to apply either survival curves or Markov chain models. We propose an approach based on machine learning. Also new measures of GOF allowing for comparison of statistical and machine learning approach will be given. Calculations will be done on real data.

Michał Chorowski,

Abstract title:

Modeling, using the Monte Carlo method, the influence of interventionism on the evolution of the company market

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Abstract title:

Towards equivalent of the Reynolds number in time series of housing prices for analyzing trends for needs of real estate management

Abstract:

In hydrodynamics, the Reynolds number is used to determine transitions between various flow regimes of fluids, lying on a spectrum from laminar (stable) to turbulent fluid dynamics. The essence of the presented research is the search for an analogy between the evolution of real estate prices and hydrodynamic phenomena accompanying the movement of bodies in the incompressible fluid. The aim of the article is to develop an equivalent of the Reynolds number (Re) used in the hydrodynamics to be implemented to analyze the dynamics of time series of housing prices. The time horizon of research (2001-2017) includes a period of rapid price growths in 2006-2007. Having the equivalent Reynolds number for the housing market, it would be possible to determine critical points between the stable and unstable evolution of property prices.

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Abstract title:
Three-part model of the distribution of the household incomes

Abstract:

Previous studies of Polish household budgets usually assumed two-part distributions of the incomes. Low and medium incomes have been approximated by a log-normal distribution. On the other hand high incomes have been described by the Pareto Type I model. In this paper we analyze cumulative distribution (cdf) of Polish household incomes. We observe significant deviations from the log-normal model describing the lowest incomes. We propose the model which better describes the left end of the income distribution. Eventually we construct a distribution consisting of three parts, that seems to be well suited to correctly describe the whole range of the incomes.

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Abstract title:
Some Statistical Models for Random Markets

Abstract:

In this communication, some economic gas-like models for random conservative markets are addressed. In these models the agents trade by pairs bringing the system toward an statistical equilibrium, this is the asymptotic wealth distribution. The time evolution of these models are given by nonlinear functional mappings.

These maps are nonlinear operators in the space of wealth distributions, which are shown to conserve the total and mean wealth of the economic system. Different asymptotic results for several models are presented. The decay to the exponential distribution is found in some of them and a transition to power-like distributions is sketched when a naive bank system is suggested. Simulations and implementations of these systems in different topologies are also presented. All these models put in evidence that economic inequality is a natural consequence of randomness, and that different kinds of randomness give place to different kinds of stable economic inequality.

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Abstract title:
Validating analogy between time series of housing prices and damped harmonic oscillations

Abstract

The aim of the article is to employ the model of a damped harmonic oscillator (DHO) to study the time-dependent evolution of housing prices. The study treats the housing markets as complex, adaptive dynamic systems, which develop through synergistic network responses. This assumption is based on an observation of the correlation of trends in housing prices, despite principal differences in the geospatial attributes of the

markets under study. The analogy between housing market and nonlinear harmonic oscillator is drawn from observation that a steep rise in housing prices (2006-2007) is in fact a transient disturbance to otherwise stable price evolution and is followed by an asymptotic return to a long-term equilibrium in a series of oscillations (system relaxation). Using the model of damped oscillator, it has been shown that the housing markets are highly inert. This can be seen during periods of rapid changes, when they quickly undergo deep structural transformations, although the pace of changes during long-term evolution is slow enough to keep the systems close to the state of equilibrium. The delay in the time series relative to each other indicates the dominant role of the Warsaw market as the initiator of changes and suggests the existence of links between markets, which supports the concept of local housing markets as a network of communicating vessels.

CO-ORGANIZERS: