



Wellcome to the Econophysics Colloquium 2016!

In this booklet you will find relevant information about the colloquium, like the program, list of abstracts, and list of participants and of participating institutions.

We hope you all have a pleasant and productive time here in São Paulo!

Program

	Wednesday, 27	Thursday, 28	Friday, 29
8.30 – 9:15 am	Registration		
9:15 – 9.30 am	Welcome		
9.30 - 10.30 am	Universality in the interoccurrence times in finance and elsewhere <i>(C. Tsallis)</i>	<i>Multiplex dependence structure of financial markets</i> <i>(T. Di Matteo)</i>	<i>Measuring economic behavior using online data</i> <i>(S. Moat)</i>
10.30-11.00 am	Coffee Break	Coffee Break	Coffee Break
11.00-12.00 am	Financial markets, self-organized criticality and random strategies <i>(A. Rapisarda)</i>	<i>Sensing human activity using online data</i> <i>(T. Preis)</i>	Portfolio optimization under expected shortfall: contour maps of estimation error <i>(F. Caccioli)</i>
12.00-2.00 pm	Lunch	Lunch	Lunch
2.00-3.00 pm	IFT-Colloquium <i>(R. Mantegna)</i>	<i>Trading networks at NASDAQ OMX Helsinki</i> <i>(R. Mantegna)</i>	Complexity driven collapses in large random economies <i>(G. Livan)</i>
3.00-4.00 pm	Poster Session	Financial market crashes can be quantitatively forecasted <i>(S.A. Cheong)</i>	Parallel Sessions 2A and 2B
4.00-4.30 pm	Coffee Break	Coffee Break	Closing
4.30-5.30 pm	<i>Macroeconomic modelling with heterogeneous agents: the master equation approach</i> <i>(M. Grasselli)</i>	Discussion Group: Financial crises and systemic risk - Presentation by Thiago Christiano Silva (Banco Central)	
5.45-6.45 pm	Parallel Sessions 1A and 1B	Discussion Group: Critical transitions in markets	
7.00-10.00 pm		Dinner	

Wednesday, 27 July

Plenary Sessions (morning)

Auditorium 9.30 am – 12 pm

9.30-10.30 am

Universality in the Interoccurrence times in finance and elsewhere

Constantino Tsallis (CBPF, Brazil)

A plethora of natural, artificial and social systems exist which do not belong to the Boltzmann-Gibbs (BG) statistical-mechanical world, based on the standard *additive* entropy SBG and its associated exponential BG factor. Frequent behaviors in such complex systems have been shown to be closely related to q-statistics instead, based on the *nonadditive* entropy S_q (with $S_1 = SBG$), and its associated q-exponential factor which generalizes the usual BG one. In fact, a wide range of phenomena of quite different nature exist which can be described and, in the simplest cases, understood through analytic (and explicit) functions and probability distributions which exhibit some universal features. Universality classes are concomitantly observed which can be characterized through indices such as q. We will exhibit here some such cases, namely concerning the distribution of inter-occurrence (or inter- event) times in the areas of finance, earthquakes and genomes. These observations neatly challenge the paradigm (traditional in physics since the magnificent Boltzmann discoveries in the 1870's) that the physical entropic functional is unique.

Chairperson: Andrea Rapisarda

11.00 am - 12.00 pm

Self-Organized Criticality models and random strategies in financial markets

Andrea Rapisarda (INFN Sezioni di Catania – Uni. Catania, Italy)

I will present some financial market models, characterized by self-organized criticality, that are able to generate endogenously a realistic price dynamics and to reproduce well-known stylized facts. In a community of heterogeneous traders, the spreading of information, based on a realistic imitative behavior, drives contagion and causes market fragility. It will be shown how the introduction of a small number of random traders is able to stabilize the market and produce beneficial effects both a micro and macro level.

Chairperson: Constantino Tsallis

IFT-Colloquium

Auditorium 2.00-3.00 pm

Talk on Econophysics by Rosário Mantegna (Central European University, Hungary; Università degli Studi di Palermo, Italy)

This talk is open to all academics of the IFT and also to all participants of the colloquium.

Poster session (afternoon)

Foyer 3.00 –4.00 pm

The poster session opens at this time, but poster will be on display for the whole colloquium. We ask the participants responsible for the posters to place them in the appropriate places by noon on Wednesday, and to remain close to their posters on the time allocated for this.

Investment strategy modelling based on trades and orders

Alef Willis Magno Miranda, Adriano Cesar Machado Pereira (UFMG, Brazil)

The financial market is an open challenge to different types of people. To Brazilian daytrade investors, the great question concerns the right moment of buying or selling. In order to decide when to operate, they use technical analysis to decide such right moment. To researchers, the financial market represents a behavioral challenge, searching for causality relations. Studies on price behavior of stocks and future contracts are common. Temporal series techniques, such as artificial intelligence and machine learning, are also explored. The use of autonomous agents in financial markets is becoming common. Their decisions are precise and they are not susceptible to investors' emotions. Their capacity of data processing makes them a useful tool in such scenario. The current work proposes an investment strategy modelling, which can be executed by an autonomous agent. Instead of using time-grouped data, like candlesticks, the strategy uses data with the smallest granularity, thus it uses orders and trades in real time. In order to evaluate the strategy, an optimal model representing the best decisions is used to comparison.

A model of limited attention for the financial market

Fernando A. Ducha (CEFET-MG, Brazil)

We present a multi-agent based model with limited attention that promotes competition among memes, applied to the study of stock markets. The model brings several elements, including two kinds of agents, namely, the news agencies, that have the role of generating the cascades of new memes, and the economic agents, that can forward the memes they receive and actually make transactions in the financial market. These agents are connected by a directed frozen network following one of the configurations, Erdős-Rényi or Albert-Barabasi (small-world). In this model, agents have two lists that help them to take decisions. One list reflects posts received from followers, we call it screen. The other reflects posts that were made by the agent, we call it memory. In works about information spreading, the meme normally is modelled as an empty packet carrying its own id. In this model, it receives a weight representing its strength as information about the asset: being negative means it is an information that encourages selling, being positive means it is information that encourages buying. By this perspective, we assumed that the distribution of meme weights is Gaussian. In the real life, agents take economic decisions based on several factors. In our model, we denominate the sum of meme weights from the memories of the agents as their humor towards buying or selling the asset. The dynamics of the model is compared to market empirical dynamics through the investigation of Hurst exponent, heavy tails and scaling.

The complex Tsallis parameter and its impact in econophysics

Everton Murilo Carvalho de Abreu (Universidade Federal Rural do Rio de Janeiro, Brazil)

In this work we will analyze the implications of the assumption of a complex Tsallis parameter in econophysics.

Forecasting Financial Time Series using Meta-Classifer based on Genetic Programming

Carlos A. Silva de Assis (CEFET-MG, Brazil); Adriano C. Machado Pereira (UFMG, Brazil); Eduardo G. Carrano (UFMG, Brazil)

Predicting the behavior of financial assets is a task that has been researched by various techniques over the last years. Despite there exists an extensive research in this area, the task to predict asset prices or trends remains an extremely difficult task because due to the uncertainties of the financial markets and other factors. This work proposes and implement a meta-classifier based on Genetic Programming to find price trends for the stock market assets. Several classifiers are combined to be optimized by Genetic Programming. Among them are: Support Vector Machine (SVM), Multilayer Perceptron (MLP), Random Forest (RF), Decision Tree (J48), Bayes Net, Genetic Algorithm (GA). Preliminary tests were performed with four assets, from Brazilian Stock Market (BM&FBovespa): Petrobrás (PETR4), Usiminas (USIM5), Bovespa (BOVA11) and Vale (VALE5). Data set is from July 2014 to July 2015. The preliminary results are promising, showing up to 60% in accuracy and some financial results achieve with 40% of earnings without transaction costs.

Predicting the direction of prices on the stock market using recurrent neural networks

David Michael Quirino Nelson (UFMG, Brazil)

The financial market has been the object of various studies that seek to model or predict its behavior. However, this prediction is a great challenge, since this market is a complex and chaotic environment. The usage of Machine Learning has become a popular prediction method for transactions on the stock market and has been offering satisfactory results in many cases for its capacity of learning from history to infer future trends. This project proposes the creation of a model using techniques like deep learning and recurrent neural networks to learn, describe and predict the behavior of assets on the stock market from a big volume of information, such as historical price data and technical analysis indicators. There were executed a series of preliminary experiments and various metrics were collected from the results in order to confirm that the proposed approach is promising, getting up to 58% of precision on determining the price direction for some assets, which leads to believe that it can result in a model capable of predicting price movement with satisfactory precision and consistency.

Model for Market Dynamics financial based on SIR model

Carla Liliane Guedes Fonseca (PPGMMC, CEFET-MG, Brazil)

We seek to model and understand the dynamics of asset prices through differential equations with reference to the SIR epidemic model, complemented by the use of statistical tools. In analogy to the SIR model was constructed a composite model of four populations: infected of purchase, infected of sale, susceptible of purchase and susceptible of sale, which resulted in a four nonlinear differential equations. The environment in question, the stock market, consists of a limited investor population. In parallel to the model equations, the price equation was formulated. The model was investigated by analyzing the eigenvalues of their Jacobian at critical points, and it was extracted several dynamic, all simulated on a specific program, built by MATLAB software. Secondly, it was inserted Randomness in the model for further analysis, which apparently has the price curves produced by it more like the curves found in real series. The idea is to contribute to modeling financial systems through simple deterministic systems that add stochastic characteristics.

A model based on a system of linear differential equations for the price dynamics of financial assets

Paloma de Oliveira Campos Xavier (PPGMMC - CEFET-MG, Centro Universitário UNA, Brazil)

The paper proposes to develop a model based on a system of homogeneous linear differential equations in an attempt to describe the volatility of the price of a financial asset. The present coefficients in the equations that comprise the system determine the purchase or sale position of the agents involved in this simulation. We also present in these same equations a term that is the volatility of the price, comparing it to a pre-set price, called the fair price (try so with this term a fundamentalist feature for agents). The variables present in this system evolve based on the quantity supplied or demanded given by agents as well as the volatility of the price of the asset contributes to the decision of the agents in seeking or offering the asset. The model highlights the behavior of agents in differentiating them imitators, antiimitadores or neutral position of others. The results found and based on references from the area, evidenced most imitator feature of agents, and both define a term that equilibrie performance of transactions presenting a cash limiter feature, so that they do not occur in order to misrepresent the process transactions in the market. We also present within the model the variation of two groups of agents, some of the agents have the fundamental characteristic, and consider their only based actions on price volatility, while the other group has the speculator feature, basing their decisions on the behavior of other agents (imitators). Within this process also provoke a change in the price defined as fair to both groups of agents. We note that in our model as the market presents a larger group of speculators, we have a cushion to reach the balance stared at the right price. We believe that the dynamics of the model presents interesting results to find characteristic exponents for series of active data in emerging markets, but we need a random term in the model to find characteristic exponents close to efficient these markets.

Option pricing with non-Gaussian models: Application to the Brazilian market

William Oswaldo Sosa Correa (UFPE, Brazil)

We present an empirical analysis of different option pricing models as applied to options on the Ibovespa index of the São Paulo Stock Exchange. Besides the standard Black-Scholes for option pricing model, which assumes that the returns are Gaussianly distributed, two non-Gaussian models are analyzed, namely, the exponential model [1,2] and the model introduced by Borland [3] which assumes that the returns follow a q -Gaussian distribution (also called Tsallis distributions), where $q=1$ recovers the Gaussian distribution. We compare the predictions of these models with the actual market prices for options on the Ibovespa index during a period spanning two years of trading (2005-2006). To do this, we analyzed 470 option chains in the period considered, where an option chain consists of all the options with same expiration date (and of course different strike prices) that are traded on a particular day. For each option chain, we fit the theoretical price formulas to the empirical data (i.e., the closing market prices as a function of the strike price). It is found that at times near the option expiration date the exponential model performs better than the Black-Scholes formula, in the sense that it fits the empirical data better than does the latter model. On the other hand, the Black-Scholes model usually gives a better fit for times longer than 20 days to maturity. As for the q -Gaussian model, we find that $q=1$ fits the data better in the majority (75%) of the cases. Moreover, in the cases where q differs from unity, the exponential models usually performs better. We thus conclude that introducing a power-law distribution (such as the q -Gaussian distribution) does not significantly improve option pricing in the Brazilian market, in comparison to the Gaussian or exponential models.

Trend prediction model of stock returns based on the system EDO

Charlene Cássia de Resende (PPGMMC, CEFET-MG, Brazil)

Under the efficient market hypothesis, all available relevant information is rapidly absorbed by the market and incorporated in asset values. However, studies indicate that the market is not as efficient in terms of rapid absorption of information and setting prices. Also show that the markets of emerging countries are more inefficient than the markets of developed countries. Faced with the possibility of questioning the efficient market hypothesis, believing that a temporary financial series present some standard and, therefore, after prices bring some information of the future price, we developed a model for the dynamics of prices based on a system of differential equations. The model aims to understand the evolution of the stock market and the possible prediction of future price trend. The data were closing prices, with granularity of 5 minutes, of 3 stocks traded on the BOVESPA. They are two stocks that showed a linear correlation and other uncorrelated with both. Optimization techniques were used to find matrices of optimal coefficients to adapt to longer intervals. Such matrices and other parameters were used in the prediction model developed from the linear differential equations. The obtained successes rates differ from a completely random process. To classify and validate these findings used matrices of confusion and hypothesis tests.

Intraday seasonality and non-stationarity trading volume in financial markets: the impact of the 200

Michelle Bau Graczyk (CBPF, Brazil)

Using high-order statistical analysis and random matrix theory, we report the study of intraday and non-stationarity properties of trading volume in financial markets, namely the equities that composed the Dow Jones Industrial Average in the second half of 2004 that spanned the interval from the first half of 2003 to the first half of 2014. Besides providing proof that the morning and the afternoon dynamics are clearly different, our results show that the trading profile suffered a significant change corresponding to a flattening of the well-known U-shape of financial markets and important modifications to the kurtosis, which is the statistical measure capable of quantifying the heuristic 'lunch effect'. Collectively, we show that the dynamics of trading volume is ruled by a robust market mode that increases its significance through the day. Such collective trading profile evinces a strong disruption from 2008 onwards pointing once more to the relevance of the subprime crisis.

Characterization of the Stock Market via Horizontal Visibility Graph and Information Theory

Bruna Amin Gonçalves (CEFET-MG, Brazil)

Complex networks theory have gained wider applicability since methods for transformation of time series to networks were proposed and successfully tested. In the last few years, The method called Horizontal Visibility Graph (*Horizontal Visibility Graph* - HVG) [B Luque *et al.*, Phys. Rev. E 80: 046103 (2009)], that has the function of converting a time series into a graph, has become a popular method due to its simplicity and good results when applied to natural and artificially generated data. In this work, world stock markets prices were evaluated by methodology that combines Horizontal Visibility Graph with Information Theory quantifiers. Through this analysis, has been shown that this methodology can be used as a quantifier to characterize the stage of market development of world stock prices.

Influence of news on the stocks of Petrobras in the Brazilian Stock Exchange

Karina Miyuki Fugita (Insper)

Petrobras is the biggest oil company in Brazil and one of the largest in the world. In recent years it has seen its stock prices plummet to about 10% of its former value, mainly due to corruption scandals involving the Brazilian government. Seldom has a stock price been more subject to the effect of economic and political news. We use data from stocks of Petrobras, of other oil companies, of commodities, and of news in order to gauge the impact that news have on the stocks of this company, using tools like correlation and transfer entropy, and centralities based on complex network theory.

Forecast model for financial time series: An approach based on harmonic oscillators

Marcelo Moreira Garcia (CEFET-MG, Brazil)

The stock market is very dynamic and sensitive to internal and external events. This dynamism and sensitivity brings great complexity in forecasting price of the assets traded. This work proposes a price trend forecasting model based on harmonic oscillators, where a curve fitting in the time series is performed in order to obtain the optimal parameters of the equation in a sliding window. With the hope that the parameters persist for some time, price predictions are extracted, generating trends forecasts for 5 future periods. The proposed model was applied to the time series of adjusted 15 minutes close prices of some stock market assets traded in BOVESPA in the period from January to December 2014. This is a work in progress, but the results indicate that the model has a predictive power, indicating inefficiency in the market and in the period analyzed.

Multifractality in finance

Riccardo Junior Buonocore (King's College London), Tomaso Aste (University College London), Tiziana Di Matteo (King's College London)

The multifractal behaviour of the financial time-series is one of the acknowledged stylized facts in the literature. Many works have been dedicated to its empirical characterization, reporting strong evidence of its presence in financial markets and several models have been proposed; also many estimation methods are present in the literature. The source of the measured multifractality in financial markets has been long debated. It was pointed out that the main two sources are the power law tails and the non linear autocorrelation of the analysed time-series. According to our research, the analysis of the scaling of the absolute moments of the log-returns with respect to different aggregation horizons shows two results: the true source of multifractality is the causal structure of the empirical time-series, the measures at small aggregation horizon are strongly biased. These results raised a question on how to choose, in a statistical sense, an appropriate region where measuring the scaling. In order to address this issue we propose a method to achieve an unbiased estimation of the scaling exponents.

Plenary Sessions (late afternoon)

Auditorium 4.30 –5.30 pm

4.30-5.30 pm

Chairperson: Benjamin Miranda Tabak

Macroeconomic modelling with heterogeneous agents: the master equation approach

Matheus Grasselli (McMaster University and Fields Institute, Canada)

Modern mainstream macroeconomics seeks to avoid ad hoc assumptions and inconsistent policy prescriptions by being micro-founded, meaning that models of aggregate behaviour ought to be entirely derived from assumptions made on individual agents. The problem with this approach is that, as soon as some mild heterogeneity is introduced in the population of agents, the results of general equilibrium are not guaranteed to hold, as evidenced by the celebrated (albeit negative) Sonnenschein–Mantel–Debreu theorem. An alternative approach inspired by the older Keynesian revolution is to treat macroeconomics as a subject on its own right and consider the phenomenological relationships between aggregate quantities directly. This is effective and has the advantage of being much closer to available data, but still somewhat unsatisfactory, as it neglects decision making by individual agents. Another approach is to revert back to agents but abandon the constraints of equilibrium and utility optimization, often relying on numerical simulations to obtain aggregate behaviour. In this talk I describe yet another alternative approach inspired by statistical physics, whereby heterogeneous agents transition between different ‘types’ according to rates that depend on aggregate variables, thereby providing an interaction between the fast time scale of individual decision making and the slower dynamics of macroeconomic aggregates. I present an example capturing the distinction proposed by Hyman Minsky between hedge, speculative, and Ponzi financing.

Parallel Session 1A – Financial Models (early evening)

Auditorium 5.45-6.45 pm

Chairperson: Benjamin Miranda Tabak

Forecasting Financial Time Series using Meta-Classifier based on Genetic Programming

5.45-6.00 pm

Carlos A. Silva de Assis (CEFET-MG, Brazil); Adriano C. Machado Pereira (UFMG, Brazil); Eduardo G. Carrano (UFMG, Brazil)

Predicting the behavior of financial assets is a task that has been researched by various techniques over the last years. Despite there exists an extensive research in this area, the task to predict asset prices or trends remains an extremely difficult task because due to the uncertainties of the financial markets and other factors. This work proposes and implement a meta-classifier based on Genetic Programming to find price trends for the stock market assets. Several classifiers are combined to be optimized by Genetic Programming. Among them are: Support Vector Machine (SVM), Multilayer Perceptron (MLP), Random Forest (RF), Decision Tree (J48), Bayes Net, Genetic Algorithm (GA). Preliminary tests were performed with four assets, from Brazilian Stock Market (BM&FBovespa): Petrobrás (PETR4), Usiminas (USIM5), Bovespa (BOVA11) and Vale (VALE5). Data set is from July 2014 to July 2015. The preliminary results are promising, showing up to 60% in accuracy and some financial results achieve with 40% of earnings without transaction costs.

Predicting the direction of prices on the stock market using recurrent neural networks

6:00-6.15 pm

David Michael Quirino Nelson (UFMG, Brazil)

The financial market has been the object of various studies that seek to model or predict its behavior. However, this prediction is a great challenge, since this market is a complex and chaotic environment. The usage of Machine Learning has become a popular prediction method for transactions on the stock market and has been offering satisfactory results in many cases for its capacity of learning from history to infer future trends. This project proposes the creation of a model using techniques like deep learning and recurrent neural networks to learn, describe and predict the behavior of assets on the stock market from a big volume of information, such as historical price data and technical analysis indicators. There were executed a series of preliminary experiments and various metrics were collected from the results in order to confirm that the proposed approach is promising, getting up to 58% of precision on determining the price direction for some assets, which leads to believe that it can result in a model capable of predicting price movement with satisfactory precision and consistency.

Tsallis Statistics in the Income Distribution of Brazil

6.15-6.30 pm

Marcelo Byrro Ribeiro (UFRJ, Brazil)

This work discusses the empirical evidence of Tsallis statistical functions in the personal income distribution of Brazil. Yearly samples from 1978 to 2014 were linearized by the q -logarithm and straight lines were fitted to the entire range of the income data in all samples, producing a two-parameters-only single function representation of the whole distribution in every year. The results showed that the time evolution of the parameters is periodic and plotting one in terms of the other reveals a cycle mostly clockwise. It was also found that the empirical data oscillate periodically around the fitted straight lines with the amplitude growing as the income values increase. Since the entire income data range can be fitted by a single function, this raises questions on previous results claiming that the income distribution is constituted by a well defined two-classes-base income structure, since such a division in two very distinct income classes might not be an intrinsic property of societies, but a consequence of an a priori fitting-choice procedure that may leave aside possibly important income dynamics at the intermediate levels.

Financial Networks and Systemic Fragility

6.30-6.45 pm

Benjamin Miranda Tabak (Universidade Católica de Brasília e Senado Federal, Brazil)

We study cascade of failures in multilayer financial networks with heterogeneous agents. We develop a flexible framework that allows for the evaluation of systemic risk and demonstrate that the model converges to a unique fixed point. We model a financial accelerator engine at the microeconomic level that incorporates feedback between the real and the financial sectors using contagion transmission channels such as loan defaults, bank credit crunches, deposit withdrawals, and deposit defaults. Using this model, we provide theoretical analysis both on the cross-sectional and time components of systemic risk. In the first, we demonstrate how idiosyncratic shocks to microeconomic agents can develop into systemic events. In the second, we investigate the structural causes of systemic risk variations in evolving financial networks. We find closed form expressions in both approaches with clear economic interpretation. We illustrate and confirm our theoretical predictions using a comprehensive and unique dataset on micro-level firm and bank data for Brazil.

Parallel Session 1B – Agent-based models

Room 3 5.45-6.45 pm

Chairperson: Allbens Atman Picardi Faria

Investment strategy modelling based on trades and orders

5.45-6.00 pm

Alef Willis Magno Miranda, Adriano Cesar Machado Pereira (UFMG, Brazil)

The financial market is an open challenge to different types of people. To Brazilian daytrade investors, the great question concerns the right moment of buying or selling. In order to decide when to operate, they use technical analysis to decide such right moment. To researchers, the financial market represents a behavioral challenge, searching for causality relations. Studies on price behavior of stocks and future contracts are common. Temporal series techniques, such as artificial intelligence and machine learning, are also explored. The use of autonomous agents in financial markets is becoming common. Their decisions are precise and they are not susceptible to investors' emotions. Their capacity of data processing makes them a useful tool in such scenario. The current work proposes an investment strategy modelling, which can be executed by an autonomous agent. Instead of using time-grouped data, like candlesticks, the strategy uses data with the smallest granularity, thus it uses orders and trades in real time. In order to evaluate the strategy, an optimal model representing the best decisions is used for comparison.

Is the anti-imitation a good strategy in a complex network when combining a technical analysis and psychological behavior of the investors?

6.00-6.15 pm

Fischer Stefan Meira (CEFET-MG, Brazil)

Behavioral Finance has become an important field of study mainly for taking into account behavioral aspects of the investors to explain some features observed in the Stock Market. Econophysics has brought many tools from the statistical physics, specially statistical mechanics which has become an innovative interdisciplinary approach proposed to describe several important features of the Financial Market. Here, we propose an extension of our behavioral finance model considering a new algorithm for guiding the investment decision based on a technical analysis. Considering a complex network to connect the investors through the financial market, we analyze how the fluctuations of the index are affected when a decision is taken from the conclusions obtained of technical analysis on the trend of the temporal series of the stock market index and the behavior of the neighborhood of the investors. We study how a wealth distribution is affected by setting a stochastic process to combine two different strategies for the decision making: first strategy is based on the neighborhood of the investor where each investor takes a decision depending on his own psychological profile (Imitation, Anti-Imitation, Indifferent (Random Trader)); second strategy is built for considering the momentum of the index oscillations (technical analysis), applying a dynamic on the hubs of the network. Interesting results from simulations have shown how anti-imitator investors become a profitable strategy taking into account the wealth distribution through a complex network.

A limited attention model for the financial market.

6.15-6.30 pm

Fernando A. Ducha (CEFET-MG, Brazil)

We present a multi-agent based model with limited attention that promotes competition among memes, applied to the study of stock markets. The model brings several elements, including two kinds of agents, namely, the news agencies, that have the role of generating the cascades of new memes, and the economic agents, that can forward the memes they receive and actually make transactions in the financial market.

These agents are connected by a directed frozen network following one of the configurations, Erdős-Rényi or Albert-Barabasi (small-world). In this model, agents have two lists that help them to take decisions. One list reflects posts received from followers, we call it screen. The other reflects posts that were made by the agent, we call it memory. In works about information spreading, the meme normally is modelled as an empty packet carrying its own id. In this model, it receives a weight representing its strength as information about the asset: being negative means it is an information that encourages selling, being positive means it is information that encourages buying. By this perspective, we assumed that the distribution of meme weights is Gaussian. In the real life, agents take economic decisions based on several factors. In our model, we denominate the sum of meme weights from the memories of the agents as their humor towards buying or selling the asset. The dynamics of the model is compared to market empirical dynamics through the investigation of Hurst exponent, heavy tails and scaling.

Order book dynamics in a cellular automata model of behavioral investors

6.30-6.45 pm

Allbens Atman Picardi Faria (CEFET-MG, Brazil)

We show some recent developments concerning the implementation of an order book into a cellular automata model of behavioral investors. We study the dynamics of the order book considering the behavioral profile of the investors. Besides the usual imitation, anti-imitation and random profiles, we have included a technical analysis factor in the decision criteria used by the investors to make an option.

Thursday, 28 July

Plenary Sessions (morning)

Auditorium 9.30 am – 12 pm

9.30-10.30 pm

Multiplex dependence structure of financial markets

Tiziana Di Matteo (King's College London, UK)

In this talk we propose network-theoretic tools to filter information in large-scale datasets and we show that applications to financial data-sets can meaningfully identify industrial activities and structural market changes. Network filtering procedures are valuable tools for risk management and portfolio optimization too and they allow to construct probabilistic sparse modeling for financial systems that can be used for forecasting, stress testing and risk allocation. In particular we look at the dependence structure and we show that the use of the multiplex approach allows us to uncover important changes in the multiplex structure, associated with financial stress periods. We observe that some features are unique to the multiplex structure and would not be visible with the isolated analysis of each single layer [10].

Chairperson: Tobias Preis

11.00 am - 12.00 pm

Sensing human activity using online data

Tobias Preis (Warwick Business School, UK)

Our everyday usage of the Internet generates huge amounts of data on how humans collect and exchange information worldwide. In this talk, I will outline recent results of our research programme in which we investigate whether data from sources such as Google, Wikipedia and Twitter can be used to gain new insight into real world human behaviour. I will provide case studies from a range of domains, including crowd size estimation and identifying early warning signs of stock market moves.

Chairperson: Tiziana Di Matteo

Plenary Sessions (afternoon)

Auditorium 9.30 am – 12 pm

2.00-3.00 pm

Dynamics of synchronicity of trading decisions of investors at the Nordic Stock Exchange

Rosário Mantegna (Central European University, Hungary; Università degli Studi di Palermo, Italy)

We investigate the investment timing of individual investors trading the Nokia asset at the Helsinki venue of the Nordic Stock Exchange. Data about the daily individual ownerships of Nokia shares have been obtained by Euroclear. We study the ownerships of Nokia shares of individual investors yearly recorded during the period from 1995 to 2009. The similarity between investment profile of investors is measured by using correlation as a similarity measure and statistically assessed with a variant of the methodology of statistically validated networks. We detect a dynamics of number of investors, number of active investors, average correlation between trading decisions of investors, and frequency and pattern similarity of trading decisions.

Specifically, we detect persistent similarity of trading decisions for clusters of investors with an over-expression of composition of some categories of investors.

Chairperson: Siew Ann Cheong

3.00-4.00 pm

Financial market crashes can be quantitatively forecasted

Siew Ann Cheong (Nanyang Technological University, Singapore)

The Global Financial Crisis of 2007-2008 wiped out US\$34 trillion across financial markets around the world, equivalent to the 2014 GDPs of the United States and the European Union combined. The defining moment of this crisis was the failure of Lehman Brothers in September 2008, which sent shock waves through financial markets around the world in the form of a pair of global market crashes: The October 2008 crash and the Asian Correction (March 2009). Had the Federal Reserve saw these crashes coming, they might have worked harder to bail out Lehman Brothers, and prevented the crashes altogether. In this talk, we show that some of these market crashes (like the March 2009 Asian Correction) can be predicted, if we assume a large number of adaptive traders employing competing trading strategies in financial markets. As the number of adherents for some strategies grow, others decline in the constant stir in strategy space. A market crash occurs when a strategy group grows into a giant component, and trader actions become increasingly correlated. This correlation carries over into the prices. By fitting tick-by-tick price movements of 20 stocks on the Singapore Exchange between January 2006 and December 2009 to a mean field formula derived from a model of fusions and fissions in strategy space, we find the mean predicted crash time range from end October 2008 to mid-February 2009 with early warning from four to six months prior to the crashes. Other large market crashes can be predicted in the same way.

Chairperson: Rosário Mantegna

Discussion Groups (early evening)

4.30-6.45 pm

Room 3

The discussion groups are an opportunity for researchers to exchange ideas on a topic of common interest in an informal way. Each will be led by a facilitator, and all participants are welcome to attend.

4.30-5.30 pm

Financial crises and systemic risk

Facilitator: Benjamin Miranda Tabak

Presentation by Thiago Christiano Silva (Banco Central do Brasil)

5.30-6.30 pm

Critical transitions in markets

Facilitator: Siew Ann Cheong

Friday, 29 July

Plenary Sessions (morning)

Auditorium 9.30 am – 12 pm

9.30-10.30 pm

Measuring economic behavior using online data

Suzy Moat (Warwick Business School, UK)

As a global society, we are now uploading increasing volumes of photographs to the Internet, creating vast volumes of data on where we are, what we are doing, and the environment we are spending time in. In this talk, I will describe recent work in which we investigate whether data recovered from photographs uploaded to the Internet can give us new insight into human behaviour in the real world. I will outline case studies in which we tackle problems such as measuring human movement around the globe, and evaluating whether the beauty of the environment we live in might affect our health.

Chairperson: Fabio Caccioli

11.00 am -12.00 pm

Portfolio Optimization under Expected Shortfall: Contour Maps of Estimation Error

Fabio Caccioli (University College London, UK)

The contour maps of the error of historical estimates for large random portfolios optimized under the risk measure Expected Shortfall (ES) are constructed. The contour maps allow one to quantitatively determine the sample size (the length of the time series) required by the optimization for a given number of different assets in the portfolio, at a given confidence level and a given level of relative estimation error. The necessary sample sizes invariably turn out to be unrealistically large for any reasonable choice of the number of assets and the confidence level. These results are obtained via analytical calculations based on methods borrowed from the statistical physics of random systems, supported by numerical simulations.

Chairperson: Suzy Moat

Plenary Session (afternoon)

Auditorium 9.30 am – 12 pm

2.00-3.00 pm

Complexity driven collapses in large random economies

Giacomo Livan (University College London, UK)

Aggregating the interactions of heterogeneous economic agents into large-scale macroeconomic behavior represents a major challenge. Mainstream Economics has often circumvented this issue by resorting to ad hoc, analytically tractable, aggregation schemes. On the other hand, computationally oriented research has favored the development of agent-based models aimed at capturing real-world complexity, which however are often beyond the reach of analytical description.

The Statistical Mechanics of disordered systems provides an appealing compromise between the two above endpoints. Indeed, the aggregate features of a large interacting complex system can often be recovered as

typical properties of ensembles of systems with suitably chosen random interactions. Furthermore, this approach captures sharp changes in collective behavior - i.e. phase transitions - which could hardly be explained from the behavior of a system's individual components.

I will discuss two applications of this approach. First, I will show how the proliferation of intermediate goods beyond a threshold can cause the collapse of industrial production in economies where firms compete to provide consumers with technological sophisticated goods. Second, I will show how an exceedingly large heterogeneity in the pricing models used by different players can precipitate financial markets into states where arbitrage opportunities emerge.

Chairperson: Allbens Atman Picardi Faria

Parallel Session 2A – Dynamical Models

Auditorium 3.00-4.00 pm

Chairperson: Kenta Yamada

Beliefs, Opinion Dynamics and Extremism

3.00-3.15 pm

André Cavalcanti Rocha Martins (EACH-USP, Brazil)

In order to understand why extreme opinions arise even when they are not supported by facts, I will present two variations of the continuous opinions and discrete actions (CODA) model. The variations will also illustrate how to obtain new models from assumptions about the social process. We will see that what the agents expect as an answer about the world has a powerful impact on how extreme their opinions can become. And I will show how this relates to problems with the way we treat our beliefs.

Wealth distribution and information flux in a differential equations model of financial market

3.15-3.30 pm

Arthur Rodrigo Bosco de Magalhães (CEFET-MG, Brazil)

The relation between wealth distribution and information flux is investigated through a model based on differential equations for a financial market in which there is only one kind of asset. The supply and demand of each agent correspond to a variable that evolves according to the particular financial position, the price the agent believes to be fair and the behavior of other agents. External information reaches the system through jumps in the prices believed to be fair. We focus on the influence of the distribution of these jumps, as well as the network morphology, on the dynamics of wealth.

The New York Times and hierarchical analysis

3.30-3.45 pm

Andrés Garcia (Universidad de Sonora, Mexico)

We use the concept of ultrametricity and tools from graph theory to analyze the taxonomy and hierarchical structure of the correlation matrix of a set of news from The New York Times and the corresponding return time series associated to 20 global financial indices along 10 trading months between the period 2015-2016. In order to quantify the collection of news, we constructed daily polarity time series from them via VADER sentiment analysis.

Blog entry model: reconstruction of popularity dynamics observed in large-scale blog data

3.45-4.00 pm

Kenta Yamada (The University of Tokyo, Japan)

Analyzing and modeling for complex human behavior becomes a major target as a twenty-first century science, thanks to a development of computer technology. The huge data of articles in cyber space written by humans such as blog and tweet is especially interesting database because the data directly reflects trends and topics in human society. For example, the number of blog entries including "earthquake" have a clear peak when a large earthquake occurs. By using a huge Japanese blog data base with the author's ID, we can observe not only the number of entries per day for any words, but also personal dynamics of blog entries. In this presentation, we report statistical properties and modeling for three major categories of words. The First is "ordinary words" which is used in our daily life, for example "soon". The number of entries of "soon" has a steady fluctuation. The Second is "News words", for example "Michael Jackson". We can observe clear jump and power law decaying in the number of entries of "Michael Jackson" after the news of which Michel Jackson died. It is remarkable that the function of decaying follows power law. We assume this decaying reflects a dropping interest in Michael Jackson. Additionally we can observe many examples of power law decaying in other words after big news. The Third is "Trending words", for example "Twitter". The number of entries of "Twitter" was increasing exponential from Oct. 2008 to Jun. 2010. Before 2008, most people didn't know the word Twitter, but now Twitter has become a very popular social networking tool. It is natural to consider that the time series implies the process. The fourth is "event words" which has growth and relaxation characterized by a power function around the peak day such as national holidays. We reproduced these dynamics by an agent-based model based on the SIR (Susceptible-Infected-Recovered) model which is well known in mathematical

Parallel Session 2B – Thermodynamics and Entropy applied to Finance

Room 3 3.00-4.00 pm

Chairperson: Aurelio Fernandez Bariviera

Information diffusion, cluster formation and entropy-based network dynamics in equity and commodity markets

3.00-3.15 pm

Leonidas Sandoval Junior (Insper, Brazil)

We investigate the interrelations between the U.S. equity and commodity markets. Using as tools the correlation and transfer entropy between time series of 12 commodities and 10 sector indices of the S&P 500, and the tools of complex networks, we build a dynamic set of networks that comprised all commodities and indices and also their counterparts. Simulations with randomized data are also used in order to gauge noise level in each network. We show evidence of emphasized disparity of correlation and entropy-based centrality measurements for all markets between pre- and post-crisis periods. Our results enable the robust mapping of network influences and contagion effects whilst incorporating agent expectations.

A comparative analysis of economical indexes based on thermodynamical concepts

3.15-3.30 pm

Hênio Henrique Aragão Rêgo (IF-MA, Brazil)

Although the hypothesis that financial markets are examples of chaotic systems, in Econophysics we often assume that the dynamics of prices is stochastic, but ruled by power laws. Nowadays power laws scaling behaviors has been observed in several economical time series, such as those related to volume transactions, growth rates of companies, in stock markets, and many others. In this work we present a comparative analysis based on thermodynamic concepts, we called "thermos-comparative analysis", that allows us to quantify the relative performance between different stock market indexes. We apply this technique to a number of stock indexes and examined the typical behavior of the markets in different time scales of the Fluctuation Function and other related variables. We also examine some common features that span across the markets and identify some scaling behaviors that may distinguish their upcoming dynamical behavior.

Bitcoin time series under the lens of information theory' quantifiers

3.30-3.45 pm

Aurelio Fernandez Bariviera (Universitat Rovira i Virgili, Spain)

Many economic data are recorded as a sequence of measurements equally spaced in time. This kind of data, commonly referred as time series, are usually the starting point for economic analysis. In this line, information-theory-derived quantifiers can help to extract relevant information from financial time series. When studying dynamical systems, the discrimination of the presence of correlations in time series, emerges as one key task. In a recent paper, Bariviera et al. (2015) proposed the joint use of the Shannon entropy and the Fisher Information Measure, as a proxy for informational efficiency. In another paper Bariviera et al. (2016) shows that the Complexity-Entropy Causality Plane constitutes a powerful graphical tool in order to discriminate stochastic and chaotic dynamics. Another element to take into account when studying time series is the probability density function estimation. We show that the use of the symbolic technique proposed by Bandt and Pompe (2002) is very useful in econophysics given its robustness to observational noise and absence of a priori assumptions. In this paper we extend our previous analysis, providing evidence that sampling frequency can uncover some additional characteristics of financial time series. We apply our technique to a time series of intraday bitcoin prices, in order to understand the behavior of this cryptocurrency.

Closing

Auditorium 4.00-4.30 pm

List of participants

Name	Affiliation	Country
Adriano Cesar Machado Pereira	UFMG	Brazil
Alef Willis Magno Miranda	UFMG	Brazil
Allbens Atman Picardi Faria	CEFET-MG	Brazil
Alvaro Julian Manrique Gomez	Universidad Nacional da Colombia	Colombia
André Borges Catalão	IFT - UNESP	Brazil
André Cavalcanti Rocha Martins	USP	Brazil
Andrea Rapisarda	INFN Sezioni di Catania – Università Catania	Italy
Andres Garcia	Universidad de Sonora	Mexico
Arthur Constantino Scardua	CBPF	Brazil
Arthur Rodrigo Bosco de Magalhães	CEFET-MG	Brazil
Aurelio Fernandez Bariviera	Universitat Rovira i Virgili	Spain
Benjamin Miranda Tabak	Universidade Católica de Brasília e Senado Federal	Brazil
Bruna Amin Gonçalves	CEFET-MG	Brazil
Carla Liliane Guedes Fonseca	PPGMMC - CEFET-MG	Brazil
Carlos Alberto Silva de Assis	CEFET-MG	Brazil
Charlene Cássia de Resende	PPGMMC - CEFET-MG	Brazil
Constantino Tsalis	CBPF	Brazil
David Michael Quirino Nelson	UFMG	Brazil
Érika Regina da Silva Gallo	Unesp - Araraquara	Brazil
Everton Murilo Carvalho de Abreu	Universidade Federal Rural do Rio de Janeiro	Brazil
Fabio Caccioli	University College London	UK
Fábio Ocaña Vieira	USP	Brazil
Fabricio Machado	PUC SP	Brazil
Felipe Gomes Miyazato	USP	Brazil
Fernando A Ducha	CEFET-MG	Brazil
Fischer Stefan Meira	CEFET-MG	Brazil
Fischer Stefan Meira	CEFET-MG	Brazil
Gerson Nassor Cardoso	Universidade Federal de São Carlos	Brazil
Giacomo Livan	University College London	UK
Gustavo Vitral Arbex	USP	Brazil
Hênio Henrique Aragão Rêgo	IF-MA	Brazil
Jonathan Venturim Zuccon	USP	Brazil
Karina Miyuki Fugita	Insper	Brazil
Kenta Yamada	The University of Tokyo	Japan
Leônidas Prado	IFT - UNESP	Brazil
Leonidas Sandoval Junior	Insper	Brazil
Luiz Eduardo de Sousa Freire	Universidade Federal de Goiás	Brazil
Marcelo Byrro Ribeiro	UFRJ	Brazil
Marcelo Moreira Garcia	PPGMMC - CEFET MG	Brazil
Marco Lázaro de Sousa Batista	USP	Brazil
Matheus Grasselli	McMaster University and Fields Institute	Canada
Michelle Bau Graczyk	CBPF	Brazil
Murilo Mazzotti Silvestrini	Universidade Federal de São Carlos	Brazil
Nanci Romero	IF-SP	Brazil

Name	Affiliation	Country
Paloma de Oliveira Campos Xavier	PPGMMC - CEFET-MG, Centro Universitário UNA	Brazil
Rosário Mantegna	Central European Univ.; Univ. degli Studi di Palermo	Italy
Siew Ann Cheong	Nanyang Technological University	Singapore
Suzy Moat	Warwick Business School	UK
Thaissa Riel	Universidade de São Paulo	Brazil
Thiago Christiano Silva	Banco Central do Brasil	Brazil
Thiago Romeiro Tavares	IFT - UNESP	Brazil
Tibor Zequini Boglar	Universidade de São Paulo	Brazil
Tiziana Di Matteo	King's College London	UK
Tobias Preis	Warwick Business School	UK
Vanessa Pacheco de Freitas	CBPF	Brazil
William Oswaldo Sosa Correa	Universidade Federal de Pernambuco	Brazil

Institution	Full name
Banco Central do Brasil	Banco Central do Brasil
CBPF	Centro Brasileiro de Pesquisas Físicas
CEFET MG	Centro Federal de Educação Tecnológica de Minas Gerais
Central European University	Central European University
Centro Unversitário UNA	Centro Unversitário UNA
Unversità degli Studi di Palermo	Unversità degli Studi di Palermo
IF-MA	Instituto Federal de Educação, Ciência e Tecnologia do Maranhão
IF-SP	Instituto Federal de Educação, Ciência e Tecnologia de São Paulo
IFT - UNESP	Instituto de Física Teórica - Universidade Estadual Paulista Júlio de Mesquita Filho
INFN Sezioni di Catania – Unversità Catania	Istituto Nazionale di Fisica Nucleare Sezioni di Catania - Unversità Catania
Insper	Insper
King's College London	King's College London
McMaster University and Fields Institute	McMaster University and Fields Institute
Nanyang Technological University	Nanyang Technological University
PUC SP	Pontifícia Universidade Católica - São Paulo
The University of Tokyo	The University of Tokyo
UFMG	Universidade Federal de Minas Gerais
UFRJ	Universidade Federal do Rio de Janeiro
Unesp - Araraquara	Universidade Estadual Paulista Júlio de Mesquita Filho - Campus de Araraquara
Universidad de Sonora	Universidad de Sonora
Universidade Católica de Brasília	Universidade Católica de Brasília
Senado Federal	Senado Federal
Universidade Federal de Goiás	Universidade Federal de Goiás
Universidade Federal de Pernambuco	Universidade Federal de Pernambuco
Universidade Federal de São Carlos	Universidade Federal de São Carlos
Universidade Federal Rural do Rio de Janeiro	Universidade Federal Rural do Rio de Janeiro
Universidade Nacional da Colombia	Universidade Nacional da Colombia
Universitat Rovira i Virgili	Universitat Rovira i Virgili
University College London	University College London
USP	Universidade de São Paulo
Warwick Business School	Warwick Business School