INSTITUTUL DE MATEMATICĂ „SIMION STOILOW" AL ACADEMIEI ROMÂNE

ACADEMIA DE STUDII ECONOMICE DIN BUCUREȘTI Departamentul de Matematici Aplicate

ACADEMIA ROMÂNĂ Institutul de Statistică Matematică şi Matematică Aplicată „Gheorghe Mihoc-Caius Iacob"

A 22-a CONFERINŢĂ A SOCIETĂŢII DE PROBABILITĂŢI ŞI STATISTICĂ DIN ROMÂNIA

Institutul de Matematică „Simion Stoilow" al Academiei Române
Academia de Studii Economice din Bucureşti
Departamentul de Matematici Aplicate
Centrul de Cercetări Matematice Avansate Fundamentale şi Aplicative
Institutul de Statistică Matematică şi Matematică Aplicată
„Gheorghe Mihoc-Caius Iacob" al Academiei Române

10-11 mai 2019

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SPSR 2019 PROGRAM

Friday May 10

"Simion Stoilow" Institute of Mathematics of the Romanian Academy
(21 Calea Griviței Street, Bucharest)

8:30 – 9:00 ***Registration***

9:00 – 9:15 ***Opening***

PLENARY SESSION 1 (chair Ciprian Tudor)

9:15 – 9:50 Plenary talk 1 (Bohdan Maslowski)

9:55 – 10:30 Plenary talk 2 (Dan Crișan)

10:35 – 11:10 Plenary talk 3 (Mădălina Olteanu)

11:10 – 11:30 ***Coffee break***

PLENARY SESSION 2 (chair Dan Crișan)

11:30 – 12:05 Plenary talk 4 (Lauri Viitasaari)

12:10 – 12:45 Plenary talk 5 (Vlad Bally)

12:45 – 14:30 ***Lunch*** (Cantina Moxa, Protocol Room, 2nd floor, 5-7 Mihail Moxa Street)

14:30 – 15:00 General assembly and presentation of SPSR (Ciprian Tudor)

15:00 – 16:00 PRESENTATION OF SCIENTIFIC SOCIETIES:

15:00 – 15:15 Presentation of the "Groupe MAS" (Modelisation Aleatoire et Statistique) de la SMAI (Societe de Mathematiques Appliquees et Industrielles), France, represented by Céline Lacaux, president of SMAI-MAS

15:15 – 15:30 Presentation of the Czech Mathematical Society, represented by Bohdan Maslowski, president of the society

15:30 – 15:45 Presentation of the Finnish Statistical Society, represented by Lauri Viitasaari, on the behalf of Paulina Ilmonen, president of the society

15:45 – 16:00 Presentation of the Romanian Mathematical Society, represented by Cătălin Liviu Gherghe, general director and Lucian Beznea, vice-president of the society

16:00 – 16:10 SPSR PRIZE 2019 FOR A YOUNG ROMANIAN RESEARCHER

16:10 – 16:30 ***Coffee break***

16:30 – 18:40 PARALLEL SESSIONS

19:00 – 22:00 ***Gala Dinner*** (Casa Universitarilor, 46 Dionisie Lupu Street)

Saturday May 11

"Simion Stoilow" Institute of Mathematics of the Romanian Academy

(21 Calea Griviței Street, Bucharest)

PLENARY SESSION 3 (chair Radu Craiu)

9:00 – 9:35 Plenary talk 6 (Valentin Pațilea)

9:40 – 10:15 Plenary talk 7 (Céline Lacaux)

10:20 – 10:55 Plenary talk 8 (Julien Randon-Furling)

10:55 – 11:15 ***Coffee break***

11:15 – 13:00 PARALLEL SESSIONS

13:15 – 14:30 ***Lunch*** (“Simion Stoilow“ Institute of Mathematics of the Romanian Academy)

PLENARY SESSION 4 (chair Lucian Beznea)

14:30 – 15:05 Plenary talk 9 (Giovanni Peccati)

15:10 – 15:45 Plenary talk 10 (Nicolas Perkowski)

15:50 – 16:25 Plenary talk 11 (Radu Craiu)

Program of the talks – Friday May 10

PLENARY SESSION 1
("Miron Nicolescu" Amphitheatre, ground floor)

Chair: Ciprian Tudor

9:15 – 9:50

Bohdan Maslowski (Charles University in Prague)

Parameter estimation and filtering for some Hilbert-space valued Gaussian processes

9:55 – 10:30

Dan Crișan (Imperial College London)

Long-time behaviour of degenerate diffusions

10:35 – 11:10

Mădălina Olteanu (Université Paris 1 Panthéon-Sorbonne)

Clustering and visualizing large cattle-trade networks using relational self-organizing maps

PLENARY SESSION 2
("Miron Nicolescu" Amphitheatre, ground floor)

Chair: Dan Crișan

11:30 – 12:05

Lauri Viitasaari (University of Helsinki)

Gaussian fluctuations for the stochastic heat equation with colored noise

12:10 – 12:45

Vlad Bally (Université Paris-Est Marne-la-Vallée)

Convergence in distribution norm in the CLT and applications to trigonometric polynomials with random coefficients

16:30 – 18:40 PARALLEL SESSIONS

Stochastic Processes 1
("Miron Nicolescu" Amphitheatre, ground floor)

Chair: Vlad Bally

16:30 – 16:45
Alexei Leahu, Veronica Andrievschi-Bagrin (Technical University of Moldova)

Lifetime distributions and their approximation in reliability of serial/parallel networks

16:45 – 17:00
Iulian Cîmpean (IMAR)

A natural extension of Markov processes and applications to singular SDEs

17:00 – 17:15
Dragoș-Pătru Covei (ASE Bucharest)

A partial differential equation that arises in stochastic production planning with production constraints

17:15 – 17:30
Romeo Negrea ("Politehnica" University of Timișoara)

On a class of Stochastic Differential Equations and Application

Statistics 1: Stochastic Models and Methods with Applications
(organized by Alexandros Karagrigoriou, University of the Aegean, Samos and Vasile Preda, University of Bucharest & ISMMA)
("Constantin Bănică" Room 306-307, 3rd floor)

Chair: Alexandros Karagrigoriou, Vasile Preda

16:30 – 16:45
Achilleas Anastasiou (University of the Aegean)

On Time Series Clustering Techniques with Applications in Healthcare Systems

16:45 – 17:00
Kimon Ntotsis (University of the Aegean)

Multifactor Analysis and Modelling of Pension Expenditures within Europe

17:00 – 17:15

Andreas Makrides (University of Rouen-Normandy and University of Cyprus), Vlad Ștefan Barbu (University of Rouen-Normandy), Alexandros Karagrigoriou (University of the Aegean)

On a special type of semi-Markov process

17:15 – 17:30
Guglielmo D'Amico (University of Chieti-Pescara), Riccardo De Blasis (University of Chieti-Pescara and CMCRC Research Center, Wollongong University)

A Multivariate Markov Chain Stock Model

Actuarial and Financial Mathematics, Optimization 1 ("Gheorghe Vrânceanu" Room 309-310, 3rd floor)

Chair: Radu Stoica

16:30 – 16:45
Andrei Bădescu (University of Toronto)

Marked Cox Processes with Special Hidden Markov Model Structures with Applications

16:45 – 17:00
Raluca Vernic ("Ovidius" University of Constanța)

On a collective model with dependent frequency and claim amounts

17:00 – 17:15
Vali Asimit (Cass Business School, City, University of London)

Optimal Robust Insurance with under Distributional Ambiguity

17:15 – 17:30
Sezen Ciorabai ("Ovidius" University of Constanța)

Application of Fuzzy Analytical Hierarchy Process in Eco-Insurance

Statistics 2 ("Miron Nicolescu" Amphitheatre, ground floor)

Chair: Luiza Bădin

17:40 – 17:55

Cornelia Enăchescu (ISMMA), Denis Enăchescu (University of Bucharest)

About some stochastic methods for numerical solving of parabolic equations

17:55 – 18:10

Romică Trandafir (Technical University of Civil Engineering, Bucharest), Vasile Preda (University of Bucharest & ISMMA), Mihaela Păun (University of Bucharest)

New properties and some statistical results concerning the Varma entropy

18:10 – 18:25

Vincent Vandewalle (Inria & Université de Lille)

Gaussian-based visualization of Gaussian and non-Gaussian model-based clustering Ornstein-Uhlenbeck process with respect to the Hurst index

18:25 – 18:40

Cristian Preda (Université de Lille)

Categorical functional data with R

Statistics 3 ("Constantin Bănică" Room 306-307, 3rd floor)

Chair: Mădălina Olteanu

17:40 – 17:55
Sorina Gramatovici, (Bucharest University of Economic Studies), Corina Mihaela Mortici (Bucharest University of Economic Studies & PricewaterhouseCoopers)

Statistical tools for asymmetric unemployment gap-inflation dependence analysis. Empirical study for Romania

17:55 – 18:10
Voicu Boscaiu (ISMMA)

On Regression-Based Approach to Mediation and Moderation Analysis

18:10 – 18:25
Petre Caraiani (Institute for Economic Forecasting, Romanian Academy; Bucharest University of Economic Studies)

Oil Shocks and Production Network Structure: Evidence from OECD

18:25 – 18:40
Iuliana Iatan (Department of Mathematics and Computer Science, Technical University of Civil Engineering Bucharest)

Neural computation in Clifford algebras

Statistics 4 ("Gheorghe Vrânceanu" Room 309-310, 3rd floor)

Chair: Vali Asimit

17:40 – 17:55
Radu Stoica (Université de Lorraine)

Parameter estimation for exponential models through simulated annealing based on the ABC Shadow dynamics

17:55 – 18:10
Pavlina Jordanova (Shumen University)

Tails and probabilities for p-outliers

18:10 – 18:25
Emil Simion (University "Politehnica" of Bucharest)

Statistical tests used in validation of cryptographic primitives

18:25 – 18:40
Bogdan Biolan (University of Bucharest)

A Fuzzy Probability Approach for Signal Processing

Program of the talks – Saturday May 11

PLENARY SESSION 3
("Miron Nicolescu" Amphitheatre, ground floor)

Chair: Radu Craiu

9:00 – 9:35

Valentin Patilea (Ensai, CREST)

M-estimation inference for partially linear single-index models: an empirical likelihood approach

9:40 – 10:15

Céline Lacaux (Avignon University)

Operator scaling random fields

10:20 – 10:55

Julien Randon-Furling (Université Paris 1 Panthéon-Sorbonne)

Brownian convex hulls and other extreme-value problems

PLENARY SESSION 4
("Miron Nicolescu" Amphitheatre, ground floor)

Chair: Lucian Beznea

14:30 – 15:05

Giovanni Peccati (University of Luxembourg)

Approximation of fractional local times in the zero energy case

15:10 – 15:45

Nicolas Perkowski (Max-Planck Institute for Mathematics in the Sciences, Leipzig)

A probabilistic approach to some singular stochastic PDEs

15:50 – 16:25

Radu Craiu (University of Toronto)

Modern Challenges in Bayesian Computation

11:15 – 13:00 PARALLEL SESSIONS

Stochastic Processes 2
("Miron Nicolescu" Amphitheatre, ground floor)

Chair: Nicolas Perkowski

11:15 – 11:30
Marko Voutilainen (Aalto University)

On model fitting and estimation of stationary processes

11:30 – 11:45
Ana Maria Răducan (ISMMA), Luigi Cătană (University of Bucharest, Faculty of Mathematics and Computer Science)

On stochastic order between random vectors

11:45 – 12:00

Meryem Slaoui, Ciprian Tudor (University Lille 1)

Generalized k-variations and Hurst parameter estimation for the fractional wave equation via Malliavin calculus

12:00 – 12:15

Obaida Assaad (Université de Lille)

Wavelet analysis for the solution to the wave equation with fractional noise

12:15 – 12:30
Bogdan Gh. Munteanu ("Henri Coandă" Air Force Academy of Brașov)

The Max Cubic Transmuted Exponential Power Series Distributions

12:30 – 12:45
Daniel Ciuiu (Technical University of Civil Engineering, Bucharest; Institute for Economic Forecasting, Romanian Academy)

Monte Carlo and Numerical Methods to Solve the MA(q) time series model

Statistics 5: Divergence measures and statistical applications

(organized by Vlad Ștefan Barbu, University of Rouen
and Aida Toma, ASE Bucharest & ISMMA)
("Constantin Bănică" Room 306-307, 3rd floor)

Chair: Aida Toma, Vlad Ștefan Barbu

11:15 – 11:30
Paschalini Trentou (University of the Aegean), Aida Toma (ASE Bucharest & ISMMA), Alexandros Karagrigoriou (University of the Aegean, Samos)

The Use of Pseudodistances in Model Selection

11:30 – 11:45
Christos Meselidis (University of the Aegean)

Statistical Inference for Multinomial Distributions based on the (Phi, alpha)-Power Divergence Family of Measures

11:45 – 12:00
Răzvan-Cornel Sfetcu (University of Bucharest)

Best Approximation Results and Some Perspectives to Information Divergences

12:00 – 12:15
Sorina-Cezarina Sfetcu (University of Bucharest)

Some Generalizations of the Kullback-Leibler Divergence

12:15 – 12:30
Manuela-Simona Cojocea (University of Bucharest)

On the use of divergence measures in Generative Adversarial Networks

12:30 – 12:45
George-Jason Siouris (Laboratory of Statistics and Data Analysis, Department of Statistics and Actuarial-Financial Mathematics, University of the Aegean)

Distributional Properties of the Percentage Change of Discrete Valued Stochastic Processes

Actuarial and Financial Mathematics, Optimization 2 (Room 309-310 "Gheorghe Vrânceanu", 3rd floor)

Chair: Andrei Bădescu

11:15 – 11:30
Marius Rădulescu (ISMMA), Gheorghiță Zbăganu (ISMMA), Constanța-Zoie Rădulescu (ICI)

Multiperiod portfolio selection models with proportional transaction costs and initial holdings

11:30 – 11:45
Ștefănuț Ciochină ("Dunărea de Jos" University of Galați, Faculty of Sciences and Environment)

Composite models used in actuarial practice: a review

11:45 – 12:00
Andreea Mădălina Rusu-Stancu, Ioan M. Stancu-Minasian (ISMMA of the Romanian Academy)

Multiobjective fractional programmimg involving semilocally type-I univex functions

12:00 – 12:15
Elena-Grațiela Robe-Voinea, Alexandru Pintilie ("Ovidius" University of Constanța)

Calculating the efficiency of an international shipping voyage using Primavera P6 software

Statistics 6 ("Gheorghe Vrânceanu" Room 309-310, 3rd floor)

Chair: Valentin Pațilea

12:15 – 12:30
Luiza Bădin (ASE Bucuresti & ISMMA), Cinzia Daraio (Sapienza University of Rome), Léopold Simar (Université Catholique de Louvain)

A bootstrap approach for bandwidth selection in estimating conditional efficiency measures

12:30 – 12:45
Mihaela Pricop-Jeckstadt (University "Politehnica" of Bucharest)

Nonlinear Tikhonov regularization in Hilbert scales with balancing principle tuning parameter in statistical inverse problems

12:45 – 13:00
Vlad Ștefan Barbu (Université de Rouen Normandie), Ghislaine Gayraud (LMAC, Compiègne); Nikolaos Limnios (LMAC, Compiègne); Irène Votsi (Le Mans Université)

Hypotheses testing for semi-Markov processes

ABSTRACTS

- Achilleas Anastasiou (University of the Aegean)

  On Time Series Clustering Techniques with Applications in Healthcare Systems

  In this work our purpose is to present and discuss Time Series Clustering Techniques and explore how these techniques can be applied to health systems. We describe various methods for Clustering and see how similarity measures affect the statistical procedures. One of the contributions of this work is the development of two new Distance Measure Algorithms, called Causality Within Groups (CAWG) and Causality Between Groups (CABG) both of which are based on the well-known Granger Causality. More specifically, we apply hierarchical Clustering to analyze multivariate time series data that come from OECD and concern 19 EU countries and 16 variables related to the health system including its efficiency. For this purpose we use not only typical distances as the Autocorrelation or the Partial Autocorrelation distance but also the proposed two distance algorithms based on Granger Causality. The experimental results reveal an indication of the most efficient countries. Based on the CAWG algorithm we conclude that almost all countries are quite similar while the use of CABG algorithm implies that the extend of causality between Northern and Southern European countries is of the same magnitude.

- Vali Asimit (Cass Business School, City, University of London)

  Optimal Robust Insurance with under Distributional Ambiguity

  Decision-makers who usually face model/parameter risk may prefer to act prudently by identifying optimal contracts that are robust to such sources of uncertainty. In this paper, we tackle this issue under a finite uncertainty set that contains a number of probability models that are candidates for the 'true', but unknown model. Various robust optimisation models are proposed, some of which are already known in the literature, and we show that all of them could be efficiently solved. The numerical experiments are run for various risk preference choices and it is found that for relatively large sample size, the modeller should focus on finding the best possible fit for the unknown probability model in order to achieve the most robust decision. If only small samples are available, then the modeller should consider two robust optimisation models, namely the Weighted Average Model or Weighted Worst-case Model, rather than focusing on statistical tools aiming to estimate the probability model. Amongst those two, the better choice of the robust optimisation model depends on how much interest the modeller puts on the tail risk when defining its objective function. These findings suggest that one should be very careful when robust optimal decisions are sought in the sense that the modeller should first understand the features of its objective function and the size of the available data, and then to decide whether robust optimisation or statistical inferences is the best practical approach.

- Obaida Assaad (Université de Lille)

  Wavelet analysis for the solution to the wave equation with fractional noise

  We will consider the linear stochastic wave equation driven by a fractional-white Gaussian noise and we construct and analyse statistical estimators for the Hurst index of the solution. The techniques that we use to study the limit behavior in distribution of the wavelet variation are based on the Malliavin calculus and Stein method.

- Vlad Bally (Université Paris-Est Marne-la-Vallée)

  Convergence in distribution norm in the CLT and applications to trigonometric polynomials with random coefficients

  We give estimates of the speed of convergence in the CLT in terms of distribution norms. Moreover, we consider local expansions and we estimate the corresponding error. These results are used in order to obtain limit theorems concerning the number of zeros of trigonometric polynomials with random coefficients.

- Vlad Ștefan Barbu (Université de Rouen Normandie), Ghislaine Gayraud (LMAC, Compiègne); Nikolaos Limnios (LMAC, Compiègne); Irène Votsi (Le Mans Université)

  Hypotheses testing for semi-Markov processes

  This presentation is concerned with statistical tests between semi-Markov processes. It should be noted that only few researchers considered hypotheses testing problem in a semi-Markov context. First, we present some existing work on semi-Markov hypotheses tests. Second, we construct robust statistical tests between Hellinger balls around semi-

Markov kernels and present some specifications to particular cases, including discrete-time semi-Markov processes, finite state space, Markov processes. If time allows, we also present a third part: we adopt a nonparametric Bayesian approach and investigate the asymptotic behavior of the posterior distribution in continuous time and general state space semi-Markov processes. The statistical tests will represent a first step that enable us to establish posterior concentration rates.

- Andrei Bădescu (University of Toronto)

  Marked Cox Processes with Special Hidden Markov Model Structures with Applications

  Motivated by common questions that arise in few actuarial and financial areas in this talk we propose a general marked Cox point process with a special Hidden Markov Model (HMM) structure in the attempt of modeling claim occurrences and their marked developments. The model is versatile in assessing temporal dependence, also allowing for natural interpretations. Some of the properties possessed by this class of models, such as closed-form expressions, thinning properties and model versatility are discussed in details. Furthermore, we provide efficient Expectation-Maximization (EM) algorithms for model calibration. We conclude the presentation with few numerical illustrations coming from distinct, but interconnected research areas where the proposed model can be applied: claim reserving, operational risk and ruin theory.

- Luiza Bădin (ASE Bucharest & ISMMA), Cinzia Daraio (Sapienza University of Rome), Léopold Simar (Université Catholique de Louvain)

  A bootstrap approach for bandwidth selection in estimating conditional efficiency measures

  Conditional efficiency measures are needed when the production process does not depend only on the inputs and outputs, but may be influenced by external factors and/or environmental variables (Z). They are estimated by means of a nonparametric estimator of the conditional distribution function of the inputs and outputs, conditionally on values of Z. Nonparametric estimation involves smoothing procedures and smoothing parameters: the bandwidths. So far, Least Squares Cross Validation (LSCV) methods have been used, which have been proven to provide bandwidths with optimal rates for estimating conditional distributions.

  In this paper, we show that the rate for the bandwidths which is optimal for estimating conditional distributions, may not be optimal for the estimation of the efficiency scores which typically depend on the boundary of the support of the distribution and not on the full conditional distribution. We propose hence a new approach based on the bootstrap which overcomes these difficulties. We analyze and compare, through Monte Carlo simulations, the performances of LSCV techniques with our bootstrap approach in finite samples. As expected, our bootstrap approach shows generally better performances and is more robust to the various Monte Carlo scenarios analyzed. We also illustrate our methodology through an empirical example using an US Aggressive-Growth Mutual Funds data set.

- Bogdan Biolan (University of Bucharest)

  A Fuzzy Probability Approach for Signal Processing

  We consider static and dynamic signal processing methods for estimating a specific signal with the property of existence of the background noise of non-Gaussian distributions.

- Voicu Boscaiu (ISMMA)

  On Regression-Based Approach to Mediation and Moderation Analysis

  The starting point was solving a parallel multiple mediator statistical model. Finally, I try to answer the question of what this class of models can and what can not do.

- Petre Caraiani (Institute for Economic Forecasting, Romanian Academy; Bucharest University of Economic Studies)

  Oil Shocks and Production Network Structure: Evidence from OECD

  Does the production network structure matter for the transmission of oil shocks? Using a Bayesian time-varying VAR, I derive the impact of oil shocks on GDP for a set of OECD economies. I further estimate various measures to characterize the production network structure based on Input-Output matrices. When I analyze the relationship between the time-varying responses of GDP to oil demand and oil supply shocks and production network characteristics, I find that measures like skewness in the in-degrees and in the out-degrees or density tend to amplify the negative impact of oil shocks on GDP. The results here are in line with the recent literature that outlines the importance of network structures for aggregate dynamics.

- Ștefănuț Ciochină ("Dunărea de Jos" University of Galați, Faculty of Sciences and Environment)

Composite models used in actuarial practice: a review

In this paper is presented a summary of the composite models developed for use in actuarial practice. I present the first composite model introduced in 2005 by Cooray and Ananda [1] which was then generalized by Scollnik [2] in 2007. The main features captured for these models were the density function, the cumulative distribution function, and the *n*-th order initial moment. I also present particular cases of these composite models such as: Gamma-Pareto, Weibull-Pareto and Exponential-Pareto models.

[1] K. Cooray and M.A. Ananda, Modeling actuarial data with a composite Lognormal-Pareto model. Scand. Actuar. J. 5 (2005), 321-334.

[2] D.P.M. Scollnik, On composite Lognormal-Pareto models. Scand. Actuar. J. 1 (2007), 20-33.

- Sezen Ciorabai ("Ovidius" University of Constanța)

Application of Fuzzy Analytical Hierarchy Process in Eco-Insurance

Raising living standards also brings negative effects on nature, namely pollution, which comes with a cost. Atmospheric pollution, discharges of waste into water and soil also involve amounts of money that can be hard to bear by companies if accidents are large. This case study proposes acquaintance with the concept of eco-insurance and the choice of a reliable policy for each company, using notions of fuzzy logic and analytical hierarchy process. The Analytic Hierarchy Process (AHP) is an effective tool for dealing with such complex decision and may aid the decision maker to set priorities and make the best choice. By reducing complex decisions to a series of pairwise

comparisons through policies of a reliable insurance policy, and then synthesizing the results, the AHP helps to capture both subjective and objective aspects of a decision. In addition, the AHP incorporates a useful technique for checking the consistency of the decision maker's evaluations, thus reducing the bias in the decision making process. Fuzzy logic is introduced to get rid of the objectiveness of the decision.

- Daniel Ciuiu (Technical University of Civil Engineering, Bucharest; Institute for Economic Forecasting, Romanian Academy)

  Monte Carlo and Numerical Methods to Solve the MA(q) time series model

  In this paper we will solve the nonlinear system of equations in the parameters of the MA(q) time series model by Monte Carlo methods and by numerical methods. When we identify the variance and the intercovariances of time series, we obtain, dividing by variance, a quadratic nonlinear system of equation that does not contain the variance of white noise. We use only the autocorrelation function. Except the innovations' algorithm, due to what we mention above, we refer to the variance of white noise only after we have estimated the coefficients.

- Iulian Cîmpean (IMAR)

  A natural extension of Markov processes and applications to singular SDEs

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- Manuela-Simona Cojocea (University of Bucharest)

  On the use of divergence measures in Generative Adversarial Networks

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- Dragoș-Pătru Covei (ASE Bucharest)

  A partial differential equation that arises in stochastic production planning with production constraints

  A stochastic production planning with production constraints is considered and existence of solutions for the derived equation is proved.

- Radu Craiu (University of Toronto)

  Modern Challenges in Bayesian Computation

  Statistical computation is at an inflection point due to increased data volume and model complexity. An important challenge concerns Bayesian inference for statistical models in which the likelihood is intractable or too expensive to evaluate iteratively, as required by standard Markov chain Monte Carlo algorithms. We will discuss some of the general strategies developed for tackling these problems, such as Approximate Bayesian Computation and parallelization of Markov chain Monte Carlo sampling. Data analyses and simulation experiments are used to illustrate the performance of the methods.

- Dan Crişan (Imperial College London)

  Long-time behaviour of degenerate diffusions

  I will discuss the long time behaviour of a large class of diffusion processes with associated infinitesimal generators of (possibly) degenerate type. The generator that we consider need not satisfy the Hormander condition. Instead, they satisfy the so-called UFG condition, introduced by Herman, Lobry and Sussman in the context of geometric control theory and later by Kusuoka and Stroock, this time with probabilistic motivations.

The talk is based on the paper "Long-time behaviour of degenerate diffusions: UFG-type SDEs and time-inhomogeneous hypoelliptic processes" and it is joint work with T. Cass, P. Dobson, M. Ottobre (arXiv preprint arXiv:1805.01350).

- Guglielmo D'Amico (University of Chieti-Pescara), Riccardo De Blasis (University of Chieti-Pescara and CMCRC Research Center, Wollongong University)

  A Multivariate Markov Chain Stock Model

- Cornelia Enăchescu (ISMMA), Denis Enăchescu (University of Bucharest)

  About some stochastic methods for numerical solving of parabolic equations

  This paper proposes a review of some stochastic methods for numerical solving of partial differential equations (PDEs) of parabolic type with Dirichlet and / or Neumann frontier conditions. Monte Carlo method, Random Walk, Artificial Neural Networks, and Genetic Algorithms are considered. The methods are studied in terms of convergence computer-time and sum of squared errors (SSE). The results obtained are illustrated and compared with exact solutions. It is shown that the presented methods have the potential to be a future efficient meshless tool for numerical solving of PDEs.

- Sorina Gramatovici, (Bucharest University of Economic Studies), Corina Mihaela Mortici (Bucharest University of Economic Studies & PricewaterhouseCoopers)

  Statistical tools for asymmetric unemployment gap-inflation dependence analysis. Empirical study for Romania

  Two empirical issues are well-known in macroeconomic forecasting since the Great Financial Crisis. Blanchard et al. noticed in 2015 that in most advanced countries, output remains far below the pre-recession trend, which impose a theoretical revision of the effect of recessions on the output. They also noticed that while inflation has decreased, it has decreased less than was anticipated, leading researchers to revisit the relation between inflation and activity. Many recent empirical studies published on the second issue use different approaches to estimate and forecast the Phillips curves both for developed countries and emerging ones. Blanchard et al. revisited the evidence on the strength of the relation between the unemployment gap and inflation (the Phillips curves). Their empirical study concerns advanced economies and they concluded that "the slope of the Phillips curve has decreased over time in most countries. Most of the decline, however, took place from the mid-1970s to the early 1990s. Since then, the coefficient has remained roughly stable. In particular, it does not appear to have decreased during the crisis". In this paper we are concerned about the Romanian case and we use asymmetry in Phillips curve and Okunâ's law to analyze the unemployment gap and inflation in Romania since 1996. Data covered the period 1996Q1-2018Q4.

- Iuliana Iatan (Department of Mathematics and Computer Science, Technical University of Civil Engineering Bucharest)

  Neural computation in Clifford algebras

  A quick tour of relevant algebra is: Groups → Rings → Fields → Vector Spaces → Algebras → Clifford Algebras. As Clifford algebras are vector spaces, a wide variety of results from Linear Algebra can be applied to them. Clifford algebras are generated by quadratic spaces from which they inherit metric structure. Neural computation in Clifford algebras, that include familiar complex numbers and quaternions as special cases has recently become an active research field. Real, complex, and quaternionic neural networks can be further generalized within the geometric algebra framework, in which the weights, the activation functions, and the outputs are now represented using multivectors. The aim of this paper is to demonstrate the usefulness of Clifford algebra for neural computation due to its geometric nature. In order to achieve this aim, we have introduced the Fuzzy Clifford Gaussian Network (FCGNN), contributing in this way to continue the development of neural networks in other than the real domain.

- Pavlina Jordanova (Shumen University)

  Tails and probabilities for p-outliers

  The task for a general and useful classification of the heaviness of the tails of probability distributions still has no satisfactory solution. Due to luck of information outside the range of the data the tails of the distribution should be described via many characteristics. Index of regular variation is a good characteristic, but it puts too many distributions with very different tail behavior in one and the same class. One can consider for example Pareto(α), Frêchet(α) and Hill-horror(α) with one and the same fixed

parameter $\alpha > 0$. The main disadvantage of VaR, expectiles, and hazard functions, when we speak about the tails of the distribution, is that they depend on the center of the distribution and on the scaling factor. Therefore, they are very appropriate for predicting "big losses", but after a right characterization of the distributional type of "the payoff". When analyzing the heaviness of the tail of the observed distribution we need some characteristic which does not depend on the moments because in the most important cases of the heavy-tailed distributions theoretical moments do not exist and the corresponding empirical moments fluctuate too much. In this paper, we show that probabilities for different types of outliers can be very appropriate characteristics of the heaviness of the tails of the observed distribution. They do not depend on increasing affine transformations and do not need the existence of the moments. The idea origins from Tukey's box plots, and allows us to obtain one and the same characteristic of the heaviness of the tail of the observed distribution within the whole distributional type with respect to all increasing affine transformations. These characteristics answer the question:
At what extent we can observe "unexpected" values?

- Céline Lacaux (Avignon University)

Operator scaling random fields

Operator-scaling random fields satisfy an anisotropic self-similarity property, which extends the classical self-similarity property. Hence they generalize the fractional Brownian field, which is the most famous isotropic Gaussian self-similar random field. In this talk, we give a review on this topic: especially we will focus on some sample path properties and on a fast and exact synthesis of a class of Gaussian operator-scaling fields with stationary

increments and with variograms defined as anisotropic deformations of the fractional Brownian field variogram. This talk is based on a joint works with Hermine Biermé (Poitiers, France).

- Alexei Leahu, Veronica Andrievschi-Bagrin (Technical University of Moldova)

  Lifetime distributions and their approximation in reliability of serial/parallel networks

  In our paper it was approached a whole class of lifetime probability distributions for series and parallel networks in the context of their reliability. Despite the difficulies of explicitly representing these distributions, we show that, under certain conditions, they can be approximated by simpler distributions.

- Andreas Makrides (University of Rouen-Normandy and University of Cyprus), Vlad Ștefan Barbu (University of Rouen-Normandy), Alexandros Karagrigoriou (University of the Aegean)

  On a special type of semi-Markov process

  This work deals with multi state systems that we model by means of semi-Markov processes. The main characteristic of this work is that the sojourn times in a given state which are seen to be independent not identically distributed random variables are assumed to belong to two different general classes of distributions. For the above setting we obtain maximum likelihood estimators of the parameters of interest and investigate their asymptotic properties. Furthermore, plug-in type estimators are furnished for various reliability indices related to the system under study. Conclusively, our main objective is the proposal of parsimonious modeling for multi-state systems, considering

also a semi-Markov framework. Thus, we introduce a useful and powerful tool with a reduced number of parameters, which can be of great importance from a practical point of view.

- Bohdan Maslowski (Charles University in Prague)

  Parameter estimation and filtering for some Hilbert-space valued Gaussian processes

  Kalman-Bucy type filter and some methods of parameter estimation are studied in the case when signals are Hilbert space-valued Gaussian processes. The corresponding integral equations are derived for the optimal estimate and covariance of the error. These general results are illustrated by an example of linear SPDEs where the noise terms are Gauss-Volterra processes (in particular, fractional Brownian motions). For this case, minimum contrast estimators of the parameter in the drift are also derived, shown to be strongly consistent and, under suitable conditions, asymptotically normal. Berry-Esseen type bounds for the speed of convergence in the total variation and Wasserstein metrics to the normal law are established. The talk is based on a joint papers with Pavel Kriz and Vit Kubelka.

- Christos Meselidis (University of the Aegean)

  Statistical Inference for Multinomial Distributions based on the (Phi, alpha)-Power Divergence Family of Measures

  In the present work we consider parameter estimation and hypothesis testing based on a general family of test statistics, namely the (Phi, alpha)-power divergence family. We propose a general family of test statistics that involves two indices, the values of which play a key role in the effectiveness of the proposed methodology. The asymptotic

properties of the associated estimators are also examined. Finally, we explore through extensive simulations, the effect of the shape of the multinomial distribution on the performance of the proposed test.

- Bogdan Gh. Munteanu ("Henri Coandă" Air Force Academy of Braşov)

  The Max Cubic Transmuted Exponential Power Series Distributions

  This study proposes and discusses the max cubic transmuted exponential (MaxCTE) distribution class. The general transmuted family of distributions was presented in paper of Rahman et al., 2018. This new class of distributions allows for better flexibility in the simulation studies of bi-modal data. The MaxCTE is the distribution of the random variable max(X_1, X_2,..., X_N), where X_1, X_2,... are independent random variables, cubic transmuted exponentially distributed and N is a random variable whose distribution is part of the family of the power series distributions. The analysis also focuses on the main characteristics and properties of this new distribution.

- Romeo Negrea ("Politehnica" University of Timişoara)

  On a class of Stochastic Differential Equations and Application

  Some aspects of numerical solutions for a class of stochastic delay differential equations (SDDEs) are presented. Also, we discuss about some applications of this type of stochastic differential equations in finances.

- Kimon Ntotsis (University of the Aegean)
  Multifactor Analysis and Modelling of Pension Expenditures within Europe
  The purpose of this work is the modelling of Pension Expenditures as percentage of Gross Domestic Product (GDP) of various European countries. For this purpose we proceed to locate, collect and analyze the factors which either on short-term or on long-term may have an impact on the shaping of this variable. By achieving that we are able to model the Pension Expenditures and make forecasts. The analysis focuses on 20 European countries for which a large amount of data are available including a set of 20 possible explanatory variables for the period 2001-2015.

- Mădălina Olteanu (Université Paris 1 Panthéon-Sorbonne)
  Clustering and visualizing large cattle-trade networks using relational self-organizing maps
  Farm contact networks or animal trade networks are being one of the most extensively studied mathematical objects these last few years. Indeed, research stemming from various fields – epidemiology, physical statistics, applied mathematics – aims at understanding the behavior of these complex, dynamic networks. One of the goals of these studies is to mindfully explore these massive data, extract meaningful information and structure, and eventually isolate specific patterns and clusters which may contribute to assessing phenomena such as preferential behaviors, epidemics spreading, ... The present contribution addresses the insights that relational clustering trained with various distances computed from temporally reachable paths may bring in the exploratory study of dynamical networks. We illustrate our findings on a representative sub-network of the cattle-trade French network – Brittany –, monitored with a daily frequency between 2005 and 2009.

- Valentin Patilea (Ensai, CREST)

  M-estimation inference for partially linear single-index models: an empirical likelihood approach

  Partially linear single-index models represent a versatile tool to capture the relationship between response variables and possibly high-dimensional covariate vectors. The approximation of the response is given by the sum of a linear term and of a nonparametric link function of a second linear combination of covariates, usually called the index. This approximation is defined with respect to a loss function which characterizes a feature of the conditional law of the response given the covariates such as the conditional mean or the conditional median. In this paper we consider a general family of loss functions and investigate the corresponding partially linear single-index regression models, including mean, quantile, expectile and robust regressions. Except for imposing some moments to be finite, the conditional law of the error term is allowed to be general. For the inference, we adopt the empirical likelihood (EL) approach based on a class of moment conditions in which we plug-in estimates of the nuisance link function. We show the asymptotic pivotality of the likelihood ratio under weak high-level conditions. A simple data-driven choice of the tuning parameter for the estimation of the link function. Several extensions are presented, including the generalized EL and the case where dimension of the parameter vector grows with the sample size.

- Giovanni Peccati (University of Luxembourg)

  Approximation of fractional local times in the zero energy case

  We consider empirical processes associated with high-frequency observations of a fractional Brownian motion (fBm) H in the interval (0,1), and show how to derive conditions under which these processes verify a (possibly uniform) law of large numbers, as well as a second order (possibly uniform) limit theorem. We will devote specific attention to the `zero energy' case, corresponding to a kernel whose integral on the real line equals zero. Our asymptotic results expressed either in terms of the local time of the fBm or of its derivatives: in particular, the full force of our finding applies to the `rough range' $0< H < 1/3$, on which the previous literature has been mostly silent. Our results are based on the use of Malliavin calculus and Fourier analysis, and extend and complete several findings in the literature, e.g. by Jeganathan (2004, 2006, 2008) and Podolskij and Rosenbaum (2018).
  Based on a joint work with A. Jaramillo and I. Nourdin.

- Nicolas Perkowski (Max-Planck Institute for Mathematics in the Sciences, Leipzig)

  A probabilistic approach to some singular stochastic PDEs

  By now there exist powerful and general solution theories for singular stochastic PDEs, based on regularity structures and related pathwise theories. But the evolution of the laws of these equations is still poorly understood because the usual probabilistic tools break down. In my talk I will present a martingale theory for a class of singular SPDEs of Burgers type. We construct a domain of controlled (and non-smooth) test functions for the infinitesimal generator and based on that we study the Kolmogorov forward and

backward equations and the martingale problem. In combination with works by Goncalves, Jara, Sethuraman and others this leads to weak universality results for generalized stochastic Burgers equations. Joint work with Massimiliano Gubinelli.

- Cristian Preda (Université de Lille)

  Categorical functional data with R

  Categorical functional data represented by paths of a stochastic jump process with continuous time are considered for dimension reduction (visualisation), regression and clustering. A simulation study and an analysis of discharge medical letters are presented in an R framework.

- Mihaela Pricop-Jeckstadt (University ”Politehnica” of Bucharest)

  Nonlinear Tikhonov regularization in Hilbert scales with balancing principle tuning parameter in statistical inverse problems

  We focus in this talk on inverse problems described by nonlinear operator equations both in a deterministic and statistical framework, and similarities and differences related to the nature of the setting are emphasized. Moreover, a convergence analysis leading to order optimal rates in the deterministic case and order-optimal rates up to a log-factor in the stochastic case for the balancing principle tuning parameter and for a range of smoothness classes is presented. Finally, the empirical and theoretical convergence rates are illustrated in the case of a parameter identification problem.

- Julien Randon-Furling (Université Paris 1 Panthéon-Sorbonne)

  Brownian convex hulls and other extreme-value problems

- Ana Maria Răducan (ISMMA), Luigi Cătană (University of Bucharest, Faculty of Mathematics and Computer Science)

  On stochastic order between random vectors

  We suggest some technique to verify a similar result in the multivariate case. We analyze distributions on arbitrary sets and we also consider the particular case of closed, convex sets and even more precisely, balls.

- Marius Rădulescu, Gheorghiţă Zbăganu (Institute of Mathematical Statistics and Applied Mathematics), Constanța Zoie Rădulescu (National Institute for Research and Development in Informatics)

  Multiperiod portfolio selection models with proportional transaction costs and initial holdings

  In this paper we extend the single period Markowitzâ€™s portfolio selection model to the multi-period case. Our multi-period models include proportional transaction costs and take into account initial holdings for the investor. Our approach is new. The investment and selling decision are made at fixed moments. The portfolio selection multi-period models are mathematical programming models with complementarity constraints. We prove that the models are equivalent to mixed-binary models.

- Elena-Grațiela Robe-Voinea, Alexandru Pintilie (”Ovidius” University of Constanța)

  Calculating the efficiency of an international shipping voyage using Primavera P6 software

  Due to the growing demand for both material and human resources involved in the shipping process the maritime market has become increasingly a subject of great interest. Whether we are talking about the shipbuilding area or how to operate effectively a ship, both of these fields imply time, money labor and non-labor resources. Consequently, it is of real interest to try to optimize the control of these two factors and implicitly on a whole voyage. This work therefore wants to demonstrate that the classical method of calculating a voyage can be transposed and calculated in a friendly, fast and lasting interface way through the most popular Primavera P6 planning software. The goal is an academic one that aims to increase the interest of younger generations to applicability and innovation.

- Andreea Mădălina Rusu-Stancu, Ioan M. Stancu-Minasian (ISMMA of the Romanian Academy)

  Multiobjective fractional programmimg involving semilocally type-I univex functions

  In this paper, we derive sufficient optimality conditions for a nonlinear multiobjective fractional programming problem, based on the generalized rho-semilocally type-I univex functions. Duality theorems are proved for a general dual problem under the generalized rho-semilocally type-I univex assumptions. Many known results are particular cases of this work.

- Răzvan-Cornel Sfetcu (University of Bucharest)

  Best Approximation Results and Some Perspectives to Information Divergences

  We give sufficient conditions for the best approximation of convex, bounded, closed and solid sets in sequence spaces. Some connections with information divergences are studied.

- Sorina-Cezarina Sfetcu (University of Bucharest)

  Some Generalizations of the Kullback-Leibler Divergence

  We consider some divergences which generalize the classical Kullback-Leibler divergence. We show that these divergences are non-additive, positive, monotone and find some bounds for them. It should be noticed that the bounds found here are similar with those corresponding to the Kullback-Leibler divergence.

- Emil Simion (University "Politehnica" of Bucharest)

  Statistical tests used in validation of cryptographic primitives

  The paper presents how the statistical tests are applied for the validation of cryptographic primitives.

- George-Jason Siouris (Laboratory of Statistics and Data Analysis, Department of Statistics and Actuarial-Financial Mathematics, University of the Aegean)

  Distributional Properties of the Percentage Change of Discrete Valued Stochastic Processes

  After extensive investigation on the statistical properties of financial returns, a discrete nature has surfaced when low price effect is present. In order to model the discrete nature of the returns the discretization of the tail density function is

applied. This is a rather logical approach, since the nature of returns is discrete, as the market always operates on a specific accuracy. As a result of this discretization process, it is now possible to improve the expected percentage shortfall estimations. This discrete nature seems to be useful in a number of scientific fields, hence it is generalized in the Percentage Changes of Discrete Valued Stochastic Processes. The exotic behaviour it exhibits, as well as the new possibilities it provides are presented below.

- Meryem Slaoui, Ciprian Tudor (University Lille 1)

  Generalized *k*-variations and Hurst parameter estimation for the fractional wave equation via Malliavin calculus

  We analyzed the generalized *k*-variations for the solution to the wave equation driven by an additive Gaussian noise which behaves as a fractional Brownian with Hurst parameter $H > 1/2$ in time and is white in space. The *k*-variations are defined along *filters* of any order $p \geq 1$ and of any length. We show that the sequence of generalized *k*-variation satisfies a Central Limit Theorem when $p > H+1/4$ and we estimate the rate of convergence for it via the Stein-Malliavin calculus. The results are applied to the estimation of the Hurst index. We construct several consistent estimators for H and these estimators are analyzed theoretically and numerically.

- Radu Stoica (Université de Lorraine)

  Parameter estimation for exponential models through simulated annealing based on the ABC Shadow dynamics

  ABC Shadow dynamics is a recent method derived for sampling posterior distributions of unnormalised probability densities (Stoica et al., 2017). This presentation introduce a new simulated annealing algorithm based on the ABC Shadow simulation dynamics. First the general method is described, next results on simulated and real data are presented. This method exhibits a general character, in the sense that it applies for probability densities that are continuously differentiable with respect to their parameters. This work is a joint project together with: M. Deaconu (Inria Nancy), A. Philippe (Université de Nantes) and L. Hurtado (Universidad CEU San Pablo).

- Romică Trandafir (Technical University of Civil Engineering, Bucharest), Vasile Preda (University of Bucharest & ISMMA), Mihaela Păun (University of Bucharest)

  New properties and some statistical results concerning the Varma entropy

  We consider a new conditional entropy and some its properties relative to monotonic. Also, residual Varma entropy is presented and new research directions are investigated. The MaxEnt methodology is given in the case Varma entropy. Further the research weighted frame is suggested.

- Paschalini Trentou (University of the Aegean), Aida Toma (ASE Bucharest & ISMMA), Alexandros Karagrigoriou (University of the Aegean, Samos)

  The Use of Pseudodistances in Model Selection

  This work is aiming on checking the performance of a novel model selection criterion, called Pseudodistance Information Criterion (PIC), which is based on pseudodistances. A simulation study was performed using PIC and comparing it to other well known criteria such as AIC (Akaike Information Criterion), BIC (Bayesian Information Criterion) and MDIC (Modified Divergence Information Criterion), in order to investigate its appropriateness. The derived results are considered to be satisfactory.

- Vincent Vandewalle (Inria & Université de Lille)

  Gaussian-based visualization of Gaussian and non-Gaussian model-based clustering Ornstein-Uhlenbeck process with respect to the Hurst index

  A generic method is introduced to visualize in a Gaussian-like way, and onto R^d, results of Gaussian or non-Gaussian model-based clustering. The key point is to explicitly force a spherical Gaussian mixture visualization to inherit from the within cluster overlap which is present in the initial clustering mixture. The result is a particularly user-friendly draw of the clusters, allowing any practitioner to have a thorough overview of the potentially complex clustering result. An entropic measure allows us to inform of the quality of the drawn overlap, in comparison to the true one in the initial space. The proposed method is illustrated on four real data sets of different types (categorical, mixed, functional and network) and is implemented on the R package ClusVis.

- Raluca Vernic ("Ovidius" University of Constanța)

  On a collective model with dependent frequency and claim amounts

  In this paper, we aim to relax the usual collective model independence assumption stating that the random variable claim frequency is independent of the random variables claim amounts (severities). Although providing a significant simplification of calculations, in practice this assumption is often unrealistic (for example, in auto insurance the claim frequencies and amounts are often negatively associated). Therefore, in this paper, we assume that the random variable claim frequency is related to each claim amount by a bivariate Sarmanov distribution; also, given the value of this frequency, the corresponding random variables claim amounts are independent and identically distributed. We determine the main characteristics of this model and discuss the parameters estimation. In particular, we emphasize the compound Poisson-Gamma model.

- Lauri Viitasaari (University of Helsinki)

  Gaussian fluctuations for the stochastic heat equation with colored noise

  In this talk we present a quantitative central limit theorem for the d-dimensional stochastic heat equation driven by a Gaussian multiplicative noise, which is white in time and has a spatial covariance given by the Riesz kernel. We show that the spatial average of the solution over a Euclidean ball is close to a Gaussian distribution, when the radius of the ball tends to infinity. Our central limit theorem is described in the total variation distance, using Malliavin calculus and Stein's method. We also provide a functional central limit theorem and analogous result in 1-dimensional case when the noise is white in both time and space.

- Marko Voutilainen (Aalto University)

  On model fitting and estimation of stationary processes

  W Stationary processes form an important class of stochastic processes that has been extensively studied in the literature. Their applications include modelling and forecasting numerous real life phenomenon including natural disasters, sustainable energy sources, sales and market movements. One of the most essential families of stationary processes is the ARMA family. When modelling existing data with an ARMA process, the first step is to fix the orders of the model. After that, one can estimate the related parameters by using standard methods such as maximum likelihood (ML) or least squares (LS) estimators. The final step is to conduct various diagnostic tests in order to determine the quality of the model. In this talk we present a novel way of fitting a model to a data that is assumed to be a realization from a discrete time stationary process. Our approach is based on a recently proved AR(1) characterisation of strictly stationary processes, where the noise is not assumed to be white. As a result, we obtain a closed form consistent estimator of the model parameter and its asymptotic normality under general conditions. In comparison to conventional ARMA modelling, in general, the ML and LS estimators do not admit closed form representations. Our method is also applicable in estimation of the generalized ARCH model with stationary liquidity. We obtain consistent estimators of the model parameters under some assumptions that are mostly natural. Also continuous time strictly stationary processes together with a connection to Langevin equation will be discussed.

Registered participants

- Achilleas Anastasiou (University of the Aegean, Greece)
- Alexandru Amărioarei (FMI, University of Bucharest, Romania)
- Vali Asimit (Cass Business School, City, University of London, UK)
- Obayda Assaad (University of Lille, France)
- Andrei Bădescu (University of Toronto, Canada)
- Luiza Bădin (ASE Bucharest, Romania)
- Vlad Bally (Université Paris Est, France)
- Vlad Ștefan Barbu (University of Rouen, France)
- Lucian Beznea (IMAR Bucharest, Romania)
- Bogdan Corneliu Biolan (FMI, University of Bucharest, Romania)
- Voicu Boscaiu (Ismma Bucharest, Romania)
- Petre Caraiani (Institute for Economic Forecasting, Romanian Academy & ASE Bucharest, Romania)
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NOTE