The 26th Conference of the Romanian Society of Probability and Statistics

University of Bucharest, May 23-24, 2025

Invited speakers:

Radu CRAIU (University of Toronto, Canada)

Mark PODOLSKIJ (University of Luxembourg, Luxembourg)

Alexandre RICHARD (CentraleSupelec, France)

Gugliemo D'AMICO (University „G. d'Annunzio" of Chieti-Pescara, Italy)

Ioana CIOTIR (INSA de Rouen, France)

Arnulf JENTZEN (CUHK-Shenzhen, China, and University of Munster, Germany)

Oana LANG (University Babes-Bolyai, Romania)

Salim BOUZEBDA (University of Technology of Compiègne, France)

Eduard ROTENSTEIN (University A. I. Cuza, Romania)

Andreas MAKRIDES (University of the Aegean, Greece)

Apostolos BATSIDIS (University of Ioannina, Greece)

Polychronis ECONOMOU (University of Patras, Greece)

Organizers:

University of Bucharest, Faculty of Mathematics and Computer Science

Romanian Sociery of Probability and Statistics

Bucharest University of Economic Studies

"Simion Stoilow" Institute of Mathematics of the Romanian Academy

Vlad-Stefan Barbu, Iulian Cîmpean, Ionel Popescu, Ciprian Tudor

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Abstract Book
26th Conference of the Romanian Society of Probability and Statistics
Bucharest, May 23–24, 2025

Preface

This abstract book compiles the titles, affiliations, co-authors, and abstracts of presentations submitted for the 26th Conference of the Romanian Society of Probability and Statistics, held in Bucharest, Romania, on May 23–24, 2025. The conference brings together researchers and practitioners to discuss advancements in probability, statistics, stochastic processes, optimization, and related fields.

The following entries are organized alphabetically by the primary presenter's last name, including their affiliation, co-authors, and, where provided, the abstract of their presentation. We thank all participants for their contributions to the conference.

Organizing Committee

Vlad-Stefan Barbu, Iulian Cîmpean, Ionel Popescu, Ciprian Tudor

Abstracts

- **Andriciuc, Alexandra-Ionela**
  University of Bucharest & Institute of Mathematics "Simion Stoilow", Romania
  Co-Authors: None listed
  Exploring Swarm Convergence: A Mathematical Lens on PSO
  Particle Swarm Optimization (PSO) captivates with its elegant design and echoes of collective behavior in nature. Since its inception, numerous swarm intelligence algorithms have emerged, reflecting a growing research trend. We focus on a specific PSO case, dissecting its behavior by fixing certain values to study convergence around fixed points. Using classical probabilistic methods, we aim to bridge rigorous theory with practical parameter choices, probing whether and how the swarm's collective judgment converges. This approach, typical of mathematicians who tackle problems by breaking them into smaller parts, isolates a sub-problem to unravel its nuances. We will also survey key literature results and approaches to contextualize our work.

- **Anton, Cristina**
  Grant MacEwan University, Canada
  Co-Authors: None listed
  Malliavian differentiability for stochastic differential equations with locally Lipschitz coefficients
  We study Malliavin differentiability for the solutions of a stochastic differential equation with drift of super-linear growth. Assuming we have a monotone drift with polynomial growth we prove Malliavin differentiability of any order. As a consequence of this result, we prove that the density of the solution's law with respect to the Lebesgue measure is infinitely differentiable.

- **Bebu, Ionuț**
  The George Washington University, USA
  Co-Authors: None listed
  On Statistical Inference of Competing Risks Failure Times Using Multiple Imputation
  This presentation is concerned with statistical methodology based on divergence measures. More precisely, we propose goodness-of-fit tests based on Tsallis and Kaniadakis entropies. After a short review on entropies, we present the Tsallis and Kaniadakis entropies. Then we provide the test statistics based on new information measures together with the asymptotic distribution under the null hypothesis. Finally, we perform a simulation study in order to explore the capabilities of the proposed test statistics.

- **Barbu, Vlad Stefan**
  LMRS, University of Rouen – Normandy, France & Centre for Demographic Research "Vladimir Trebici", "Costin C. Kiritescu" National Institute of Economic Research of Romanian Academy, Romania
  Co-Authors: Alex Karagrigoriou (University of Piraeus, Greece), Vasile Preda (University of Bucharest & "Gheorghe Mihoc-Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics & "Costin C. Kiritescu" National Institute of Economic Research, Romania)
  Hypotheses testing based on Tsallis and Kaniadakis entropies
  This presentation is concerned with statistical methodology based on divergence measures. More precisely, we propose goodness-of-fit tests based on Tsallis and Kaniadakis entropies. After a short review on entropies, we present the Tsallis and Kaniadakis entropies. Then we provide the test statistics based on new information measures together with the asymptotic distribution under the null hypothesis. Finally, we perform a simulation study in order to explore the capabilities of the proposed test statistics.

- **Batsidis, Apostolos**
  Department of Mathematics, University of Ioannina, Greece
  Co-Authors: None listed
  Biased samples and weighted distributions: Statistical Inference
  In many scientific fields, such as those involving environmental, meteorological, and biomedical data, biased sampling is a common phenomenon. This bias may arise either from unintentionally applying a non-random sampling scheme or from the nature of the problem itself. Since failing to account for the presence of such a biased sample can lead to serious problems, the concept of weighted distributions has been used in numerous works not only to describe the biased sample but also as an adjustment methodology when the probability of selecting a unit from the respective population is proportional to some known non-negative weight function. Using the concept of weighted distributions, this talk deals with hypothesis testing for the population mean and variance based on r-sized biased samples, with statistical inference for the expectation of a function of a random vector based on biased samples and robust inference under r-size biased sampling without replacement from a finite population.

- **Bouzebda, Salim**
  Université de Technologie de Compiègne, France
  Co-Authors: Nour-Eddine Berrahou (Cadi Ayyad University, Morocco), Lahcen Douge (Cadi Ayyad University, Morocco)
  A nonparametric distribution-free test of independence among continuous random vectors based on L_1-norm
  We propose a novel statistical test to assess the mutual independence of multidimensional random vectors. Our approach is based on the L_1-distance between the joint density function and the product of the marginal density associated with the presumed independent vectors. Under the null hypothesis, we employ Poissonization techniques to establish the asymptotic normal approximation of the corresponding test statistic, without imposing any regularity assumptions on the underlying Lebesgue density function, denoted as $f(\cdot)$. Remarkably, we observe that the limiting distribution of the L_1-based statistics remains unaffected by the specific form of $f(\cdot)$. This unexpected result contributes to the robustness and versatility of our method. Moreover, our tests exhibit nontrivial local power against a subset of local alternatives, which converge to the null hypothesis at a some rate. Finally, the theory is supported by a comprehensive simulation study to investigate the finite-sample performance of our proposed test.

- **Caraiani, Petre**
  Bucharest University of Economic Studies, Romania
  Co-Authors: Dan Gabriel Anghel (Bucharest University of Economic Studies, Romania)
  Investor Sentiment Spillovers and Tail Risk Spillovers
  We use high frequency data to construct measures of sentiment spillovers for financial stocks listed in the United States. We then test and find a statistically and economically significant response of tail risk spillovers to investor sentiment spillovers. We found significant effects for both positive and negative sentiment. For the former, this leads to dampening tail risk spillovers, while for the latter, tail risk spillovers are amplified.

- **Ciotir, Ioana**
  INSA de Rouen Normandie, France
  Co-Authors: Dan Goreac (Université Laval, Canada), Juan Li (Shandong University, China), Antoine Tonnoir (INSA de Rouen Normandie, France)
  Stochastic porous media equation with Robin boundary conditions and gravity-driven in-

filtration
We aim at studying a novel mathematical model associated to a physical phenomenon of infiltration in an homogeneous porous medium. The particularities of our system are connected to the presence of a gravitational acceleration term proportional to the level of saturation, and of a Brownian multiplicative perturbation. Furthermore, the boundary conditions intervene in a Robin manner with the distinction of the behavior along the inflow and outflow respectively. We provide qualitative results of well-posedness, the investigation being conducted through a functional approach.

- **Cojocea, Manuela-Simona**
Faculty of Mathematics and Computer Science, University of Bucharest, Romania
Co-Authors: None listed
The construction of the Kolmogorov expected value for random variables with applications
We present the theorem of existence for the Kolmogorov expected value for both the continuous and the discrete case, and we provide some of its applications in the field of random variables with non-finite mean.

- **Covei, Dragos-Patru**
Department of Applied Mathematics
The Bucharest University of Economic Studies
Piata Romana, No. 6, Bucharest, District 1, 010374, Romania
Co-Authors: None listed
Stochastic Production Planning with Regime Switching
This study investigates a stochastic production planning problem with regime switching parameters inspired by economic cycles that impact production and inventory costs. The model considers multiple goods and uses a Markov chain to capture regime transitions together with an N-dimensional Brownian motion for stochastic demand. A quadratic cost functional integrates production and holding cost components, while a system of regime-dependent elliptic partial differential equations characterizes the optimal control strategy. Numerical results from a monotone iteration algorithm alongside sensitivity analyses illustrate the conservative bias of regime-switching models compared to static alternatives.

- **Craiu, Radu**
University of Toronto, Canada
Co-Authors: Robert Zimmerman (Imperial College London, United Kingdom)
Statistical Elucidation of Latent Structures via Copulas
Latent variable models, be they static or dynamic, are ubiquitous in statistical analyses. We present copula-based extensions of such models and discuss the inferential benefits and computational challenges that result from these extensions. The methodology is illustrated using numerical experiments and data analyses.

- **D'Amico, Guglielmo**
University G. d'Annunzio of Chieti-Pescara, Italy
Co-Authors: Salvatore Vergine (Marche Polytechnic University, Italy)
Invited talk: Reliability analysis for assessing the discrepancy between wind power production and demand in energy communities
Dependability measures are essential for various engineering problems, the one dealing with the planning and development of a wind farm included. In this work, we address the problem of quantifying the mismatch between wind production and energy demand within energy

communities through well-known dependability measures, such as reliability and availability functions, and recent metrics such as sequential interval reliability. To achieve this objective, we modeled wind power using the discrete-time semi-Markov process and compared the obtained real wind power and the simulated data to demonstrate the validity of the proposed approach. Furthermore, we test different energy communities by aggregating buildings both randomly selected from the database and correctly chosen by solving an optimization problem that minimizes the mismatch between wind production and cumulative demand. The results show that the proposed model and metrics are suitable for studying wind production in relation to energy demand and provide useful information for the management and design of an energy community.

- **De Blasis, Riccardo**
  Marche Polytechnic University, Italy
  Co-Authors: Graziella Pacelli (Marche Polytechnic University, Italy), Salvatore Vergine (Marche Polytechnic University, Italy)
  Investment valuation of photovoltaic and energy storage systems for diverse energy communities: a real option approach
  The use of energy storage devices and renewable energy sources has evolved over the past few decades from an individual to a community concept, whereby the energy produced and stored is distributed among energy community participants. In this context, there is the need to provide an investment strategy to decide whether and when to invest in a photovoltaic-battery system to cover the energy demand. Therefore, we propose an optimization methodology to assess the profitability of these systems to be installed in such energy communities while exploiting the variability of the demand curves from different types of users. Moreover, considering the future uncertainty of photovoltaic production, energy demand, and price of electricity, we evaluate the possibility of deferring the investment by employing a real option approach. We perform the analysis on several energy communities composed by different types of users. Results show that being part of a diverse energy community guarantees savings in terms of total costs and battery capacity, together with a reduction in investing time and an increase in the value of the option.

- **Di Bari, Antonio**
  University of Campania "L. Vanvitelli", Italy
  Co-Authors: Michele Bufalo (University of Bari, Italy), Giovanni Villani (University of Bari, Italy)
  Modelling solar energy projects performance through compound exchange options with jump processes
  Solar energy projects represent a sustainable investment opportunity. This sustainability aspect becomes stronger if solar energy projects involve more inhabitants, while pursuing the smart city goal. The evaluation of these projects is a very demanding task, as they are characterized by unpredictable electricity prices and uncertainty about their future performance. The non-storability of electricity implies that a small change in demand or capacity generates jump in prices that, in turn, can make the revenues volatile. In addition to this, smart city projects are characterized by sequential logic because they are not pursued in one-shot investment, but they are characterized by various investment stages. Considering these aspects, we propose an innovative methodology to model the performance of solar energy projects by using a compound exchange option model with jump processes. This model allows to consider: the stochastic nature of revenues and costs; the jump component in the electricity prices evolution; the sequential logic and the "optionality" to abandon the project if it becomes unprofitable during the

time. A case study is also proposed and the results show that, differently from the classical Net Present Value approach, the compound exchange option model with jump processes prices adequately the smart city renewable projects that, in addition to be financially profitable, are in line with the UN Sustainable Development Goals.

- **Economou, Polychronis**
  Department of Civil Engineering, University of Patras, Greece
  Co-Authors: None listed
  Biased samples and weighted distributions: Revealing and modeling sampling bias
  The use of a biased sample from a specific population may cause serious problems if treated as a random one from that population since any statistic computed based on a non-representative sample is systematically erroneous. For instance, a biased sampling scheme can be the reason for observing in practice a false positive or negative correlation between two random variables, which are either not correlated or correlated with a different direction (Berkson's paradox). In this talk, initially, the concept of bivariate weighted distributions is used and four different families of weight functions are proposed to describe Berkson's paradox. Afterward, using the concept of weighted distributions to represent bias, the ABC algorithm to approximately draw samples from Bayesian posteriors and the Deviance Information Criterion to compare the fit of different models, we discuss how the four weight functions can be used to understand if the observed bias in a bivariate sample is caused either by both random variables or by one of them.

- **Flondor, Ioana-Maria**
  Department of Mathematics-Informatics, Faculty of Applied Sciences, University POLITEHNICA of Bucharest, Romania
  Co-Authors: None listed
  α-windowed Fourier transform
  We introduce a new time-fractional-frequency transform, named α-windowed Fourier transform (α-WFT) $G_{\phi}^{\alpha} : L^2\left(\mathbb{R}^2\right) \to L^2\left(\mathbb{R}^2\right)$, where α is a fractional parameter (i.e. $\alpha \in \mathbb{R}, \alpha \neq n\pi, n \in \mathbb{Z}$) and $\phi \in L^2(\mathbb{R})\backslash\{0\}$ is a window function. We investigate some fundamental properties of this generalized windowed Fourier transform, such as the Parseval relation, the orthogonality relation and the inversion formula. Then, we establish some Heisenbergtype inequality for the α-WFT in the fractional Fourier domain and we also give a result concerning Lieb's inequality for α-WFT. Furthermore, we study a relationship between the α-WFT and a version of the fractional Wigner distribution introduced for this purpose. In the end, we introduce a semi-discrete and a discrete version of the α-WFT.

  The results related to this topic were obtained in the joint paper [1], called " α-Windowed Fourier transform (α-WFT)".

  References:

  [1] V. Catană, I.M. Flondor, M.G. Scumpu, α-Windowed Fourier transform $(\alpha - WFT)$, J. Pseudo-Differ. Oper. Appl., vol.15, article number 75, 2024. [2] V. Catană, I.M. Flondor, M.G. Scumpu, Localization operators related to α-windowed Fourier transform, U.P.B. Sci. Bull., Series A, vol. 86, iss. 4, 2024. [3] H.M. Srivastava, A.F. Shah, A.Y. Tantary, A family of convolution-based generalized Stockwell transforms, J. Pseudo-Differ. Oper., vol. 11, 1505-1536, 2020. [4] M.W. Wong, Wavelet Transforms and Localization Operators, Birkhäuser, Boston, 2002, (Operator theory; Advances and Applications; vol. 136).

- **Georgescu, Horia-George**
  Department of Mathematics-Informatics, Faculty of Applied Sciences, University POLITEHNICA

of Bucharest, Romania
Co-Authors: None listed
Essential spectra and semigroups of perturbations of generalized SG-hypoelliptic pseudo-differential operators on $L_p(\mathbb{R}^n)$
In this talk we study some problems concerning Sobolev estimates in the framework of $L^p(\mathbb{R}^n)$-spaces, $1 < p < \infty$, for a subclass of the class of generalized *SG*-hypoelliptic pseudo-diferential operators on $L^p(\mathbb{R}^n), 1 < p < \infty$, introduced by Camperi in [1]. We mention that this study was conducted in connection with the work of V. Catană [2].

Using a particular case of a version of Erhling's inequality for L^p-Sobolev spaces $H^{s,p}(\mathbb{R}^n)$ on $\mathbb{R}^n, s = (s_1, s_2), -\infty < s_1, s_2 < +\infty, s_2 \leq 0, 1 \leq p < \infty$, we establish an analogue of the Agmon-Douglis-Nirenberg inequality for SGhypoelliptic pseudo-differential operators perturbed by singular potentials on $L^p(\mathbb{R}^n), 1 < p < \infty$. Further, we give some results regarding the essential spectra of *SG*-hypoelliptic pseudo-differential operators T_σ on $L^p(\mathbb{R}^n), 1 < p < \infty$, perturbed by the operators of the form $\sum_{j=1}^{r} V_j T_{\tau_j}$. We also obtain a self-adjointness result for perturbations of *SG*-hypoelliptic pseudo-differential operators on $L^2(\mathbb{R}^n)$ whose symbols are independent of x in $\mathbb{R}^n$. Finally, an application to strongly continuous semigroups of contractions generated by *SG*-hypoelliptic pseudo-differential operators on $L^p(\mathbb{R}^n), 1 < p < \infty$, is given.

The results presented in this talk are included in the paper [3].

References

[1]. I. Camperi, Global hypoellipticity and Sobolev estimates for generalized SG pseudodifferential operators, Rend. Sem. Mat. Univ. Pol. Torino 66(2), 99-112 (2008). [2]. V. Catană, Essential spectra and semigroups of perturbations of Mhypoelliptic pseudo-differential operators on $L^p(\mathbb{R}^n)$, Complex Var. Elliptic Equ. 54(8), 731744 (2009). [3]. V. Catană, H-G. Georgescu, Essential spectra and semigroups of perturbations of generalized SG-hypoeiliptic pseudo-differential operators on $L^p(\mathbb{R}^n)$, J. PseudoDiffer. Oper. Appl. 13, 25 (2022).

- **Iatan, Iuliana**
University of Bucharest, Faculty of Law, Department of Private Law, Romania
Co-Authors: None listed
Function Approximation using Non-neural and Neural Methods
In many applications from science and engineering, a function needed by a user depends on multiple variables. For instance, the ideal gas says that the pressure is a function of its density and its temperature. This paper will focus on the approximation theory, based on the problem of approximating or interpolating a continuous Multivariate Function (MF) by an approximating function having a fixed number of parameters, that provides the best possible approximation of the respective function on the set of examples. From this point of view, the approximation of a function is equivalent with the learning problem for a Neural Network (NN). Various non-neural methods have been developed to solve the problem of approximating functions of many variables: both the classical that use Polynomials, Taylor series, or Tensor Products and the modern methods using Wavelets, Radial Basis Functions, Multivariate Splines or Ridge Functions. One of our research objective is to highlight many advantages of exploring the capabilities of the NNs to implement Function Approximation (FA). Based on this research program, we will develop a work started during my two postdoctoral stages (made at the Computer Science Department of the University of Amsterdam, Netherlands) that consists in using the Orthogonal NNs as universal approximators to continuous functions on compact domain. In this paper we aim to perform new non-neural and neural models for approximating off all

the kind of the MFs (trigonometric functions, multivariate polynomial, exponential functions, etc.). A lot of real world applications like prediction, Pattern Recognition, Data Mining, classification and problems from Mechanics are targeted to show that FA plays a very important role in the numerical computation. Our purpose is that, the multidisciplinary fields studied by the present paper to have significant references for the research of FA and to prove all its conclusions after the actual simulation tests, in Matlab, Maple and Wolfram Mathematica.

- **Istrate, Gabriel**
  University of Bucharest, Romania
  Co-Authors: Bogdan Dumitru (University of Bucharest, Romania), Mihai Prunescu (University of Bucharest, Romania)
  Conway's Army Percolation
  We study a probabilistic version of the celebrated Conway's Army game. In this game the lower semiplane of an infinite chessboard may be filled with checker pieces. A celebrated result due to Conway (1961) shows that one cannot move a piece in a finite number of steps to a cell on row 5 (however, rows 1-4 are reachable). In the version of this problem we are interested in, inspired by percolation theory, we assign pieces to all cells of the lower semiplane independently by flipping a coin with success probability p (a fixed constant between 0 and 1). We estimate $D_k(p)$, the probability that one can reach a fixed cell on line k, for $k = 1,2,3,4$. We first give several results that provide rigorous lower and upper bounds on this probability. These results suggest the fact that the $D_k(p)$ is an analytic function of p. We complement these rigorous results by experimental ones, based on SAT solving. We then show that our problem is related to a percolation game on hypergraphs as follows: we identify a percolation property on the 3-uniform hypergraph (with hyperedges corresponding to three consecutive cells of the 2-dimensional integer lattice) that yields probabilities $D_k(p)$. We then study this property on a hypergraph analog of the Bethe lattice, and show that there is a critical probability for percolation on this hypergraph. This critical probability can be rigorously computed via an argument reminiscent of the computation of the extinction probability of Galton-Watson branching processes.

- **Jentzen, Arnulf**
  CUHK-Shenzhen & University of Muenster, China & Germany
  Co-Authors: Steffen Dereich, Thang Do, Robin Graeber, Adrian Riekert
  On stochastic optimization and the Adam optimizer: Divergence, convergence rates, and acceleration techniques
  Stochastic gradient descent (SGD) optimization methods are nowadays the method of choice for the training of deep neural networks (DNNs) in artificial intelligence systems. In practically relevant training problems, often not the plain vanilla standard SGD method is the employed optimization scheme but instead suitably accelerated and adaptive SGD optimization methods such as the famous Adam optimizer are applied. In this talk we show that Adam does typically not converge to minimizers or critical points of the objective function (the function one intends to minimize) but instead converges to zeros of another function, which we refer to as Adam vector field. Moreover, we establish convergence rates in terms of the number of Adam steps and the size of the mini-batch for all strongly convex stochastic optimization problems. Finally, we present acceleration techniques for Adam in the context of deep learning approximations for partial differential equation and optimal control problems. The talk is based on joint works with Steffen Dereich, Thang Do, Robin Graeber, and Adrian Riekert.

- **Karagrigoriou, Alex**

University of Piraeus, Greece
Co-Authors: Christos Meselidis (Ministry of Education of Hellenic Republic, Greece), Ilia Vonta (National Technical University of Athens, Greece)
Statistical Inference for Censored Data under a General Class of Measures
Divergence measures are fundamental in statistical inference, serving as key tools for parameter estimation and the development of goodness-of-fit tests. Generalized families of divergence measures, such as the (Φ, α)-power divergence family, can lead to estimators and test statistics that outperform conventional approaches. A crucial challenge in statistical modeling is selecting an appropriate model when dealing with censored data, a frequent issue in survival analysis and reliability studies. This work introduces and analyzes a family of estimators and test statistics derived from the (Φ, α)-power divergence family, specifically designed for censored data schemes. Additionally, a comprehensive simulation study is conducted to assess the effectiveness of the proposed methodology. Acknowledgement: This work has been partly supported by the University of Piraeus Research Center.

- **Lang, Oana**
Babeș-Bolyai University, Romania
Co-Authors: Dan Crisan (Imperial College London, UK), Alexandra Blessing (University of Konstanz, Germany)
Euler Equations Driven by Fractional Transport Noise
We extend previous work on Euler equations driven by transport noise, replacing the standard Brownian motion with fractional Brownian motion. This modification is motivated by real-world applications where fractional noise provides a more realistic model for turbulence and fluid dynamics. We analyse the existence of solutions and present a methodology for estimating the Hurst parameter, which characterises the roughness of the noise. Our results offer new insights into the impact of fractional transport noise on fluid equations and open avenues for further applications in modelling complex systems. This is joint work with Dan Crisan (Imperial College London) and Alexandra Blessing (University of Konstanz).

- **Lazari, Alexandru**
Moldova State University, Institute of Mathematics and Computer Science, Moldova
Co-Authors: None listed
Enhanced Methods for Modeling Markov Processes with Final Sequences of States and Related Games
We investigate the evolution of Markov processes with a finite state space, where the stopping criterion is defined by the system reaching one or more specified final sequences of states. Prior research has established that the distribution of the evolution time follows a homogeneous linear recurrence. In this paper, we introduce several methods to significantly reduce the order of this recurrence, thereby lowering the computational complexity of algorithms used to characterize the evolution time probabilistically. These improvements are not only efficient but also readily applicable to related game-theoretic models, paving the way for further extensions to broader classes of stochastic problems.

- **Makrides, Andreas**
University of the Aegean, Greece
Co-Authors: Evangelia Georgakopoulou (Aristotle University of Thessaloniki, Greece), Theodoros Tsapanos (Aristotle University of Thessaloniki, Greece), Emmanuel Scordilis (University of Thessaloniki, Greece), Alex Karagrigoriou (University of Piraeus, Greece), Alexandra Papadopoulou (Aristotle University of Thessaloniki, Greece), Vassilios Karastathis (National Ob-

servatory of Athens, Greece)
Evaluating Time-Dependent Risks under Dual Discrete-Time Stochastic Processes
A study of earthquake seismicity is undertaken over the areas of Central and South America, the tectonics of which are of great interest. The whole territory is divided into 10 seismic zones based on some seismotectonic characteristics, as in previously published studies. The earthquakes used in the present study are extracted from the catalogs of the International Seismological Center, cover the period of 1900–2021, and are restricted to shallow depths (≤ 60 km) and a magnitude $M \geq 4.5$. Fore- and aftershocks are removed according to Reasenberg's technique. The paper confines itself to the evaluation of earthquake occurrence probabilities in the seismic zones covering parts of Central and South America, and we implement the hidden Markov model (HMM) and apply the EM algorithm.

- **Margarint, Vlad**
University of North Carolina at Charlotte, USA
Co-Authors: A. Campbell, K. Luh
A bridge between Random Matrix Theory and Schramm-Loewner Evolutions
I will describe a newly introduced toolbox that connects two areas of Probability Theory: Schramm-Loewner Evolutions (SLE) and Random Matrix Theory. This machinery opens new avenues of research that allow the use of techniques from one field to another. One aspect of this research direction is centered in an interacting particle systems model, namely the Dyson Brownian motion. In the first part of the talk, I will introduce basic ideas of SLE theory, then I will describe the connection with Random Matrix Theory via a first application of our method. I will finish the talk with some open problems that emerge using this newly introduced toolbox. This is a joint work with A. Campbell and K. Luh.

- **Petroni, Filippo**
Università G. d'Annunzio, Chieti-Pescara, Italy
Co-Authors: Guglielmo D'Amico (Università G. d'Annunzio, Chieti-Pescara, Italy)
Mobility indices for Markov processes with application in the management of wind farm
The rate of occurrence of failure (ROCOF) is one of the most commonly utilized indicators available for assessing a system's performance over time. This paper introduces some new measures of the occurrence and non-occurrence of specific events of interest in reliability theory. Explicit expressions for their computation are derived for a Markov system, and the benefit of their use in conjunction with the ROCOF is demonstrated in a numerical example and in an application to the wind farm management by providing new evidence from the computation of the proposed rates.

- **Pircalabelu, Eugen**
UCLouvain, Belgium
Co-Authors: None listed
Directional false discovery rate control via distributed procedures for Gaussian graphical models
We propose a multiple testing procedure for conditional dependence in Gaussian graphical models based on a distributed estimator constructed using K local samples. In practice, due to privacy concerns, building test statistics using local data is challenging since one is not able to aggregate the K different datasets from several locations at one single location. In this paper, different test statistics are constructed using debiased and distributed estimators to address this problem in a multiple testing framework. It is shown that under conditions, the proposed procedure can control asymptotically at any pre-specified level the directional false

discovery rate, a metric which focuses on the sign of the estimation. An asymptotic power equal to one is also attainable under conditions on the non-zero entries of the precision matrix. Different simulation scenarios and a real data example are used to investigate the performance of the proposed procedure in practice and to verify the theoretical results.

- **Podolskij, Mark**
  University of Luxembourg, Luxembourg
  Co-Authors: Denis Belomestny (University Duisburg-Essen, Germany), Shi-Yuan Zhou (University of Luxembourg, Luxembourg)
  Non-parametric estimation of the interaction force in McKean-Vlasov diffusions
  This talk delves into the challenging problem of nonparametric estimation for the interaction function within diffusion-type particle system models. We introduce estimation methods based on empirical risk minimization. Our study encompasses an analysis of the stochastic and approximation errors, along with an examination of certain minimax lower bounds. In particular, we show that there is a natural metric under which the corresponding estimation error of the interaction function converges to zero with a parametric rate that is minimax optimal. This result is rather surprising given the complexity of the underlying estimation problem and a rather large class of interaction functions for which the above parametric rate holds.

- **Pricop-Jeckstadt, Mihaela**
  University POLITEHNICA of Bucharest, Romania
  Co-Authors: Ka Chun Wong (Florida State University, USA), Vic Patrangenaru (Florida State University, USA), Robert Paige (Missouri University of Science and Technology, USA)
  Extrinsic Data Analysis on Object Spaces
  This is work on complex data, jointly with Vic Patrangenaru, Robert L. Paige, Ka Chun Wong. The talk aims to develop a methodology for object-oriented data analysis based on chord distance on manifolds. We focus on a matched sample test for extrinsic means and on extrinsic principal component analysis on a manifold. Instead of using the local inverse of exponential map at the intrinsic mean of a random object on a manifold with a geodesic distance associated with a Riemannian structure, that may lead to inadequate results as intrinsic PCA fails to take into account that often times geodesics fill densely a higher dimensional submanifold, one uses an embedding of the manifold into a numerical space, with the associated chord distance. The resulting extrinsic k-dimensional principal subspace is obtained as preimage via the given embedding, of the intersection of the embedded manifold with the affine subspace spanned by the eigenvectors of the extrinsic covariance matrix corresponding to the k largest eigenvalues, tied at the embedded extrinsic population mean and by the orthocomplement of this tangent space in the ambient numerical space. Examples of estimation and data dimension reduction for analysis of random objects such as direct similarity shapes of contours are also presented.

- **Radulescu, Marius**
  Institute of Mathematical Statistics and Applied Mathematics, "Gheorghe Mihoc-Caius Iacob" of the Romanian Academy, Romania
  Co-Authors: Constanta Zoie Radulescu (National Institute for Research and Development in Informatics, Romania)
  Portfolio selection models with transaction costs and initial holdings
  The classical mean-variance portfolio theory, as developed by Markowitz, does not account for transaction costs or initial asset holdings. In this paper, we extend the traditional model to incorporate transaction costs while considering the investor's initial portfolio. Our approach is novel and aims to derive an optimal portfolio that minimizes risk or maximizes return. How-

ever, the optimal solution under this extended model may involve simultaneously buying and selling the same asset—an impractical strategy. To address this, we introduce complementarity constraints that prevent such simultaneous transactions. These constraints, while necessary for realistic portfolio strategies, increase the model's complexity, transforming it into a combinatorial optimization problem. The resulting feasible region becomes a union of convex sets, rather than a single convex set. We explore several methods for solving portfolio selection problems under these constraints and present a range of numerical results to illustrate our findings.

- **Richard, Alexandre**
  CentraleSupélec, Université Paris-Saclay, France
  Co-Authors: L. Anzeletti, L. Galeati, E. Tanré
  Regularisation by fractional noise: regularity of the density of SDEs and application to McKean-Vlasov equations
  First, we will consider the SDE $dX_t = b(t,X_t)dt + dB_t$, where b is a singular drift (e.g. a distribution) and B is a fractional Brownian motion. We will review some recent results on existence and uniqueness for this equation, providing criteria linking the regularity of b and the Hurst parameter H of the fractional Brownian motion. Next, we will study the time-space regularity of the conditional density of the solution in Lebesgue-Besov spaces, and also provide Gaussian bounds. Then by exploiting this regularity, we will demonstrate the existence of solutions for McKean-Vlasov equations of the form $dY_t = \mu_t * b(t,Y_t) + dB_t$, where μ_t is the law of the solution Y_t, for a drift b that can be more singular than in the linear case, and chosen in the full sub-critical regime of such SDEs. Finally, we discuss uniqueness for this singular McKean-Vlasov equation. Joint work with L. Anzeletti, L. Galeati and E. Tanré.

- **Rotenstein, Eduard**
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  Deterministic and stochastic variational inequalities driven by generalized reflection on non-convex domains
  We are interested in the existence and uniqueness of the solution for deterministic and stochastic differential equations driven by (generalized) reflection on a non-convex domain. The reflection is provided by a Fréchet subdifferential operator, perturbed by a Lipschitz transformation, which changes the maximal monotonicity property of the multivalued term. The presence of the oblique reflection brought by the multivalued term leads to the use of different techniques compared to the cases of standard reflection in non-convex domains or oblique reflection in convex domains. An important milestone for achieving the desired results consists in reconsidering the classical approach for dealing with the subdifferential operator. We extended the standard Yosida penalization technique from the convex setup to a non-convex framework. The next step is focused on the qualitative analysis of a non-convex Skorokhod problem, with generalized reflection, which leads to the study of Generalized Stochastic Variational Inequalities in non-convex domains. A second goal is to extend the study to the infinite dimensional setup. For doing this, we first need a comprehensive analysis of the solution for the deterministic differential dynamic, followed by the study of the Skorokhod problem and SVIs.

- **Sfetcu, Razvan-Cornel**
  University of Bucharest, Romania
  Co-Authors: Vasile Preda (ISMMA, INCE and University of Bucharest, Romania)
  Asymptotic behavior of some fractal divergences
  We consider a sequence of discrete probability distributions defined with the help of some gen-

eralized Jacobi polynomials and introduce fractal Kullback-Leibler divergence, fractal Tsallis divergence and fractal Rényi divergence between every element of the sequence of probability distributions introduced above and the element of the equiprobability distribution corresponding to the same index. In this way, we obtain three sequences of fractal divergences and prove that the first two are convergent and the last is divergent.

- **Stănciulescu, Vasile**
  Romania
  Co-Authors: None listed
  Classical solutions or some classes of nonlinear parabolic SPDEs with Neumann boundary conditions
  We investigate the existence and uniqueness of the solution in the strong sense of a class of nonlinear SPDE associated with a measure valued branching process by the stocastic characteristic method developed by Kunita. We also use the Ito-Wentzell formula proved by Tubaro and results from Barbu and Beznea.

- **Suter, Florentina**
  University of Bucharest and "Gheorghe Mihoc – Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics, Romania
  Co-Authors: None listed
  Using Uncertainty Measures to Evaluate Coherent System Reliability Properties
  Coherent systems play a central role in reliability theory, as they are systems in which all components are relevant to the system's functionality. In this work, we present several information measures for coherent systems with both independent and dependent identical components. We analyze how these measures impact the assessment of performance in terms of the reliability properties of the mentioned systems. Additionally, we explore ways in which such systems can be compared using various measures of uncertainty.

- **Vaidya, Tushar**
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  Quantum Pathwise Lasso Algorithms
  We propose a quantum algorithm for high-dimensional linear regression with an ℓ_1-penalty that builds on the classical LARS (Least Angle Regression) method. Our approach computes the entire regularisation path as the penalty changes, but it runs quadratically faster per iteration under certain conditions. By using Dürr and Høyer's quantum minimum-finding routine, we obtain a quadratic speedup in the number of features. We further enhance our method with an approximate quantum minimum-finding technique, achieving quadratic improvements in both the number of features and the number of observations. Additionally, we discuss lower bounds and dequantized versions of these algorithms, which could be valuable for practitioners working with large-scale high-dimensional data sets. Quantum technicalities will be kept to a minimum to appeal to a wider mathematical audience.

- **Vergine, Salvatore**
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  Investing in wind-storage systems for energy communities: a compound real options approach with least-square Monte Carlo
  The use of energy storage devices and renewable energy systems has evolved over the past few

decades from an individual to a community concept, whereby the energy produced and stored is shared among network users. Moreover, the members of an energy community own and have control over renewable systems and can share energy among different buildings. Therefore, the presence of these renewable technologies is fundamental for the existence of the community. Users can also manage battery storage systems to store excess energy produced by renewable energy systems and to use it when it is more cost-comfortable. Due to the high upfront investment costs and lower operating and maintenance costs of production and storage systems, it arises the need to provide an investment strategy for diverse energy communities. A suitable method to consider the flexibility of project design that is carried out in an uncertain environment consists of the Real Options approach. In this study, we implement an optimization model coupled with an investment valuation through real options, which includes the option to defer the investment and the subsequent option to expand the investment in diverse energy communities. We consider the following three sources of uncertainty: wind production, energy demand, and price of electricity. We study diverse energy communities, thanks to which we associate consumption profiles with different characteristics in terms of variability and time synchronism.

- **Villani, Giovanni**
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Flexibility to switch project size: A real option application for energy investment valuation
Energy projects contribute to smart city goals by reducing pollution and assisting cities to become self-sustaining. However, these projects, characterised by their sequential nature, require a huge amount of irreversible investment, especially in the case of large-scale energy projects (MW). To mitigate the risks of financial losses the investor could invest in small-scale solar projects and switch to large-scale investment projects only if the market conditions are favourable. This paper aims to embed this managerial flexibility of changing investment size during the project lifetime into its valuation. To accomplish this, we use a compound options approach with a switch and call options models to reliably price these projects by considering their riskiness and, their stochastic and multi-stage nature. We also consider the determination of the optimal investment time like an American option. We also propose a case study that shows that considering the managerial flexibility value in the project valuation makes them attractive and financially profitable.