**The 23rd Conference of the Romanian Society of Probability and Statistics**

**Bucharest, November 18-19, 2022**

**ABSTRACTS**

- Alexandru Agapie (ASE & ISMMA Bucharest)

  **Convergence of Evolution Strategies**

  For large space dimensions, the log-linear convergence of the elitist evolution strategy with 1/5 success rule on the sphere fitness function has been observed, experimentally, from the very beginning. Finding a mathematical proof took considerably more time. We review in this paper the most consistent theories developed so far, concerning both global convergence and the estimation of convergence rates.

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- Alexandra Andriciuc (University of Bucharest & IMAR)

  **The PSO algorithm – a particular version**

  The PSO algorithm is a very popular one among the practitioners in ML thanks to the elegant coding manner and its interesting parallel with animal behavior. However, the mathematical literature is still lacking a solid background in this regard; for instance, one cannot say much about the convergence of the algorithm, given a precise choice for the hyperparameters. Our purpose is to take advantage of the stochastic intervention from this algorithm - not approximating it with constants as in most previous algebraic works - in order to obtain qualitative results. Hence, classical probabilistic instruments are put to use, aiming to create a context that unifies the rigorous conditions with the go-to values from practice.

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- Maria-Alexandra Badea ("Ovidius" University of Constanta)

  **On bivariate composite distributions: the Gumbel-Pareto Distribution**

  In this work, a bivariate extension of univariate composite distributions (also called two-spliced) is proposed, defined by a bivariate type I Pareto distribution for values larger than some thresholds and by a bivariate Gumbel distribution on the complementary domain. The purpose of this distribution is to capture the behavior of bivariate data consisting of mainly small and medium values, but also containing some extreme values. We present some properties of the proposed distribution and we propose an estimation method, illustrated on a real data set from insurance.

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- Viorel Barbu (Romanian Academy)

  **Uniqueness for nonlinear Fokker-Planck equations and for McKean-Vlasov SDEs**

  Under suitable assumptions the nonlinear Fokker-Planck equation $\rho_{t}-\Delta\beta(\rho) + div(Db(\rho)\rho = 0; \rho(0) = \rho_{0}$ has a unique mild solution. For bounded initial data also the distributional solution is unique. This implies the existence and uniqueness of probabilistically weak solutions to corresponding McKean-Vlasov SDEs. These results were obtained in a joint work with Michael Rockner (Bielefeld University).

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- Vlad Ștefan Barbu (LMRS, University of Rouen Normandie) **smmR: an R package for Simulation, Estimation and Reliability of Semi-Markov**

  Our presentation is dedicated to the R package smmR, devoted to statistical topics of discrete-time semi-Markov processes and reliability/survival applications. The package is available at https://cran.r-project.org/web/packages/smmR/index.html

  Semi-Markov processes represent an important generalization of Markov processes, in the sense that the sojourn time can be any discrete/continuous distribution, as opposed to exponential/geometric distribution in the Markov case.

  The smmR package implements nonparametric and parametric estimation; it also considers several important associated features: several types for the conditional sojourn time distributions, one or several trajectories for the estimation, several censoring mechanisms, like complete trajectories, censored at the begin, censored at the end.

  Associated reliability/survival metrics are also computed and estimated: reliability/survival function, maintainability, availability, failure rates, Mean Time To Failure (MTTF), Mean Time To Repair (MTTR).

  This is a joint work with Florian Lecocq, Corentin Lothodé Nicolas Vergne (Laboratory of Mathematics Raphaël Salem, University of Rouen-Normandy, France).

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- Ionuț Bebu (The George Washington University)

  **Personalized Screening Schedules for Chronic Diseases**

  Periodic evaluations are required in the clinical management of chronic diseases in order to identify opportunities for early treatment that can avert further progression and complications. For example, in nephropathy, patients with type 1 diabetes are screened annually for the onset of microalbuminuria, an early sign of chronic kidney disease. However, as our understanding of the etiology of diseases improves, there is the opportunity to design personalized schedules for future visits based on the estimated risk of progression, instead of a fixed schedule for the entire population. Herein we describe two approaches for constructing such personalized screening schedules. A screening interval to the next visit is selected to optimize some function such as limiting the probability that the event will occur (e.g. < 5% chance) prior to the next visit, or limiting the time that progression might go undetected before the next visit. The methods are illustrated using screening for retinopathy and screening for microalbuminuria in the DCCT/EDIC study

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- Solesne Bourguin (Boston University)

  **Quantitative fluctuation analysis of multiscale dynamical systems**

  In this talk, we consider multiscale dynamical systems perturbed by a small Brownian noise and study the limiting behavior of the fluctuations around their deterministic limit from a quantitative standpoint. Using a second order PoincarÃ© inequality based on Malliavin calculus, we obtain rates of convergence for the central limit theorem satisfied by the slow component in the Wasserstein metric. This is joint work with K. Spiliopoulos.

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- Petre Caraiani (Bucharest University of Economic Studies)

  **Do Monetary Policy Shocks Impact the Network Structure of Financial Markets?**
  Monetary policy shocks are known to affect financial markets. However, it is less clear how a monetary policy shock can affect their network structure. We estimate daily total connectedness and net connectedness for 10 industry portfolio indices based on intraday data. Using event-based regressions, we show that total connectedness is positively influenced by surprise changes in the interest rates. Net connectedness of some industry indices is also influenced, some in a positive, while others in a negative direction, revealing how monetary policy shocks propagate through the stock market network at a high-frequency level. The results point to the sectoral differences in the propagation of the monetary policy shocks.

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- Daniel Ciuiu (Technical University of Civil Engineering, Bucharest; Institute for Economic Forecasting, Romanian Academy; Centrul de Modelare Macroeconomica INCE)

  **Partial autocorrelation function, cycles, SARMA, including cycles in other cycles, exchange markets**

  In this paper we will define and compute first the cyclic partial autocorrelation function as generalization of partial autocorrelation function of order s, where s is the period of the cycle (7 for daily data, 12 for monthly data, 4 for quarterly data). For the mentioned generalization, we take into account that φss is the correlation between Xt and Xt-s after removing of the influence of Xt-1, Xt-2,…, Xt-s+1. Using this cyclic partial autocorrelation function instead of autocorrelation function, we compute next the coefficients of Ls*I, i=1,2,… as in an ARMA(p1,q1) model. Finally, the white noise of the mentioned ARMA(p1,q1) time series is treated next as an ARMA(p,q) time series, using Yule-Walker algorithm, innovations' algorithm, respectively Hannan-Rissanen algorithm. We generalize also the above case of SARMA(p1,q1;p,q) time series model to the hierarchical SARMA(p2,q2; p1,q1;p,q) time series model, where a small cycle of period s1 (for instance 7 for daily data) is included in a bigger cycle with the period multiple of s1, s2 (for instance 364 – almost one year – or 28 – almost one month- for daily data). We can also have multiple cycle inclusion. For instance, in the case of daily data we can consider a weekly cycle included in 364 days cycle, which is also included in an election cycle of 1456=364*4 days (approx. 4 years). When we choose the size of a classical/ hierarchical SARMA time series model, we choose all the sizes according to an informational criterion. Only the size of first two values of p and q (p1 and q1 for classical SARMA model) are unbounded. The other are bounded: for instance, in the case of SARMA(p1, q1;p,q) time series, p and q are at most six if the period is seven (one week for daily data).

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- Diana Conache (TU Münich)

  **A variational condition for uniqueness of Doeblin measures**
  Doeblin measures are known in the literature under many names: chains of infinite order, chains with complete connections, uniform martingales or g-measures. Intuitively, they can be regarded as a generalization of Markov chains to processes with infinite memory. In such a setting, the uniqueness of the stationary measure becomes a non-trivial problem. In this talk, I will review the previously known uniqueness criteria for Doeblin measures and present a new result obtained in collaboration with N. Berger, A. Johansson and A. Öberg. I will also give a conjecture regarding the threshold between the uniqueness and non-uniqueness regimes.

- Dragoș-Pătru Covei (Bucharest University of Economic Studies)

  **Some results about a stochastic production planning problem**

  We analyze some stochastic production planning problems.

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- Radu Craiu (University of Toronto)

  **Approximate Computation for Approximate Bayesian Methods**

  With larger amounts of data at their disposal, scientists are emboldened to tackle complex questions that require sophisticated statistical models. We will discuss the computational challenges that accompany large data and intractable likelihoods and discuss some of the solutions proposed. We propose perturbed MCMC samplers that can be used to significantly accelerate Bayesian computation while maintaining control on computational efficiency. The algorithmic design is supported by a theoretical analysis while practical performance is examined via a series of simulation examples and data analyses. This is joint work with Dr. Evgeny Levi.

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- Mădălina Deaconu (Inria Nancy - Grand Est & IECL)

  **An excursion through the probabilistic representations of the fragmentation**

  The models of coagulation / fragmentation are used in many real problems as: in Astrophysics, the formation of stars and the creation of meteorites; in Geophysics, the accumulation of snow or the breakage of fragments in the avalanches. We study here the stochastic process which represents the evolution of the mass of a typical particle performing a fragmentation process. In particular, we will introduce some possible probabilistic approaches and representations of the fragmentation equation. These interpretations allow the use of the probabilistic methodology to recover known results or to identify new behaviours. These probabilistic representations range from Markov chains to stochastic differential equations with jumps. We focus on how these processes are interconnected and we show also how these representations lead to new and easy to implement probabilistic numerical methods.

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- Silvia Dedu (Bucharest University of Economic Studies), Iuliana Iatan (Technical University of Civil Engineering, Bucharest), Muhammad Sheraz (Institute of Business Administration Karachi & Department Financial Mathematics, Fraunhofer ITWM)

  **Loss models involving truncated and censored random variables**

  This paper develops an information theory approach to risk assessment for actuarial models involving truncated and censored random variables. The effect of some partial insurance models, such as inflation, truncation and censoring from above and truncation and censoring from below is analyzed, by using generalized information measures. The properties of the residual loss entropy and past loss entropy are derived. Relationships between the entropy of losses of the right-truncated loss random variable corresponding to the per-loss risk model are obtained and the combined effect of a deductible and a policy limit is also analyzed. Acknowledgments: This work was supported by a grant of the Romanian Ministery of Education and Research, CNCS—UEFISCDI, project number PN-III-P4-ID-PCE-2020-1112, within PNCDI III.

- Benedikt Eisenhuth (Technical University Kaiserslautern)

  **Hypocoercivity for second order in time Reaction-Diffusion and Cahn-Hilliard type equations with multiplicative noise**

  We analyze non-linear degenerate stochastic partial differential equations with multiplicative noise in terms of their infinitesimal generators. The focus is on second order in time stochastic Reaction-Diffusion and Cahn-Hilliard type equations with multiplicative noise. We establish essential m-dissipativity of the associated generators in $L^2(\mu^{\Phi})$ on smooth finitely based functions. Here $\Phi$ is an appropriate potential and $\mu^{\Phi}$ is a measure with density $e^{-\Phi}$ w.r.t.~an infinite dimensional Gaussian measure. Using resolvent methods developed by Beznea, Boboc and Röckner we construct corresponding $\mu^{\Phi}$-standard right processes with infinite lifetime and weakly continuous paths providing weak solutions to such non-linear degenerate stochastic partial differential equations. Moreover, we identify the transition semigroup of the process with the $C_0$-semigroup $(T_t)_{t\geq 0}$ generated by the essential m-dissipative generator of the equation. Afterwards, we use the abstract Hilbert space hypocoercivity method, developed by Grothaus and Stilgenbauer to derive hypocoercivity of $(T_t)_{t\geq 0}$ and the transition semigroup, respectively.

- Mitra Fouladirad (Ecole Centrale Marseille, Aix Marseille Université)

  **Model selection for wind data in the frame work of wind turbine reliability analysis**

- Julie Gamain (Université de Lille)

  **Exact variation and drift parameter estimation for the nonlinear fractional**

  We consider the fractional stochastic heat equation driven by a nonlinear Gaussian space time white noise and we want to construct an estimator of the drift parameter based on quadratic variation. In a first step, we focus on its mild solution. In fact, it can be decomposed with fractional Brownian motion plus a gaussian process satisfying a certain condition. Then, by approximating the increment of the solution to the nonlinear fractional stochastic heat equation thanks to those of the linear case, we study the limit behavior of the quadratic variation.
  More precisely, we construct an estimator for the drift parameter of the fractional stochastic heat equation with nonlinear noise, which is defined in terms of the quadratic variation and it's based on the observation of the solution at a fixed time and at discrete point.

- Thomas Gkelsinis (Laboratoire de Mathématiques Raphaël Salem - Université de Rouen Normandie)

  **General order Markov chains, Homogeneity tests, Goodness-of-fit tests, φ-divergence**

  In this work we propose a family of test statistics for assessing the fit (goodness-of-fit or homogeneity) between general order Markov chains. The underlying mechanism is based on the class of weighted φ-divergences, where the weight matrix treats the issue of the presence (or not) of prior information on the transitions of the Markov system. The appropriate asymptotic theory is presented according with Monte Carlo simulations for assessing the performance of the proposed test statistics.

- Martin Grothaus (Technical University Kaiserslautern)

  **Hypocoercivity for non-linear infinite-dimensional degenerate stochastic differential equations**

  Motivated by problems from Industrial Mathematics we further developed the concepts of hypocoercivity. The original concepts needed Poincaré inequalities and were applied to equations in linear finite dimensional spaces. Meanwhile we can treat equations in manifolds or even infinite dimensional spaces. The condition giving micro- and macroscopic coercivity we could relax from Poincaré to weak Poincaré inequalities. In this talk an overview and many examples are given.

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- Karen Habermann (University of Warwick)

  **A polynomial expansion for Brownian motion and the associated fluctuation process**

  We start by deriving a polynomial expansion for Brownian motion expressed in terms of shifted Legendre polynomials by considering Brownian motion conditioned to have vanishing iterated time integrals of all orders. We further discuss the fluctuations for this expansion and show that they converge in finite dimensional distributions to a collection of independent zero-mean Gaussian random variables whose variances follow a scaled semicircle. We then link the asymptotic convergence rates of approximations for Brownian LÃ©vy area which are based on the Fourier series expansion and the polynomial expansion of the Brownian bridge to these limit fluctuations. We close with a general study of the asymptotic error arising when approximating the Green's function of a Sturm-Liouville problem through a truncation of its eigenfunction expansion, both for the Green's function of a regular Sturm-Liouville problem and for the Green's function associated with the classical orthogonal polynomials.

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- Cedric Heuchenne (University of Liege)

  **Statistical matching and WGAN generation for administrative data**

  When dealing with administrative data to solve complex public economics problems, we often use a large number of variables available in different databases.
  We thus need to analyze data from different sources; the observations, which only share a subset of the variables, cannot always be paired to detect common individuals.
  This is the case, for example, when the information required to study a certain phenomenon comes from
  different sample surveys. Statistical matching is a common practice to combine these data sets. In this talk, we investigate and extend to statistical matching three methods based on Kernel Canonical Correlation Analysis, Super-Organizing Map and Autoencoders-Canonical Correlation Analysis. These methods are designed to deal with various variable types, sample weights and incompatibilities among categorical variables.
  In our context, data privacy and anonymization are important. Under these circumstances, the need for synthetic databases that replicate the characteristics of the population while preserving privacy is arising. In this presentation, we investigate how we can use Wasserstein Generative Adversarial Networks (WGANs), developed in the context of image synthesis, to create administrative databases and we also adapt it to take weights into account.

Administrative data have the specificity of mixing continuous and categorical data, which should be taken into account in the architecture of the WGANs.

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- Bogdan Ichim (University of Bucharest & IMAR)

  **Computations of probabilities in five candidates elections**

  We present several precise results for probabilities obtained in five candidates elections under the assumption of the Impartial Anonymous Culture. These include the Condorcet and Borda paradoxes, as well as the Condorcet efficiency of plurality, negative plurality and Borda voting, including their runoff versions. The computations are done by Normaliz. It finds precise probabilities related to volumes of polytopes in dimension 119, using its recent implementation of the Lawrence algorithm.

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- Alex Karagrigoriou (University of the Aegean)

  **Explaining Artificial Intelligence: On the Identification of Influential Features & Points**

  In this work we discuss classical techniques for explaining artificial intelligence actions and propose the use of some standard statistical tools for measuring (a) the contribution of each feature to the resulting model and (b) the importance of each observation/instance in the machine learning process of constructing the resulting model. The focus will be placed on the Break Down and the Permutation Feature Importance methods while the learning will be based on the random forest algorithm.

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- Oana Lang (Imperial College London)

  **On local and global solutions for a class of stochastic shallow water models**

  In this talk I will talk about the analytical properties of a class of stochastic shallow water (SRSW) models which include SRSW models derived using the Location Uncertainty (Mérmin, 2014) approach. We prove that there exists a unique maximal strong solution and a unique global weak solution, using a method which relies on a Cauchy approximating sequence. Our method is very convenient as although the strong solution exists in a higher order Sobolev space, we show that it suffices to prove the Cauchy property in L^2. Comparisons with other types of SRSW models will also be made.
  This is joint work with Dan Crisan and Étienne Mérmin.

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- Emmanuel Lepinette (Paris-Dauphine University)

  **Dynamic programming principle and computable prices in financial market models with transaction costs**

  How to compute (super) hedging costs in rather general financial market models with transaction costs in discrete-time? Despite the huge literature on this topic, most of results are characterizations of the super-hedging prices while it remains difficult to deduce numerical procedure to estimate them. We establish here a dynamic programming principle and we prove that it is possible to implement it under some conditions on the conditional supports of the price and volume processes for a large class of market models including convex costs such as order books but also non convex costs, e.g. fixed cost models.

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- Andreas Makrides (University of the Aegean)

  **A continuous-time stepwise transitions semi-Markov system**

  A class of stochastic processes in continuous time, called step semi-Markov processes is introduced. The main idea comes from bringing an additional insight to a classical semi-Markov process: the transition between two states is accomplished through two or several steps. After defining the models and the main characteristics of interest, we derive the recursive evolution equations for two-step semi-Markov processes.

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- Ioannis Mavrogiannis, Vlad Ștefan Barbu, Nicolas Vergne (Laboratoire de Mathématiques Raphaël Salem, Université de Rouen Normandie)

  **Drifting Semi-Markov Models: Estimation and Simulation through the dsmmR R package**

  Drifting Semi-Markov models (DSMM) are non-homogeneous Markov models which capture the heterogeneities of sequences with more flexibility than Semi-Markov models, a Markov model generalization. This is achieved by describing the kernel of the Drifting Semi-Markov models as a linear combination of d + 1 Semi-Markov kernels, for every instance of the visited states. In this presentation, we will introduce and define three different Drifting Semi-Markov model specifications, show how the estimation of these models is possible and showcase through the R package dsmmR how we can estimate and simulate parametric and non-parametric Drifting Semi-Markov models.

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- Alexandra Diana Meleșteu (Transilvania University of Brașov)

  **Convex ordering of Polya random variables and approximation monotonicity of Bernstein-Stancu operators**

  In the present paper we show that in Polya's urn model, for an arbitrarily fixed initial distribution of the urn, the corresponding random variables satisfy a natural convex ordering with respect to the replacement parameter. As an application, we show that in the class of convex functions, the error of approximation for Bernstein-Stancu operators is a non-decreasing function of the corresponding parameter.

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- Bogdan Gheorghe Munteanu (”Henri Coandă” Air Force Academy)

  **Analysis of combat dynamics by means of Markov chains**

  The stochastic model characterizing Markov chains describes a sequence of events which, if applied to military conflict situations, allows for the dynamic modeling of a combat action able to predict their outcomes, and, more specifically, to provide insight on the state and effective capability of the combat systems currently in use in military facilities.
  In this case, the Markov chain can be associated with a physical system (S) that can be in only one of the states (Si), i=1, 2, ..., n at any moment t, with transition probabilities that do not depend on the previous states, but solely on the state (Sj), in which the system is at the time of transition t towards state (Sj+1).

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- Ionuț Munteanu (Al. I. Cuza University of Iassy, Faculty of Mathematics)

  **Well-posedness of the Cahn-Hilliard-Navier-Stokes equations pertubed by gradient type noise**

  In this work we study the problem of existence and uniqueness of solutions for the Cahn-Hilliard-Navier-Stokes system perturbed by divergence type noise. We apply a rescaling argument to transform the stochastic system into a random deterministic one. The rescale operators possess very good properties which allow us to show that the rescaled Navier-Stokes equation has a unique solution by appealing to m-accretive operators theory, and to show the existence for the Cahn-Hilliard equation via a fixed point argument. For the two-dimensional case we prove global in time well-posedness, while, for the three-dimensional case, we obtain only a local in time result, but with the maximal existence time non-random. We emphasize that, the literature on the subject of existence of solutions for the stochastic Navier-Stokes equations provide results that involve only random maximal time existence (stopping-time). Hence, our deterministic existence-time result is itself another important obtain of the present work.

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- Alexandru Mustățea (IMAR)

  **Stochastic integration from a functional-analytic point of view**

  We present a construction of the concept of stochastic integration in Riemannian manifolds from a purely functional-analytic point of view. We show that there are infinitely many such integrals, and that any two of them are related by a simple formula. We also find that the Stratonovich and Itô integrals known to probability theorists are two instances of the general concept constructed herein.

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- Ashkan Nikeghbali (University of Zurich)

  **Higher order Poisson approximations**

  In this talk we will discuss an extension of the Chen-Stein inequality for Poisson approximation in the total variation distance for sums of independent Bernoulli random variables in two ways. We prove that: a) we can improve the rate of convergence (hence the quality of the approximation) by using explicitly constructed signed or positive probability measures and b) we can extend the setting to possibly dependent random variables. The framework which allows this is that of mod-Poisson convergence and more precisely those mod-Poisson convergent sequences whose residue functions can be expressed as a specialization of the generating series of elementary symmetric functions. This combinatorial reformulation allows us to have a general and unified framework in which we can fit the classical setting of sums of independent Bernoulli random variables as well as other examples coming e.g. from probabilistic number theory and random permutations.

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- Adina Oprișan (New Mexico State University)

  **Large deviations via almost sure central limit theorems**

  In this talk we discuss the invariance principle with logarithmic averaging for some classes of additive functionals of Markov and semi-Markov processes. A large deviation principle (LDP) for the corresponding empirical processes is derived from the LDP of martingale

additive functionals. The rate function corresponding to the deviations from the paths of the empirical processes is given as a specific relative entropy with respect to the Wiener measure.

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- Christina Parpoula (Panteion University of Social and Political Sciences)
  **Change-point analysis for Public Health surveillance and decision-making**
  Surveillance is a core public health activity that provides information vital for the protection and promotion of health. In particular, surveillance is critical for detecting disease outbreaks rapidly and for guiding interventions to effectively control epidemics. Considerable research has been directed towards early detection of the start of the epidemic, in order to initiate a timely response, and rarely the focus has been given on the whole signal and/or the end of the epidemic. Toward this end, this study aims at evaluating the ability of change-point analysis methods to identify the full-time course of an epidemic and locate the whole disease outbreak signal. Depending on the underlying model used to solve the change-point problem, we compare the performance of some state of the art parametric, nonparametric and Bayesian change-point model approaches with those considered as "gold standard" methods. The empirical and simulation-based results support that change-point analysis is a useful analytic tool that can be extensively used to understand disease development, evaluate the design of new strategies of prevention and control of the disease, and thus steer public health decision-making processes.

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- Tatiana Pașa (Universitatea de Stat din Moldova)
  **Genetic algorithms for solving non-linear transportation problems on large-scale networks**
  Even if genetic algorithms are not known to represent a ubiquitous solution to all optimization problems, their use is recommended, since knowledge of the gradient or Hessian is not required for application; in addition, they are resistant to blockages in a local optimum, a fact that allows them to get out of local minima even if the structure of the restrictions that describe the domain of admissible solutions is quite complex. Given the fact that a large number of variables can be handled without a significant increase in computation time, genetic algorithms are successful for solving large-scale non-linear optimization problems.
  Since the transportation problem with concave cost functions belongs to the class of NP-hard problems, this means that there is no efficient algorithm for determining a solution in a reasonable time. The problem is too complicated to be solved exactly for large transport networks, which is why we rely on a heuristic algorithm such as the genetic ones presented in the paper.

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- Valentin Patilea (CREST Ensai)
  **Some new developments in functional data analysis**
  Combining information both within and across trajectories, we propose simple estimators for the local regularity of the trajectories of a stochastic process. Independent trajectories are measured with errors at randomly sampled time points. Non-asymptotic bounds for the concentration of the estimator are derived. Given the estimate of the local regularity, we build optimal kernel smoothers of the curves for different inference purposes in functional data analysis (FDA): mean and covariance functions estimation, sample paths reconstruction, functional principal component analysis. The extensions to weakly dependent curves, and to

functional data obtained from surfaces is briefly mentioned.

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- Marian Petrică (University of Bucharest & ISMMA)

  **A modified SIRD model for Covid19 spread prediction using ensemble neural networks**

  In this talk, we propose an analysis of Covid19 evolution and prediction on Romania combined with the mathematical model of SIRD, an extension of the classical model SIR, which includes the deceased as a separate category. In addition, one of the parameters of our model includes the proportion of infected and tested versus infected. Since there are many factors which have an impact on the evolution of the pandemic, we decide to treat the estimation and the prediction based on the previous 7 days of data, particularly important here being the number of deceased.

  We perform the estimation and prediction using neural networks in two steps. Firstly, by simulating data with our model, we train several neural networks which learn the parameters of the model. Secondly, we use an ensemble of ten of these neural networks to forecast the parameters from the real data of Covid19 in Romania. Many of these results are backed up by a theorem which guarantees that we can recover the parameters from the reported data.

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- Eugen Pircalabelu (UC Louvain)

  **Unbalanced distributed estimation and inference for Gaussian graphical models**

  This talk focuses on the estimation of Gaussian graphical models in the unbalanced distributed framework. It presents an effective method when the available machines are of different powers or when the existing dataset comes from different sources with different sizes and cannot be aggregated in one single machine. In this talk, we propose a new aggregated estimator of the precision matrix and justify such an approach by both theoretical and practical arguments. The limit distribution and convergence rate for this estimator are provided under sparsity conditions on the true precision matrix and controlling the number of machines. Furthermore, a procedure for performing statistical inference is proposed. On the practical side, using a simulation study and a real data example, we show that the performance of the distributed estimator is similar to that of the non-distributed estimator that uses the full data.

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- Adela Popescu (LTSTI & IMAR)

  **Pure branching and total mass processes**

  We will show that for a branching process the number of particles in the system is a discrete branching process.

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

  **Minimax rates of convergence for statistical inverse problems based on discretely sampled functional data**

  Optimal mean estimation from noisy independent pathes of a stochastic process that are indirectly observed is an issue of great interest in functional inverse problems. In this talk, minimax rates of convergence for a class of linear inverse problems with correlated noise, general source conditions and various degrees of ill-posedness are proven in a continuous setting, when the pathes are entirely observed, and in a projected framework. The phase

transition phenomenom characteristic to the functional data analysis appears also here and the thresholds that separate the sparse and the dense data set scenarios are computed for different smoothness conditions. The common design proves to be a special case of the independent design in view of the interpretation of the sampling properties via s-numbers and the price to pay for the data correlation turns out to be high. Finally, the theoretical results are illustrated in various settings for a classical linear inverse problem.

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- Anișoara Maria Răducan ("Gheorghe Mihoc - Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy)

  **On the existence of a leader in a random set**

  We study sufficient or necessary conditions for the existence of a leader in a random set.

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- Marius Rădulescu (Gheorghe Mihoc-Caius Iacob Institute of Mathematical Statistics and Applied Mathematics), Constanța-Zoie Rădulescu (ICI), Sorin Rădulescu

  **Convexity Properties of the Multivariate Monomial**

  Let a=(a_1, a_2,…, a_n) be a vector from R^n. Denote by f_a the multivariate monomial with exponents equal to the entries of vector a. That is

  f_a (x_1, x_2,…,x_n ) = x_1^(a_1) x_2^(a_2)…x_n^(a_n), x_1, x_2,…, x_n∈(0,∞). Without loss of generality, we may suppose that a_1 ≥ a_2 ≥ … ≥ a_n.

  We determine conditions that should be satisfied by the parameter a = (a_1, a_2, …, a_n) such that the multivariate monomial f_a is a convex, concave, logarithmically convex, logarithmically concave, quasi-convex, quasi-concave, sub-additive or super-additive function. Conditions for convexity of f_a may be found in Crouzeix [1]. Our proof is different from the Crouzeix's proof from [1]. Our proof is based on the computation of the determinant of a matrix.

  [1] J.P. Crouzeix, Criteria for generalized convexity and generalized monotonicity in the differentiable case, Chapter 2 in Handbook of Generalized Convexity and Generalized Monotonicity, ed. by N. Hadjisavvas, S. Komlósi, S. Schaible (Springer, New York, 2005), pp. 89–119.

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- Max von Renesse (Universität Leipzig)

  **Spectral Gap Estimates for Brownian motion with sticky reflecting boundary diffusion**

  Introducing an interpolation method we estimate the spectral gap for Brownian motion on general domains with sticky-reflecting boundary diffusion associated to the first nontrivial eigenvalue for the Laplace operator with corresponding Wentzell-type boundary condition. In the manifold case our proofs involve novel applications of the celebrated Reilly formula.

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- Andreea Mădălina Rusu-Stancu, Ioan Stancu-Minasian ("Gheorghe Mihoc – Caius Iacob" Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy)

  **Wolfe and Mond-Weir duality for multiobjective programming problems involving higher-order invex functions**

  A class of functions called higher-order invex functions is introduced. Using the assumptions on the functions involved, weak, strong and strict converse duality theorems are established for Wolfe and Mond-Weir higher order type multiobjective dual programs in order to relate

the efficient solutions of primal and dual problems.

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- Răzvan-Cornel Sfetcu (University of Bucharest)

  **Order results for Awad-Varma entropy**

  We define an order on Awad-Varma quantile entropy. For this order we prove some closure and reversed closure properties. Also we show that it is preserved in the proportional hazard rate model, proportional reversed hazard rate model, proportional odds model and record values model.

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- Wilhelm Stannat (Technical University Berlin)

  **Two results on the optimal control for stochastic partial differential equations (SPDE)**

  The talk will consist of two parts:

  In the first part we present an extension of Peng's maximum principle for semilinear SPDEs in one space-dimension with non-convex control domains and control-dependent diffusion coefficients to the case of general cost functionals with Nemytskii-type coefficients (ref [1]). The analysis is based on a new approach to the characterization of the second order adjoint state as the solution of a function-valued backward SPDE.

  In the second part we present preliminary results on the approximation of optimal feedback controls for SPDEs using a general type of approximation that allows us to reduce the control problem to an optimization over deterministic controls. Similar to ref [2] we derive necessary optimality conditions, prove the existence of an optimal control and derive explicit convergence rates for the reduced problem. We also provide numerical illustrations using radial basis functions in the approximation.

  The talk is based on joint work with A. Vogler and L. Wessels.

  References:

  [1] W. Stannat, L. Wessels: Peng's Maximum Principle for Stochastic Partial Differential Equations, SIAM J. Control Optim., 59 (2021), 3552-3573

  [2] W. Stannat, L. Wessels: Deterministic control of stochastic reaction-diffusion equations. Evolution Equations & Control Theory, 10 (2021), 701--722.

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- Florentina Suter (University of Bucharest & “Gheorghe Mihoc – Caius Iacob” Institute of Mathematical Statistics and Applied Mathematics of the Romanian Academy)

  **Some stochastic orders between the concomitants of order statistics**

  Considering a sample from a continuous bivariate distribution and ordering increasingly the first variates, the corresponding second variates are the concomitants of order statistics. In this presentation we analyze some stochastic orders between the concomitants of order statistics from the bivariate FGM distribution.

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- Alexandra Teodor ("Simion Stoilow" Institute of Mathematics of the Romanian Academy & Politehnica University of Bucharest)

  **The stochastic solution to a nonlinear Dirichlet problem with discontinuous boundary data**

  We give a probabilistic representation of the solution of a nonlinear Dirichlet problem associated to a branching process with general boundary data, in the sense of the controlled convergence initiated by A. Cornea. The talk is based on a joint work with. L. Beznea.

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- Ioana-Antonia Țacă (Branea) (Transilvania University of Brașov)

  **A new partial ordering of sequences of real numbers and applications**

  In the present paper we introduce a new (partial) order relation on the set of finite sequences of real numbers. We derive a series of properties of this ordering, and we find a connection between this ordering of sequences of real numbers and the stochastic ordering of random variables.
  As an application, we give a sufficient condition for the convexity of certain integrals. The proof relies on a lemma of independent interest.

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