First Congress of Greek Mathematicians
Special Session in Probability and Statistics
June 26-29, 2018

Organizers

Dimitris Cheliotis – Ioannis Kontoyiannis – Christos Koukouvinos
Michael Loulakis – Michael Zazanis

Time Schedule of Talks

	Tuesday, June 26	**Thursday, June 28**	**Friday, June 29**
09:00 – 09:30	Toumpakari		Fountoulakis
09:30 – 10:00	Fokianos		Dareiotis
10:00 – 10:30	Karagrigoriou		Vakeroudis
10:30 – 11:00	Maroulas		Georgiou
17:00 – 17:30		Ganatsiou	
17:30 – 18:00		Kardaras	
18:00 – 18:30		Tzaninis	

Speakers

Konstantinos Dareiotis (Max Planck Institute, Leipzig)
Entropy solutions for stochastic porous media equations

Nonlinear diffusion equations describe macroscopic phenomena such as flow of gas or fluid in a porous medium, heat propagation with temperature-dependent conductivity, and the evolution of crowd-avoiding populations. Often, a source term is present that forces/removes mass into/from the system. This source term can be random. As a particular example, generalised stochastic porous media equations (SPME) appear as scaling limits of the empirical measure of interacting branching diffusion particle systems. The interaction leads to a nonlinear, degenerate second order operator in the drift, while the randomness of the branching mechanism leads to a non-linear noisy source term. We will discuss the main diffculties towards well posedness of these equations and introduce the concept of entropy solutions. In the class of entropy solutions we obtain well-posedness, L_1-contraction, and stability estimates. Our results cover the full range of powers of the porous medium operator and allow for nonlinearities in the noise that are 1/2-Hölder continuous. This is a joint work with Máté Gerencsér and Benjamin Gess.

Konstantinos Fokianos (University of Cyprus)
Tests of independence based on multivariate distance correlation matrix

We introduce the notions of multivariate auto-distance covariance and correlation functions for time series analysis. These concepts have been recently discussed in the context of independent and time series data but we extend them in a different direction by putting forward their matrix version. We discuss their interpretation and we give consistent estimators for practical implementation. Additionally, we develop a test for testing the iid hypothesis for multivariate time series data. The proposed test statistic performs better than the standard multivariate version of Ljung-Box test statistic. Several computational aspects are discussed and some data examples are provided for illustration of the methodology. This talk is based on a joint work with Maria Pitsillou.

Nikolaos Fountoulakis (University of Birmingham, UK)

The giant component in hyperbolic random graphs

We consider a recent model of random geometric graphs on the hyperbolic plane developed by Krioukov et al. (Phys. Rev. E 2010). This may be also viewed as a geometric version of the well-known Chung-Lu model of inhomogeneous random graphs and turns out to have basic properties that are ubiquitous in complex networks.

We consider the size of the largest component of this random graph and show that a giant component emerges when the basic parameters of the model cross certain values. We also show that the fraction of vertices that are contained there converges in probability to a certain constant, which is related to a continuum percolation model on the upper-half plane. This is joint work with Tobias Müller (Groningen University).

Chrysoula Ganatsiou (Technological Educational Institute of Thessaly)

On the study of transience and recurrence of circuit chains associated with a random walk with jumps in random environments

It is known that a systematic work has been developed (Kalpazidou, MacQueen, Qian Minping and Qian Min and others) in order to investigate representations of Markov processes (with discrete or continuous parameter) having an invariant measure as decompositions in terms of the well-known circuit passage functions. The representations are called circuit representations while the corresponding discrete or continuous parameter Markov chains generated by directed weighted circuits are called circuit chains. By using the circuit representation theory of Markov processes, the present work arises as an attempt to investigate suitable criteria regarding positive/null recurrence and transience of the corresponding "adjoint" Markov chains associated with a random walk with jumps in random environments represented uniquely by directed circuits and weights extending the results for fixed environments.

Nicos Georgiou (University of Sussex)

Last passage percolation in an exponential environment with discontinuous rates

We are studying a last passage percolation model on the two dimensional lattice, where the environment is a field of independent random exponential weights with different parameters. Each variable is associated with a lattice vertex and its parameter is selected according to a discretization of lower semi-continuous parameter function that may admit discontinuities on a set of curves.

We prove a law of large numbers for the sequence of last passage times, defined as the maximum sum of weights which a directed path can collect from $(0, 0)$ to a target point (Nx, Ny) as N tends to infinity and the mesh of the discretisation of the parameter function tends to 0 as $1/N$. The LLN is cast in the form of a variational formula, optimised over a given set of macroscopic paths. Properties of maximizers to the variational formula above are investigated in two models where the parameter function allows for analytical tractability. This is joint work with Federico Ciech.

Alex Karagrigoriou (University of the Aegean, Samos)

Semi-Markov Modeling for Multi-State Systems

In this work we focus on multi state systems that we model by means of semi-Markov processes. The sojourn times are seen to be independent not identically distributed random variables and assumed to belong to a general class of distributions that includes several popular reliability distributions like the exponential, Weibull, and Pareto. We obtain maximum likelihood estimators of the parameters of interest and investigate their asymptotic properties. Plug-in type estimators are furnished for various quantities related to the system under study.

Kostas Kardaras (London School of Economics)

Density of (non)complete market extensions

We consider questions of density in the total variation topology of probabilities having – or failing – the martingale representation property, when processes defined in a backwards manner. Workable sufficient conditions are given, illuminating especially the case of continuous filtrations. The results find application to markets with less liquid assets than sources of uncertainty, where the question becomes whether the set of (non)complete market extensions via options, parametrised by consistent valuation measures, is dense in the set of all possible market extensions. Based on joint work with Sergio Pulido.

Vasileios Maroulas (University of Tennessee)

Nonparametric estimation of probability density functions of random persistence diagrams

We introduce a nonparametric way to estimate the global probability density function for a random persistence diagram. Precisely, a kernel density function centered at a given persistence diagram and a given bandwidth is constructed. Our approach encapsulates the number of topological features and considers the appearance or disappearance of features near the diagonal in a stable fashion. In particular, the structure of our kernel individually tracks long persistence features, while considering features near the diagonal as a collective unit. The choice to describe short persistence features as a group reduces computation time while simultaneously retaining accuracy. Indeed, we prove that the associated kernel density estimate converges to the true distribution as the number of persistence diagrams increases and the bandwidth shrinks accordingly. We also establish the convergence of the mean absolute deviation estimate, dened according to the bottleneck metric. Lastly, examples of kernel density estimation are presented for typical underlying datasets.

Evelin Toumpakari (American Community Schools)

Leukaemia in young children in the vicinity of British nuclear power plants: a case-control study

Recently, there has been world-wide concern about the incidence of childhood cancer close to nuclear power plants (NPPs). A cluster of cancer incidents in young people near Sellafield, UK, made public in 1983, sparked public and governmental concern. A subsequent report based on geographical studies in Great Britain did not confirm excess incidence of childhood tumours in any local 25 km area for 13 NPPs in the country. Analyses in Germany, France and Belgium yielded mixed findings. A German large-scale case-control study (the Kikk study) reported a doubled risk of leukaemia for children resident within 5 km of an NPP compared with the remainder of the study area. The Kikk study triggered further studies in the UK, including the present one.

I will discuss the statistical methodology and findings of an analysis conducted by Bithell et al at the Childhood Cancer Research Group in Oxford University. The study uses case-control analyses, matched for sex and approximate date of birth, performed by logistic regression. It concluded that there is no evidence of statistically significant increased risk of childhood leukaemia and non-Hodgkin lymphoma (LNHL) associated with residential proximity to an NPP in Great Britain. The odds ratio at 5 km for LNHL was found to be 0.86 (0.49-1.52), while the odds ratio at 5 km for children with other cancers was 0.86 (0.62-1.18). One limitation of the study results from the partial matching of controls with cases with respect to location, the controls being chosen from the same birth-registers as the cases.

Spyridon Tzaninis (University of Piraeus)

Change of measures for compound renewal processes with applications to premium calculation principles

Given a compound renewal process S under a probability measure P we characterize all probability measures Q on the domain of P such that Q and P are progressively equivalent and S remains a compound renewal process under Q. As a consequence we prove that any compound renewal process can be converted into a compound Poisson process through change of measure, and we show how this approach is related to equivalent martingale measures and to premium calculation principles.

Stavros Vakeroudis (University of the Aegean, Samos)

Windings of planar stochastic processes

Two-dimensional (planar) processes attract the interest of many researchers. This happens both because of their richness from a theoretical point of view and because their study turns out to be very fruitful in terms of applications (e.g. in Finance, in Biology etc.). This talk focuses on the fine study of trajectories of planar processes, and in particular on their windings. We will survey several results concerning windings of two-dimensional processes, including planar Brownian motion, complex-valued Ornstein-Uhlenbeck processes and planar stable processes.

We start from the planar Brownian motion case where fine properties of their trajectories are discussed (e.g. asymptotic properties in relation with Spitzer's theorem, integrability properties of the random exit times from a cone, infinite divisibility properties, etc). by using the skew-product representation and Bougerol's celebrated identity in law: for $u > 0$ fixed,

$$\sinh(\beta_u) \overset{(\text{law})}{=} \hat{\beta}_{A_u(\beta)=\int_0^u ds \exp(2\beta_s)},$$

where $(\beta_t; t \geq 0)$ and $(\hat{\beta}_t; t \geq 0)$ are two independent linear Brownian motions starting from 0, and the second one is also independent from $A_u(\beta)$.

Then, similar questions are addressed for complex-valued Ornstein-Uhlenbeck processes and for planar stable processes. For the last case, the methods applied in the planar Brownian motion setting are no longer valid. Hence, we shall first use new methods invoking the continuity of the composition function. Then, we shall further stuby the stable case by invoking new techniques from the theory of self-similar Markov processes which involve the so-called Riesz-Bogdan-Żak transform. The latter gives the law of the stable process when passed through the spatial Kelvin transform and an additional time change. This approach allows to study similarly one-dimensional and possibly higher-dimensional windings.