Sesión Especial 25

Probabilidad y Procesos Estocásticos

Organizador

- José Miguel Angulo Ibáñez (Universidad de Granada)

Descripción

La Probabilidad, cuya fundamentación matemática entronca en la Teoría de la Medida, si bien con un desarrollo diferenciado a partir de los conceptos propios de independencia y condicionamiento, así como epistemológicamente en el contexto de la representación y el tratamiento de la incertidumbre, constituye la raíz en la construcción de los Procesos Estocásticos, así como de la Estadística Matemática, disciplinas con un amplio cuerpo de conocimiento consolidado e implicaciones muy diversificadas en el conjunto de la Ciencia. En esta sesión se exponen los avances recientes en algunas líneas de investigación que actualmente desarrollan grupos representativos de nuestro entorno. Los contenidos abarcan aspectos de carácter fundamental y metodológico, con proyección en diferentes campos de aplicación.

Programa

Lunes, 4 de febrero (mañana)

11:30 – 12:00	Josep Vives (Universitat de Barcelona) *Option Price Decomposition Formulas: Applications to Pricing and Calibration*
12:00 – 12:30	Eustasio del Barrio (IMUVA, Universidad de Valladolid) *Smooth Cyclically Monotone Interpolation and Empirical Center-Outward Distribution Functions*
12:30 – 13:00	Gerardo Sanz (Universidad de Zaragoza) *Stochastic orders and couplings for nonconservative particle systems*
13:00 – 13:30	Javier Villarroel (Universidad de Salamanca) *On some results for escape probabilities for compound Poisson processes with drift*

Lunes, 4 de febrero (tarde)

17:00 – 17:30	Manuel Molina (Universidad de Extremadura) *Some Recent Contributions to the Theory on Two Sex Branching Processes*
17:30 – 18:00	Jorge Mateu (Universitat Jaume I de Castellón) *An ANOVA-Type Procedure for Replicated Spatial and Spatio-Temporal Point Patterns*
18:00 – 18:30	José Miguel Angulo (Universidad de Granada) *Risk Assessment of Random Field Threshold Exceedances*

Option Price Decomposition Formulas: Applications to Pricing and Calibration

Josep Vives

Universitat de Barcelona

josep.vives@ub.edu

Abstract. In [1], a new type of decomposition formula for the plain vanilla option price for the Heston model was obtained. This formula is useful in two directions. One is to obtain approximated closed form option price formulas that allow precise and computationally efficient pricing and the other is model calibration, see [2]. This decomposition formula has been extended to more general stochastic volatility jump-diffusion models in [3] and [4], and other extensions are coming. The purpose of the talk is to present a survey of this technique and some of its applications.

Referencias

[1] Alòs, E. (2012): *A decomposition formula for option prices in the Heston model and applications to option pricing approximation*. Finance and Stochastics 16 (3): 403-422.

[2] Alòs, E., De Santiago, R. and Vives, J. (2015): *Calibration of stochastic volatility models via second order approximation: the Heston case*. International Journal of Theoretical and Applied Finance 18 (6): 1550036.

[3] Merino, R. and Vives, J. (2015): *A generic decomposition formula for pricing vanilla options under stochastic volatility models*. International Journal of Stochastic Analysis, volume 2015.

[4] Merino, R., Pospísil, J., Sobotka, T. and Vives, J. (2018): *Decomposition formula for jump diffusion models*. International Journal of Theoretical and Applied Finance. Accepted.

Smooth Cyclically Monotone Interpolation and Empirical Center-Outward Distribution Functions

Eustasio del Barrio

IMUVA, Universidad de Valladolid

tasio@eio.uva.es

Abstract. We consider the smooth interpolation problem under cyclical monotonicity constraint, namely, given $\mathcal{X} = \{x_1, \ldots, x_n\}$ and $\mathcal{Y} = \{y_1, \ldots, y_n\}$ in $\mathbb{R}^d$ we assume the existence of a unique cyclically monotone bijection $T : \mathcal{X} \to \mathcal{Y}$. Our goal is to define continuous, cyclically monotone maps $\bar{T} : \mathbb{R}^d \to \mathbb{R}^d$ such that $\bar{T}(x_i) = y_i$, $i = 1, \ldots, n$. Our solutions $\bar{T}$ are Lipschitz, and we provide a sharp lower bound for the corresponding Lipschitz constants. The problem is motivated by the concept of empirical center-outward distribution function in $\mathbb{R}^d$ in [2], defined only at sample points. Our interpolation (see [1]) provides a smooth extension, generalizing the traditional left-continuous univariate concept. We provide also a Glivenko-Cantelli result.

Referencias

[1] del Barrio, E.; Cuesta-Albertos, J.A.; Hallin, M. and Matrán, C. (2018). Center-outward distribution functions, quantiles, ranks and signs in $\mathbb{R}^d$ II: Cyclically monotone interpolation of distribution functions. Preprint.

[2] Hallin, M. (2018). Center-outward distribution functions, quantiles, ranks and signs in $\mathbb{R}^d$ I: A measure transportation approach. Preprint.

Joint work with Juan A. Cuesta-Albertos, Marc Hallin and Carlos Matrán

Stochastic orders and couplings for nonconservative particle systems

Gerardo Sanz

Universidad de Zaragoza

gerardo.sanz@unizar.es

Abstract. We find necessary and sufficient conditions for the comparability and attractiveness of general Interacting Particle Systems (IPS). We work with processes allowing births, deaths and migration of elements but migration needs not be conservative. That is, a batch of k elements leaving a site x arrives at y as a batch of l elements.
The proof relies on the construction of an order-preserving coupling based on the theory of network flow. Our results improve currently available results.

Joint work with Raúl Gouet (Univ. of Chile, rgouet@dim.uchile.cl) and F. Javier López (Univ. of Zaragoza, javier.lopez@unizar.es)
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On some results for escape probabilities for compound Poisson processes with drift

Javier Villarroel

Universidad de Salamanca

javier@usal.es

Abstract. Given a Poisson process $(N_t)_{t\geq t_0}$ we study escape probabilities off the interval (a,b) of general compound Poisson processes with drift: $X_t = x+ct+\sum_{n=0}^{N_t} J_n$. We formulate integral equations that satisfies $\mathbb{P}_x(\tau_b < \tau_a)$ starting from $x \in (a,b)$. In the case of purely negative jumps J_n we give closed form expressions for this probability. The ruin probabilty of risk theory is recovered via limits. We draw a parallelism with the "speed function" of difussion processes.

Referencias

[1] E.S. Andersen (1957) On the collective theory of risk in case of contagion between the claims. *Transactions XVth Intern. Congress Actuar., New York*, 219-229

[2] J. Villarroel and M. Montero (2011) Poisson driven stochastic nonlinear Schrödinger equation. *Stud. Appl. Math.* 127(4), 372-393

[3] J. Villarroel, J.A. Vega and M. Montero (2018) Escape probabilities of compound renewal processes with drift. (*In preparation*)

[4] D.C.M. Dickson (1998) On a class of renewal risk processes. *North American Act. J.* 2(3), 60-68

[5] D.C.M. Dickson and C. Hipp (1998) Ruin probabilities for Erlang(2) risk processes. *Insur. Math. Econ.* 22(3), 251-262

Joint work with Juan Antonio Vega and Miquel Montero
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Some Recent Contributions to the Theory on Two Sex Branching Processes

Manuel Molina

Universidad de Extremadura

mmolina@unex.es

Abstract. In the general setting of stochastic modeling, branching process theory provides mathematical models to describe the dynamics of populations whose size evolves over time, due to random births and deaths. In order to describe the evolution of biological populations with sexual reproduction, several classes of two sex branching processes have been investigated. In such classes of processes, the population consists of two types of individuals, females and males, and two biological phases are considered, the mating phase where the couples (female-male) are formed, and the reproduction phase in which each couple produces new individuals according to a probability distribution. In this talk, we provide a survey about the recent advances on two sex branching processes. In particular, we present some results about the class of continuous time two sex branching processes introduced in [1].

Referencias

[1] Molina M. and Yanev N.M. (2003). Continuous time bisexual branching processes. Comptes Rendus de l'Académie Bulgare des Sciences, Tome 56, No 8, pp: 5-10.

Joint work with Manuel Mota and Nykolai M. Yanev.
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An ANOVA-Type Procedure for Replicated Spatial and Spatio-Temporal Point Patterns

Jorge Mateu

Universitat Jaume I de Castellón

mateu@uji.es

Resumen.

Abstract.
Several methods to analyse structural differences among groups of replicated spatial, spatio-temporal and possibly marked point patterns are presented. We calculate a number of functional descriptors of each pattern to investigate departures from completely random patterns, both among subjects and groups. We also develop strategies for analysing the effects of several factors marginally within each factor level, and the effects due to interaction between factors. We consider the K-function and its mark-weighted version as particular descriptors of each pattern in our sample, and develop a set of statistics based on classical analysis of variance statistics and their analogues in functional data analysis.
The statistical distributions of our functional descriptors and of our proposed tests are unknown, and thus we use bootstrap and permutation procedures to estimate the null distribution of our statistical test. A simulation study provides evidence of the validity and power of our procedures. Several applications in environmental and engineering problems will be presented.

Joint work with Jonatan González.

Risk Assessment of Random Field Threshold Exceedances

José Miguel Angulo

Universidad de Granada

jmangulo@ugr.es

Abstract. Functionals describing structural aspects of random field threshold exceedance sets provide indicators useful for characterization of extremal behaviour and risk assessment. First-order indicators such as exceedance areas or excess volumes on bounded domains are suitably formalized in terms of compound distribution functions, a framework under which effects of spatial deformation, local change of measure, or specification of non-constant thresholds, among other extensions involving certain forms of heterogeneity, are properly adressed. Model-based conditional simulation, from available space or space-time observations, can be used as a suitable approach to the empirical assessment of the probability distributions of selected indicators, and subsequent implementation of different risk measures [1]. In particular, quantile-based risk measures, which play an important role in the analytical development of the modern theory of risk measures, have a direct loss-related interpretation and can be applied under general system dynamics conditions.

Referencias

[1] Romero, J.L., Madrid, A.E. and Angulo, J.M. (2018). Quantile-based spatiotemporal risk assessment of exceedances. Stochastic Environmental Research and Risk Assessment 32:2275-2291.

Joint work with Ana E. Madrid and José L. Romero

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