Conference on Stochastic modeling (in finance and insurance)

February 11th-February 15th,

Będlewo 2019,

IMPAN

Conference programme:

Monday, February 11th

9.00-9.10 Opening

9.10-9.55 **Monique Jeanblanc**, University of Evry
Characteristics of default time (p.9)

10.10-10.55 **Robert Stelzer**, University of Ulm
Geometric Ergodicity of Affine Processes on Cones (p.15)

10.55-11.30 Coffee break

11.30-12.15 **Wolfgang Runggaldier**, University of Padova
Classical and Restricted Impulse Control for the Exchange Rate under Incomplete Knowledge of the Model (p.13)

12.30-13.00 **Maciej Wiśniewolski**, Warsaw University
Another look at Hartman-Watson distributions (p.15)

13.00 - Lunch

15.00-15.45 **Peter Imkeller**, Humboldt-Universität Berlin
Rough Weierstrass curves as attractors: SBR measure and local time (p.8)

16.00-16.45 **Peter Spreij**, University of Amsterdam
Accounting Noise and the Pricing of CoCos (p.14)

17.00-17.30 **Marcin Pitera**, Jagiellonian University Cracow
Backtesting Expected Shortfall - duality approach (p.12)

17.40-18.10 **Oksana Chernova**, University of Kiev
Hypothesis testing in Cox proportional hazards model with measurement errors (p.6)

18.10 Supper

Tuesday, February 12th

9.00-9.45 **Nizar Touzi**, Ecole Polytechnique, Paris
Nonlinear stochastic representation and application to contract theory (p.15)

10.00-10.45 **Claudio Fontana**, Paris Diderot University
The Value of Informational Arbitrage (p.6)

11.00-11.30 Coffee break

11.30-12.15 **Jacek Jakubowski**, University of Warsaw
Generalized Hawkes Processes (p.8)

12.30-13.00 **Mariusz Nieweglowski**, Warsaw University of Technology
BSDE on random horizon: applications to quadratic hedging (p.11)

13.00 - Lunch

15.00-15.45 **Yuliya Mishura**, Univeristy of Kiev
Fractional models in finance and statistics (p.11)

16.00-16.45 **Miklos Rasonyi**, Renyi Institute HAS
Trading with processes of long memory (p.13)

17.00-17.30 **Anton Yurchenko-Tytarenko**, University of Kiev
Fractional modification of stochastic volatility process in Heston model: rough case (p.16)

17.40-18.10 **Wieslaw Grygierzec**, University of Agriculture Kraków
Maximum Principle for Optimal Control of Infinite Dimensional Diffusion Equation (p.7)

18.10 Supper

Wednesday, February 13th

9.00-9.45 **Paolo Guasoni**, Univ. of Dublin
Asset Prices in Segmented and Integrated Markets (p.7)

10.00-10.45 **Teemu Pennanen**, Kings College
Duality and optimality conditions in convex stochastic optimization (p.12)

10.45-11.15 Coffee break

11.15-12.00 **Ralf Wunderlich**, Brandenburg University of Technology Cottbus – Senftenberg
Power Utility Maximization in a Continuous-Time Black Litterman Model (p.16)

12.15-12.45 **Dariusz Zawisza**, Jagiellonian University
On the parabolic Cauchy equation related to portfolio optimization problems (p.17)

12.45 Lunch

13.30 Excursion

19.00 Supper

Thursday, February 14th

9.00-9.45 **Jörn Sass**, University of Kaiserslauten
Utility Maximization under Model Uncertainty in a Multivariate Black Scholes Type Market (p.14)

10.00-10.45 **Pavel Gapeev**, London School of Economics
On the perpetual American options on a traded account (p.7)

11.00-11.30 Coffee break

11.30-12.15 **Laurence Carassus**, De Vinci Pôle Universitaire and Université de Reims, France
Pricing without martingale measure (p.5)

12.30-13.00 **Piotr Jaworski**, University of Warsaw
On Copulas and Stochastic Differential Equations (p.9)

13.00 Lunch

15.00-15.45 **Christoph Belak**, Univ. of Trier
Optimal Investment for Private Investors (p.5)

16.00-16.45 **Marzia de Donno**, Universita di Parma
Double continuation regions for american and swing options with negative discount rate in Levy models (p.6)

17.00-17.30 **Agnieszka Rygiel**, Cracow University of Economics
Super-replication under model uncertainty (p.13)

17.45-18.15 **Zofia Michalik**, University of Warsaw
Inhomogeneous change of time for Markov chains (p.11)

19.00 Conference dinner

Friday, February 15th

9.00-9.45 **Adam Ostaszewski**, London School of Economics
The sound of silence: equilibrium filtering and optimal censoring in financial markets (p.12)

10.00-10.45 **Rafal Łochowski**, Szkoła Główna Handlowa w Warszawie (Warsaw School of Economics)
Pathwise quadratic variation and local times of deterministic cadlag paths - linking several approaches (p.10)

10.45-11.15 Coffee break

11.15-12.00 **Daniel Hernandez**, CIMAT
Periodic strategies in optimal execution with multiplicative impact (p.8)

13.00 Lunch

Abstracts:

Optimal Investment for Private Investors

Christoph Belak, University of Trier

We study a portfolio optimization problem under various transaction cost structures which resemble those of a private investor: (1) proportional and fixed costs; (2) proportional costs floored and capped at fixed levels; (3) the limit of (1) as the fixed cost component tends to zero. In the absence of short-selling and borrowing constraints, the value functions turn out to be truly discontinuous viscosity solutions of the corresponding quasi-variational inequalities, which can nevertheless be characterized uniquely within a suitable class of functions. Having established this unique characterization, we study the optimal trading regions numerically. For power utility investors, we find that the optimal no-trading region in (1) is approximately cone-shaped. For the cost structure (2), the situation is richer in that the optimal action depends on the cost regime (floored, proportional, capped) the investor is in. Finally, regarding (3), we show that the optimal strategies in (1) have an accumulation point which solves the problem with purely proportional costs.

This talk is based on joint work with Erhan Bayraktar, Sören Christensen, Lukas Mich, and Frank Seifried.

Pricing without martingale measure.

Laurence Carassus, De Vinci Pôle Universitaire and Université de Reims, France

For several decades, the no-arbitrage (NA) condition and the martingale measures have played a major role in the financial asset's pricing theory. Here, we propose a new approach based on convex duality instead of martingale measures duality: our prices will be expressed using Fenchel conjugate and bi-conjugate. This naturally leads to a weak condition of (NA) called Absence of Immediate Profit (AIP). It asserts that the price of the zero claim should be zero or equivalently that the super-hedging cost of some call option should be non-negative. We propose several characterizations of the (AIP) condition and also study the relation with (NA) and a stronger notion of (AIP) linked to the no-free lunch condition. We show in a one step model that under (AIP) the super-hedging cost is just the payoff's concave envelop. In the multiple-period case, for a particular, but still general setup, we propose a recursive scheme for the computation of a the super-hedging cost of a convex option. We also give some promising numerical illustrations.

This talk is based on joint work with Julien Baptiste and Emmanuel Lépinette.

Hypothesis testing in Cox proportional hazards model with measurement errors

Oksana Chernova, University of Kiev

Cox proportional hazards model with measurement errors is considered, in which baseline hazard rate $\lambda(\cdot)$ belongs to a parameter set consisting of nonnegative Lipschitz functions, with fixed constant, and regression parameter β belongs to a compact parameter set. Censored lifetimes and regressors with additive errors are observed. Based on the simultaneous consistent estimator we construct statistics to test hypothesis about the regression parameter β and the integral functional of the baseline hazard rate $\lambda(\cdot)$.

Double continuation regions for american and swing options with negative discount rate in Levy models

Marzia de Donno, Universita di Parma

We study perpetual American call and put options in an exponential Levy model, when the effective discount rate is negative, which occurs in severalfi nancial applications, including stock loans and real options, where the strike price can potentially grow at a higher rate than the original discount factor. We show that in this case a double continuation region arises and we identify the two critical prices. We also generalize this result to multiple stopping problems of Swing type, that is, when successive exercise opportunities are separated by i.i.d. random refraction times.

The Value of Informational Arbitrage

Claudio Fontana, Paris Diderot University

In the context of a general semimartingale model, we aim at answering the following question: How much is an investor willing to pay for learning some inside information that allows to achieve arbitrage? If such a value exists, we call it the value of informational arbitrage. In particular, we are interested in the case where the inside information yields arbitrage opportunities but not unbounded profits with bounded risk. In the spirit of Amendinger et al. (2003), we provide a general answer to this question by means of an indifference valuation approach. To this effect, we establish some new results on models with additional information and study optimal investment-consumption problems in the presence of additional information and arbitrage, also allowing for the possibility of leverage. We characterize when the value of informational arbitrage is universal, in the sense that it does not depend on the preference structure. This talk is based on joint work with H.N. Chau

and A. Cosso.

On the perpetual American options on a traded account

Pavel Gapeev, London School of Economics

We formulate and solve the problem of rational valuation of perpetual American options on a traded account in the Black-Merton-Scholes model under the fixed and proportional costs for the trading and exercise operations. The resulting optimal stochastic impulse control problem is decomposed into a multi-step optimal stopping problem for the operational times and a subsequent optimisation problem for the strategies of the holders. The optimal times are shown to be the first times at which the risky asset price hits certain constant boundaries and the optimal positions of the holders have a switching character between these times. The proof is based on the analysis of the associated ordinary free-boundary problem and an application of the local time-space formula.

Maximum Principle for Optimal Control of Infinite Dimensional Diffusion Equation

Wieslaw Grygierzec, University of Agriculture Kraków

We consider a distributed parameter optimal control problem for system governed by a stochastic Ito type diffusion equation in a bounded domain. The diffusion coefficient in front of the Wiener process depend both on the control and the gradient the unknown function. When the equation is rewritten in the abstract form in a Hilbert space, the coefficient of the diffusion term is an unbounded operator. Above equation may describe a diffusion process in a bounded domain D of R^d with zero type Dirichlet boundary conditions, in moving environment with velocity $u(t,x,\omega) = (u_1, ..., u_d)$, which represent the control parameter. The stochastic maximum principle of Pontryagin type is proposed in the case when control parameter takes values in nonconvex set.

Asset Prices in Segmented and Integrated Markets

Paolo Guasoni, University of Dublin

This paper evaluates the effect of market integration on prices and welfare, in a model where two Lucas trees grow in separate regions with similar investors. We find equilibrium asset price dynamics and welfare both in segmentation, when each region holds its own asset and consumes its dividend, and in integration, when both regions trade both assets and consume both dividends. Integration always increases welfare. Asset prices may increase

or decrease, depending on the time of integration, but decrease on average. Correlation in assets' returns is zero or negative before integration, but significantly positive afterwards, explaining some effects commonly associated with financialization.

Periodic strategies in optimal execution with multiplicative impact

Daniel Hernandez, CIMAT

In this talk we study the optimal execution problem with multiplicative price impact in algorithm trading, when an agent holds an initial position of shares of a financial asset. The inter-selling-decision times are modelled by the arrival times of a Poisson process. The criterion to be optimised consists in maximising the expected net present value of gains of the agent, and it is proved that an optimal strategy has a barrier form, depending only on the number of shares left and the level of asset price. Joint work with H. Moreno-Franco and J.L: Pérez.

Rough Weierstrass curves as attractors: SBR measure and local time

Peter Imkeller, Humboldt-Universität Berlin

We investigate geometric properties of Weierstrass curves with one or two components, representing series based on trigonometric functions. They are $\frac{1}{2}-$ Hölder continuous, and not (para-)controlled with respect to each other. They can be embedded into a smooth dynamical system, where their graph emerges as a pullback attractor. Each one-dimensional component of the curve may also be seen in the light of this dynamical system. It turns out that occupation measures and SBR measures on its stable manifold are dual to each other, via time reversal. A suitable version of approximate self similarity for deterministic functions yields approximate scaling properties for the measures. As a consequence, absolute continuity of the SBR measure is obtained, as well as the existence of a local time. The link between rough Weierstrass curves and smooth dynamical systems can be generalized considerably. Applications to regularization of singular ODE by rough (Weierstrass type) signals are on our agenda. This is joint work with G. dos Reis (U Edinburgh) and O. Pamen (U Liverpool and AIMS Ghana).

Generalized Hawkes Processes

Jacek Jakubowski, University of Warsaw

In my talk I present generalized multivariate Hawkes processes. This class of stochastic processes was introduced by Hawkes (1971) to model self-exciting and mutually-exciting random phenomena that evolve in time. Generalized multivariate Hawkes processes are multivariate marked point processes that add an important feature to the family of the (classical) multivariate Hawkes processes: they allow for explicit modelling of simultaneous occurrence of excitation events coming from different sources, i.e. caused by different coordinates of the multivariate process. I define and study generalized multivariate Hawkes processes, as well as a consistency property and the related structures. On the end I present some applications. My talk is based on joint work with T.R. Bielecki (IIT Chicago) and M. Nieweglowski (MiNI PW Warsaw).

On Copulas and Stochastic Differential Equations

Piotr Jaworski, University of Warsaw

Copulas are mathematical objects that fully capture the dependence structure among random variables and offer a great flexibility in building multivariate stochastic models. Since their discovery in the early 50?s, copulas have led to a much better understanding of stochastic dependence and allowed to break away from the multivariate Normal distribution, which generally underestimates the probability of joint extreme risks.

Due to the celebrated Sklar's Theorem, one can split a study of a pair (X_1, X_2) of random variables into two parts. First one can deal with each X_i separately and then with the interdependence between them. In my talk, I will apply this methodology to the study of a pair of stochastic processes. I assume that dynamics of each process is described by a stochastic differential equation and the interdependence is determined by randomly varying quadratic covariation. The objective is to describe the evolution of the corresponding family of copulas C_t. This is achieved in terms of the weak solutions of parabolic partial differential equations. The usefulness of the results will be illustrated on the example of the possible applications to systemic risk modelling and basket derivatives pricing.

Characteristics of default time

Monique Jeanblanc, University of Evry

In this talk, we present different processes associated with default times, as intensity, conditional densities, Azéma's supermartingales, optional and predictable dual projections of the default process. We show how these characteristics can be used and what is the information they contain. We also show how to construct a default time starting from the characteristics and give examples.

Pathwise quadratic variation and local times of deterministic cadlag paths - linking several approaches

Rafal Łochowski, Szkoła Główna Handlowa w Warszawie (Warsaw School of Economics)

Since the seminal paper of Föllmer [2] there is growing interest in probability-free approach to stochastic calculus. Föllmer proved that properly defined quadratic variation of a deterministic cadlag path (as the limit of discrete quadratic variations along some sequence of partitions) leads to the same formula as Itô's formula for cadlag semimartingales. Bichteler ([1], see also [3]) noticed that the discrete quadratic variations of a semimar- tingale X along so called Lebesgue partitions (with vertical meshes tending sufficiently fast to 0) tend almost surely to the quadratic variation [X] of X. In recent paper [5] Vovk proved the same result for model-free cadlag paths with mildly restricted jumps. Recently, it was noticed in [4] that normalized truncated variations of a cadlag semi-martingale X also tend almost surely to the quadratic variation [X] (minus sum of squares of jumps). This led to the question raised by David Prömel and Pietro Siorpaes what is the relationship between both limits in the case when we rather deal with deterministic cadlag paths than with semimartingale paths. Surprisingly, the answer is very straightforward and it appears (in the simplest - continuous case) that the normalized truncated variation may be obtained as the integrated discrete quadratic variations along shifted Lebesgue partitions. Further investigations leading to local times of deterministic cadlag paths and Tanaka- Meyer formula will be also mentioned. The talk will be based on joint research with Jan Oblój, David Prömel (University of Oxford) and Pietro Siorpaes (Imperial College).

References

[1] K. Bichteler. *Stochastic integration and lp theory of semimartingales.* Ann. Probab., 9(1):49–89, 1982.

[2] H. Föllmer. *Calcul d'Itô sans probabilités.* Séminaire de Probabilités XV, 80:143–150, 1981.

[3] R. L. Karandikar. *On pathwise stochastic integration.* Stoch. Process. Appl., 57(1):11–18, 1995.

[4] R. Lochowski. *Quadratic variation of crdlrg semimartingales as a.s. limit of the normalized truncated variations.* Preprint arXiv:1708.00732, 2017.

[5] V. Vovk. *Itô calculus without probability in idealized financial markets.* Lith. Math. J., 55(2):270–290, 2015

Inhomogeneous change of time for Markov chains

Zofia Michalik, University of Warsaw

In the talk we consider change of time given as a solution to the inhomogeneous time-change equation of the form

$$\tau_t = \int_0^t g(s, X_{\tau_s})\mathrm{d}s, \tag{0.1}$$

where X is a finite-state Markov chain and g is a nonnegative Borel function. Such a change of time is a generalisation of changes of time studied e.g. by Ethier and Kurtz in [1] and Krühner and Schnurr in [2]. The question of existence and uniqueness of solution to (0.1) demands different approach than in the homogeneous case and for Markov chains it can be solved via explicit construction. We will show some properties of such a change of time, especially those connected to Markov consistency of a time-changed process. Such changes of time may be applied to introduce stochastic volatility in the asset price models.

References

[1] S.N. Ethier, T.G Kurtz, *Markov Processes: Characterization and Convergence* Wiley, New York, 1986.

[2] P. Krühner, A. Schnurr, *Time Change Equations for Lévy Type Processes*, Stochastic Processes and their Applications, Vol. 128, Issue 3, 2018, pp. 963-978.

Fractional models in finance and statistics

Yuliya Mishura, Univ. of Kiev

We consider stochastic processes that are the solutions of SDE involving fractional Brownian motion as the models for financial markets, especially to model stochastic volatility. The properties of such processes are studied and generalized from fBm to wider classes of continuous Gaussian processes. Parameter estimation is proposed.

BSDE on random horizon: applications to quadratic hedging

Mariusz Nieweglowski, Warsaw University of Technology

Abstract: We consider BSDE's on random interval driven by general martingale M. Contrary to existing results for such BSDE's we assume that generator have additional term with finite number of jumps. We show that one can construct solution of such BSDE's by

solving corresponding recursive system of simplified BSDE on random intervals and piecing them together appropriately. This generalizes BSDE's considered by Carbon et.al and El Karoui and Huang. Then we prove that under some Markovianity assumption solution of the above BSDE are associated with system of Cauchy problems.This results are then applied to quadratic hedging problems i.e. risk-minimization of claims described by general dividend process.

The sound of silence: equilibrium filtering and optimal censoring in financial markets

Adam Ostaszewski, London School of Economics

Following the approach of standard filtering theory, we analyse investor valuation of firms, when these are modelled as geometric-Brownian state processes that are privately and partially observed, at random (Poisson) times, by agents. tasked with disclosing forecast values. Agents are able purposefully to withhold their observations; explicit filtering formulae give downgrading valuations in the absence of disclosures. The analysis is may be conducted both for a solitary firm and for m co-dependent firms.

Duality and optimality conditions in convex stochastic optimization

Teemu Pennanen, Kings College

We study problems of convex stochastic optimization in a functional analytic framework that unifies and extends various models from stochastic control, operations research and mathematical finance. Combining techniques from convex and stochastic analysis, we establish the existence of primal solutions, the absence of a duality gap and optimality conditions that turn out to be not just sufficient but necessary under some natural stability assumptions on the primal problem.

Backtesting Expected Shortfall - duality approach

Marcin Pitera, Jagiellonian University Cracow

We propose a new backtesting framework for Expected Shortfall. Our test statistics is given by the biggest number of worst realisations for the secured position that add up to a negative total. Surprisingly, this simple quantity could be used to construct an efficient backtesting framework for unconditional coverage of Expected Shortfall in a natural

extension of the regulatory traffic-light approach for Value-at-Risk. While being easy to calculate, the test statistic is based on the underlying duality between coherent risk measures and scale-invariant performance measures.

Trading with processes of long memory

Miklos Rasonyi, Renyi Institute HAS

An investor is maximizing the growth rate of his expected utility when the price process has a covariance structure with power decay. In particular, fractional Brownian motions with all possible parameters are included. We present an explicit asymptotically optimal strategy and quantify the growth rate as a function of the covariance decay rate. Based on joint work with Paolo Guasoni and Zsolt Nika.

Classical and Restricted Impulse Control for the Exchange Rateunder Incomplete Knowledge of the Model

Wolfgang Runggaldier, University of Padova

We consider the problem faced by a Central Bank of optimally controlling the exchange rate over a finite time horizon by controlling directly the exchange rate in the form of an impulse control as well as by controlling it indirectly via the domestic exchange rate in the form of a continuously acting control. It is thus a mixed classical-impulse control problem for which, on the basis of a quasi-variational inequality, we search for an analytic solution within a specific class of value functions and controls. Besides the finite horizon, the main novelty here is the assumption that the drift in the exchange rate dynamics is not directly observable and has thus to be filter-estimated from observable data. The problem becomes thus time in-homogeneous and the Markovian state variables have to include also the filter of the drift. This is a joint work with Kazuhiro Yasuda.

Super-replication under model uncertainty

Agnieszka Rygiel, Cracow University of Economics

We consider a finite discrete time multi-asset market model with transaction costs. We give the dual formulation for the super-hedging price under volatility uncertainty. In an one-dimensional case, we study the semi-static super-replication of path dependent European options.

Utility Maximization under Model Uncertainty in a Multivariate Black Scholes Type Market

Jörn Sass, University of Kaiserslauten

When modeling financial markets one is often confronted with model uncertainty in the sense that parameters of the model or the distributions of some factors in the model are only known up to a certain degree. We look at a multivariate continuous-time financial market driven by a Brownian motion.

In an extreme setting, we investigate how optimal trading strategies for a utility maximization problem behave when we have Knightian uncertainty on the drift, meaning that the only information is that the drift parameter lies in a certain set. This is a robust portfolio optimization setting in which we aim at the best performance given that the true drift parameter is the worst possible parameter for our chosen strategy within this set. If the model uncertainty exceeds a certain threshold simple strategies such as uniform portfolio diversification outperform more sophisticated ones due to being more robust, see Pflug, Pichler and Wozabel (2012) in discrete time. We extended theses results to continuous time, and provide quite explicit strategies and convergence results and discuss these in terms of different performance measures.

If time allows we also discuss a model with expert opinions in a market with Gaussian drift. In such a parametric model, the underlying drift can be estimated from the observed stock returns and the expert opinions lead to an improvement of the basic Kalman filter. So the expert opinions reduce parameter uncertainty in this setting. In Sass, Westphal and Wunderlich (2017) bounds on the performance are derived. We relate and compare the two approaches.

References

G.C. Pflug, A. Pichler, D. Wozabel (2012) The 1/N investments strategy is optimal under high model ambiguity, Journal of Banking & Finance 36, 410–417.

J. Sass, D. Westphal, R. Wunderlich (2017) Expert Opinions and Logarithmic Utility Maximization for Multivariate Stock Returns with Gaussian Drift, International Journal of Theoretical and Apllied Finance 20, 41 pages.

Accounting Noise and the Pricing of CoCos

Peter Spreij, University of Amsterdam

Contingent Convertible bonds (CoCos) convert into equity or are written down in times of distress. Existing pricing models assume conversion triggers based on market prices and assume that markets can observe relevant firm information. But existing CoCo triggers are based on accounting ratios and/or regulatory intervention. We incorporate that markets receive information through noisy accounting reports and distinguish between market and

accounting values, and between automatic and regulator-mandated conversions. We also incorporate that coupon payments cannot exceed the Maximum Distributable Amount; this trigger explains the crash in CoCo prices after Deutsche Bank's profit warning in February 2016. We examine the impact of CoCo design, asset volatility and accounting noise on CoCo prices. Joint work with Mike Derksen and Sweder van Wijnbergen.

Geometric Ergodicity of Affine Processes on Cones

Robert Stelzer, University of Ulm

For affine processes on finite-dimensional cones, we give criteria for geometric ergodicity - that is exponentially fast convergence to a unique stationary distribution. Ergodic results include both the existence of exponential moments of the limiting distribution, where we exploit the crucial affine property, and finite moments, where we invoke the polynomial property of affine semigroups. Furthermore, we elaborate sufficient conditions for aperiodicity and irreducibility. Our results are applicable to Wishart processes with jumps on the positive semidefinite matrices, continuous-time branching processes with immigration in high dimensions, and classical term-structure models for credit and interest rate risk.

If time permits we also discuss the geometric ergodicity of a non-linear process on the positive semi-definite matrices, viz. the multivariate COGARCH(1,1) processes.

Nonlinear stochastic representation and application to contract theory

Nizar Touzi, Ecole Polytechnique, Paris

The predictable representation property of the Brownian motion states that, in a the Brownian filtration, any centered (integrable) random variable can be represented as a stochastic integral with respect to the underlying Brownian motion. Backward SDEs and their extension to the second order can be viewed as a nonlinear extension of this representation property. We provide an overview of the most recent wellposedness results, and we present corresponding applications in continuous-time contract theory.

Another look at Hartman-Watson distributions

Maciej Wiśniewolski, Warsaw University

We present some new results on classical for mathematical finance and problem of pricing of Asian options, distributions of Hartman-Watson. The family of such distributions is defined using the special function u strictly connected with the distribution of functional A_t

of Brownian motion. The new obtained representation for the density of A_t leads to the new form of u. Integral relations of convolution type between Hartman-Watson distributions and modified Bessel functions I_0 and K_0 are presented: it turns out that u can be represented as a integral convolution of itself and the modified Bessel function K_0. Using the excursion theory we develop a time-state space convolution identity for u which in turn, by using a subordinator connected to hyperbolic cosine of Brownian motion, leads to another new representation of the function u.

Power Utility Maximization in a Continuous-Time Black Litterman Model

Ralf Wunderlich, Brandenburg University of Technology Cottbus – Senftenberg

We consider a continuous-time financial market with partial information on the drift and solve utility maximization problems which include expert opinions on the unobservable drift. Stock returns are driven by a Brownian motion and the drift depends on a factor process which is an Ornstein Uhlenbeck process. Thus the drift is hidden and has to be estimated from observable quantities. If the investor only observes stock prices then the best estimate is the Kalman filter. However, to improve the estimate, an investor may also rely on expert opinions providing a noisy estimate of the current state of the drift. This reduces the variance of the filter and thus improves expected utility. That procedure can be seen as a continuous-time version of the classical Black-Litterman approach. For the associated portfolio problem with logarithmic utility explicit solutions are available in the literature. In this talk we consider the case of power utility. Here, we apply dynamic programming techniques and solve the corresponding dynamic programming equation for the value function. In particular we investigate the asymptotic behavior of the filter for high-frequency experts and derive limit theorems for two different asymptotic regimes. In the first variances of the expert opinions grow linearly with the arrival frequency while in the second they are constant. The derived limit theorems allow for simplified approximate solutions of utility maximization problems since the convergence of the filter carries over to the convergence of the value function. Numerical results are presented. The talk is based on joint work with A. Gabih, H. Kondakji, J. Sass and D. Westphal.

Fractional modification of stochastic volatility process in Heston model: rough case

Anton Yurchenko-Tytarenko, University of Kiev

Recent studies of financial markets have shown that the volatility might be extremely irregular and the value of the Hurst index estimated from the real-world time series may be

around 0.1. Such effect is not reflected by classical models including the well-known Heston model. This talk is devoted to fractional modification of stochastic volatility in Heston model in case of an arbitrary Hurst parameter including "irregular" situation $H < \frac{1}{2}$. Construction of the corresponding process as well as its properties are overviewed.

On the parabolic Cauchy equation related to portfolio optimization problems

Dariusz Zawisza, Jagiellonian University

In this talk we consider a semilinear equation linked to the finite horizon consumption -investment problem under the multidimensional stochastic factor framework. We prove it admits a classical solution and provide all obligatory estimates required for successful application of the verification reasoning. The paper covers standard time additive utility, as well as the recursive utility framework. We extend existing results by considering more general factor dynamics including a nontrivial diffusion part and stochastic correlation between assets and factors. In addition, this is the first paper which compromise many other optimization problems in finance, for example those related to the indifference pricing or the quadratic hedging problem. The essence of our paper lies in using improved stochastic methods to prove gradient estimates for suitable HJB equations with restricted control space.