Stochastic Analysis and Its Applications XIV

Room Praktikum (First Floor)
KPMS MFF UK, Sokolovska 83, Praha 8

January 5, 2018

Program

9:30 – 10:00: Arrival, Coffee

10:00 – 10:45
Jiří Witzany, Milan Fičura:
Applications of Particle Filters for Estimations of Stochastic Volatility Jump Diffussion Models

10:45 – 11:30
Jan Swart, Tibor Mach:
The mean-field dual of systems with cooperative branching

11:30 – 12:00
Jana Šnupárková, María Garrido-Atienza, Bohdan Maslowski:
Semilinear equations with multiplicative fractional noise

12:00 – 13:30: Lunch Break

13:30 – 14:15
Jiří Hozman, Tomáš Tichý, Michal Holčapek:
Modern numerical methods for one-factor BS model

14:15 – 15:00
Jan Večeř, Robert Navrátil:
Performance of volatility maximization strategies

15:00 – 15:15: Coffee Break

15:15 – 16:00
Petr Dostál, Tibor Mach:
Robust filtering and progressive projection

16:00 – 16:45
Pavel Kříž:
Parameter estimation in stochastic PDEs

16:45 – 17:30
Karel Kadlec:
Ergodic control of diffusion processes with Levy noise in Hilbert spaces

17:30+: Dinner

Abstracts

Jiří Witzany, Milan Fičura:
Applications of Particle Filters for Estimations of Stochastic Volatility Jump Diffussion Models

We present a methodology of how Particle Filters can be used for latent state filtering and Bayesian parameter learning in Stochastic-Volatility Jump-Diffusion (SVJD) models. The first part of the contribution explains how the Sequential Importance Resampling (SIR) Particle Filter can be used to estimate the evolution of the latent state variables (stochastic variances, jump occurrences and jump sizes) in the SVJD model, and how the performance of this filter can be significantly improved by adapting it to the jump sizes and jump occurences. In the second part, the Marginalized Resample Move (MSMS) algorithm is presented, for the task of Bayesian parameter learning in SVJD models, and the problem of an appropriate choice of proposal distribution is discussed. In the final part, the performance of the Particle Filters is compared on simulated time series, as well as real-world financial time series of foreign Exchange rates.

Jan Swart, Tibor Mach:
The mean-field dual of systems with cooperative branching

In this talk we consider interacting particle systems where pairs of particles can give birth to new particles, and in addition particles die with a certain rate. We are interested in the random map that describes how the state at a given time depends on the initial state, for well-mixing populations in the limit that the size of the population is large. We will reveal an interesting link to Random Tree Processes (RTPs) as studied by Aldous and Bandyopadhyay, which are a sort of Markov chains with a tree-like time parameter. In particular, we will discuss endogeny of RTPs related to systems with cooperative branching.

Jana Šnupárková, María Garrido-Atienza, Bohdan Maslowski:
Semilinear equations with multiplicative fractional noise

In the talk, semilinear stochastic differential equations with pathwise multiplicative fractional noise will be presented. This is a joint work with María Garrido-Atienza and Bohdan Maslowski.

Jiří Hozman, Tomáš Tichý, Michal Holčapek:
Modern numerical methods for one-factor BS model

Option pricing theory is a very important discipline which has a lot of applications in financial engineering. This research is focused on a single plain vanilla option pricing problem, which can generally lead to analytical solution and thus can be used as a benchmark for novel numerical approaches. Hence, our goal is to acquaint the audience with relatively novel numerical techniques for solving a PDE model arising from a classical Black-Scholes framework.

After general introduction to the topic we present option pricing methods based on a concept of discontinuous Galerkin methods, wavelets and fuzzy transform techniques, which have some potential to overcome problems associated with commonly used methods (i.e., MC, tree, FD or FE techniques). The schemes we derive are tested on a simple numerical benchmark with real market data and the computational results are compared each to the other. Moreover, mutual differences are discussed, including dimensionality and convergence issues.

Jan Večeř, Robert Navrátil:
Performance of volatility maximization strategies

Volatility in finance is traditionally regarded negatively. The classical risk measures are increasing functions of volatility. Thus a traditional portfolio management tries to completely eliminate or minimize the risk associated with volatility. However, volatility is just a measure of dispersion, so a high volatility can result in both substantially negative or substantially positive outcomes. We show that the volatility maximization portfolio is maximizing the costs associated with insuring an actively traded portfolio. These contracts are called options on a traded account and their existence in practice is very limited precisely for the high price. Option pricing theory uses risk neutral measures (also called martingale measures) for pricing in contrast to using the real measure. The martingale measures determine the replication costs of the scenarios insured by the option. These replication costs can differ substantially from the real expectation and thus the risk neutral measures and the real measures may exhibit some discrepancies. In fact, they differ most on the scenarios associated with high volatility. In particular, the substantially negative outcomes for high volatility strategies are much less likely to happen in reality in comparison to their replicating costs. We illustrate the performance of the high volatility strategies on the portfolio of major world currencies.

Petr Dostál, Tibor Mach:
Robust filtering and progressive projection

We use the model of log-optimal investment to several risky assets in order to motivate the problem of robust filtering. This model also provides very interesting interpretation of our results. Namely, very important is the density of the distribution of final wealth among all primary investors with respect to the initial distribution (chosen by a secondary investor). It corresponds to the density of the posterior distribution of our interested parameter with respect to its prior distribution. This is true if we assume that the primary investors follow log-optimal strategy in frictionless market. It is a joint work with Tibor Mach.

Pavel Kříž:
Parameter estimation in stochastic PDEs

The moment-based estimator of the drift parameter of a linear stochastic PDE with additive (fractional) Brownian noise will be introduced. Such estimator is easy to calculate and exhibits nice asymptotic properties - strong consistency and asymptotic normality. Strong consistency can be shown via ergodicity. For asymptotic normality, recently developed techniques based on Malliavin calculus (commonly called the 4th moment theorems) can be applied. For diagonalizable SPDEs, a reweighting technique enables to modify the studied estimator so that it becomes strongly consistent and asymptoticaly normal in space (fixed time-window, increasing number of observed coordinates).

Karel Kadlec:
Ergodic control of diffusion processes with Levy noise in Hilbert spaces

In this contribution, controlled linear stochastic evolution equations driven by Levy processes are presented in the Hilbert space setting. The control operator may be unbounded which makes the results obtained in the abstract setting applicable to parabolic SPDEs with boundary or point control. In the first part, some examples, as various parabolic type SPDEs with point or boundary control, are introduced. The second part contains some preliminary technical results, notably a version of Itˆo formula which is applicable to weak/mild solutions of controlled equations. In the last part, the ergodic control problem is solved: The feedback form of the optimal control and the formula for the optimal cost are found.