Abstracts of talks to be presented at the workshop

"Risk: modelling, optimization and inference".

Darinka Dentcheva

Stevens Institute of Technology, Hoboken, NJ

Title: "**Optimization problems with stochastic ordering constraints"**

Abstract: Stochastic orders formalize preferences among random outcomes and are widely used in statistics and economics. We focus on stochastic optimization problems involving stochastic ordering relations as constraints that relate performance functionals, depending on our decisions, valued in an appropriate L_p space, to benchmark random outcomes.

Necessary and sufficient conditions of optimality and duality theory for these problems will be presented. The analysis puts additional light on the expected utility theory, the dual (rank-dependent) utility theory, and the theory of coherent measures of risk. The optimization models with stochastic ordering constraints provide a link between various approaches for risk-averse optimization.

The most prominent stochastic orders are the first and second order stochastic dominance relations, and the increasing convex order. These relations are defined by a continuum of compositions of convex non-smooth functions with possibly non-convex smooth functions. Our results contribute to the theory of semi-infinite and composite optimization in vector spaces.

Potential applications will be outlined.

Ben Goldys

The University of New South Wales/ The University of Sydney

Title: "Modelling the stochastic volatility matrix"

Abstract: Models with a single stochastic volatility have become by now a standard tool in financial analysis and they are relatively well understood. Recently there has been growing interest in multidimensional stochastic volatility models, where the whole matrix of stochastic volatilities and correlations is modelled using matrix-valued stochastic differential equations. The question how these models reflect some stylised facts is currently open. In particular the condition for mean reversion property and the rate of convergence to stationarity are not known. We will present recent developments in this area and present results on the existence and some properties of stationary solutions to a certain class of stochastic volatility models.

This is a joint work with Tim Glass.

Spiridon Penev

The University of New South Wales

Title: "Statistical Inference about risk: some recent results"

We discuss some recent results on inference about risk extending some previous approaches.

We start with an improved confidence interval construction for quantiles. This construction is based on Edgeworth expansion for the kernel quantile estimator. The benefit of using one more term beyond the normal approximation is especially useful when inverting the expansion to get an improved confidence interval for the quantile. Both standardized and studentized cases are discussed. Conditions on the kernel are formulated that allow us to get the correct expansion. The results are used to demonstrate numerically improvements of the coverage probabilities for VaR when sample sizes are moderate.

Further, we discuss inference issues about specific coherent risk measures, the so-called Higher Order Coherent tail risk measures. These have some advantages in comparison to their predecessors like e.g., expected shortfall, since the cut-off point is adjustable for the chosen confidence level alpha. As opposed to the case of average value at risk (AVaR), no explicit formulae exist for point estimators and (asymptotic) confidence intervals for these measures. However, both point estimators and confidence intervals can still be easily calculated numerically by conveniently solving convex optimization problems with convex constraints.

Finally, we also demonstrate the advantages of using higher order coherent risk measures in a framework for Option Portfolio Optimization. This is implemented via multistage risk averse optimization using stochastic programming. We demonstrate on a simple example of Vanilla Options composed from the Dow Jones Index that when using Higher Order Coherent Risk Measures we can attain higher returns in comparison to using AVaR or mean-variance model.

Gareth Peters

The University of New South Wales

Title: "Sequential Monte Carlo for Rare Event Simulation in Risk Estimation and Capital Allocation"

Abstract: In this talk we present statistical methodology based on Sequential Monte Carlo (SMC) algorithms to solve important risk management problems relating to Basel II Capital estimation and allocation. This is studied in the setting of multiple risk processes with dependence under a framework of the Loss Distributional Approach (LDA). Typically, this involves estimation of risk measures which require estimation of functionals of compound processes, such as tail quantiles (VaR), tail expectations (Expected Shortfall) and others. In this talk we develop efficient estimation of these quantities via SMC methods in multiple risk process settings in which dependence between the risk processes, or the severity distribution in the risk processes results in analytic intractability and as a result standard techniques are difficult to utilise. We demonstrate how to overcome some of these difficulties with the class of SMC methods.

Andrzej Ruszczynski

Rutgers University

Title: “Dynamic Risk-Averse Optimization”

Abstract: We present the concept of a dynamic risk measure and discuss its important properties. In particular, we focus on time-consistency of risk measures. Next, we focus on dynamic optimization problems for Markov models. We introduce the concept of a Markov risk measure and we use it to formulate risk-averse control problems for two Markov decision models: a discounted infinite horizon model and an undiscounted transient model. For both models we derive risk-averse dynamic programming equations and a value iteration method. We also develop a risk-averse policy iteration method and we prove its convergence. We propose a version of the Newton method to solve a non-smooth equation arising in the policy iteration method and we prove its global convergence. Finally, we discuss relations to Markov games.

Marek Rutkovski

The University of Sydney

Title: "Credit Value Adjustments for Bilateral Counterparty Risk of Collateralized Contracts under Systemic Risk"

Abstract: We depart from the usual methods for pricing contracts with the counterparty credit risk found in most of the existing literature. In effect, typically, these models, first, do not account for either systemic effects or `at first default' contagion, second, postulate that the contract value at default equals either the default-free value or the pre-default value, and third, do not take margin agreements into account. We propose instead a fairly general framework, which is aimed to furnish effective credit value adjustment (CVA) computations for a contract with bilateral counterparty risk in the presence of systemic and right- or wrong-way risks. Our general methodology focuses on alternative settlement conventions and it covers various covenants regarding margin agreements. Numerical results reported in the final section support our conjecture that alternate specifications of settlement values will have non-negligible impact on the CVA of contracts with bilateral counterparty risk.

Pavel Shevchenko

CSIRO and The University of New South Wales

Title: "Combining Different Data Sources for Risk Estimation"

Abstract: Typically, estimation of low-frequency/high-impact risks is difficult due to small datasets. Often expert opinions and external data are used to improve these estimates. Combining different sources of information such as internal data, external data and expert opinions is a challenging problem that often should be resolved in practical applications. It is also one of the regulatory requirements for operational risk in the banking industry. In this talk we present different approaches proposed to solve this problem. In particular, we focus on the Bayesian inference methods that provide a consistent statistical framework to combine different data sources.