VCMF Educational Workshop

WU Vienna, Thu-Fri, September 15-16, 2016

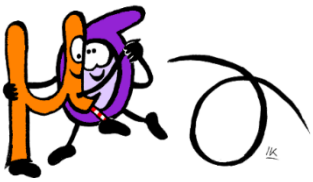
TC.2.01 Siemens Auditorium, TC - Teaching Center, 2nd floor
Mensa Cafeteria, D1/TC - Teaching Center, ground floor

Thursday, September 15, 2016

TC.2.01 Siemens Auditorium

8:30 – 9:00	Registration
9:00 – 9:10	Welcome Address
9:10 – 10:40	Johannes **Muhle-Karbe** (University of Michigan) Option Pricing and Hedging with Model Uncertainty (part 1)
10:40 – 11:10	Coffee Break
11:10 – 12:40	Peter **Tankov** (Université Paris-Diderot) Asymptotic Methods for Optimal Tracking: Lower Bounds, Feedback Strategies and Applications in Finance (part 1)
12:40 – 14:00	Lunch Break in Mensa Cafeteria
14:00 – 15:30	Alexander McNeil (Heriot-Watt University, Edinburgh) Market Risk Models and Backtesting (part 1)
15:30 – 16:00	Coffee Break
16:00 – 17:30	Nicole **Bäuerle** (KIT, Germany) Markov Decision Processes with Applications to Finance and Insurance (part 1)

VCMF 2016 – Workshop



Friday, September 16, 2016

TC.2.01 Siemens Auditorium

9:00 – 10:30	Alexander McNeil (Heriot-Watt University, Edinburgh) Market Risk Models and Backtesting (part 2)
10:30 – 10:50	Coffee Break
10:50 – 12:20	Nicole **Bäuerle** (KIT, Germany) Markov Decision Processes with Applications to Finance and Insurance (part 2)
12:20 – 13:30	Lunch Break in Mensa Cafeteria
13:30 – 15:00	Johannes **Muhle-Karbe** (University of Michigan) Option Pricing and Hedging with Model Uncertainty (part 2)
15:00 – 15:20	Coffee Break
15:20 – 16:50	Peter **Tankov** (Université Paris-Diderot) Asymptotic Methods for Optimal Tracking: Lower Bounds, Feedback Strategies and Applications in Finance (part 2)

Invited lecture: TC.2.01, Thu, 16:00 & Fri, 10:50

Nicole **Bäuerle** (KIT, Germany)

Markov Decision Processes with Applications to Finance and Insurance

Markov Decision Processes are controlled Markov processes in discrete time. They appear in various fields of applications like e.g. economics, finance, operations research, engineering and biology. The aim is to maximize the expected (discounted) reward of the process over a given time horizon. We consider problems with arbitrary (Borel) state and action space with a finite and an infinite time horizon. Solution methods and the Bellman equation are discussed as well as the existence of optimal policies. For problems with infinite horizon we give convergence conditions and present solution algorithms like Howard's policy improvement or linear programming. The statements and results are illustrated by examples from finance and insurance like consumption-investment problems and dividend pay-out problems.

In the second lecture we investigate the problem of maximizing a certainty equivalent of the total or discounted reward which is generated by a Markov Decision Process. The certainty equivalent is defined by $U^{-1}(\mathbb{E}U(X))$ where U is an increasing function. In contrast to a risk-neutral decision maker this optimization criterion takes the variability of the reward into account. It contains as a special case the classical risk-sensitive optimization criterion with an exponential utility. We illustrate our results with the help of a risk-sensitive dividend pay-out problem.

Invited lecture: TC.2.01, Thu, 14:00 & Fri, 9:00

Alexander **McNeil** (Heriot-Watt University, Edinburgh)

Market Risk Models and Backtesting

The outcome of the "Fundamental Review of the Trading Book" (FRTB) is that the capital requirement for banks using an internal model approach for their trading books will be based on the expected shortfall (ES) risk measure. However, the process of gaining internal model approval will continue to be based on backtesting value-at-risk (VaR) estimates at the 99% level and the approval process will be extended to individual trading desk level; desks that submit unsatisfactory backtest results may lose internal model approval. The Basel documentation also suggests that banks will be expected to go beyond the basic backtesting requirements by considering VaR exceptions at multiple confidence levels, tests based on expected shortfall and tests based on so-called realized p-values.

To understand these regulatory developments better, we will look at the following topics in this educational workshop:

1. methods used by banks to measure the market risks in their trading books, including the risk-factor mapping process and the statistical and econometric modelling methods used to estimate risk measures like VaR;
2. the current backtesting regime based on VaR exceptions and its shortcomings;
3. the recent academic debate surrounding the backtesting of alternative risk measures, such as expected shortfall;
4. more advanced backtesting approaches based on realized p-values that can address some of the ambitions of regulators as expressed in the FRTB.

The workshop will be partly based on material from the book "Quantitative Risk Management: Concepts, Techniques & Tools" (PUP, 2015) by McNeil, Frey & Embrechts, as well as new research. Some R examples will be integrated into the presentation.

Invited lecture: TC.2.01, Thu, 9:10 & Fri, 13:30

Johannes **Muhle-Karbe** (University of Michigan)

Option Pricing and Hedging with Model Uncertainty

The starting point for classical option pricing theory is a probabilistic model for the future evolution of the underlying asset. In reality, every such model is of course at best a useful approximation. Whence, it is important to assess the susceptibility of classical results to model uncertainty and to derive robust decision rules that take it into account in an appropriate manner.

In these lectures, we discuss some approaches to tackle this problem. We start from the so-called "uncertain volatility model", where one considers a whole class of possible scenarios for the volatility process of the underlying. The goal then is to determine robust superhedging strategies that eliminate all risk in all of these conceivable scenarios.

We then move on to more moderate attitudes towards uncertainty, where different scenarios are not treated in the same way but instead weighted by their plausibility, measured in terms of their "distance" from a given reference model.

Finally, we discuss how the above results change if liquidly traded vanilla options are available as additional instruments for static or dynamic hedging.

References:
[1] Herrmann, S. and Muhle-Karbe, J. and Seifried, F. (2015): Hedging with small uncertainty aversion. Preprint, available at http://ssrn.com/abstract=2625965.
[2] Herrmann, S. and Muhle-Karbe, J. (2016): Model uncertainty, recalibration, and the emergence of delta-vega hedging. Preprint, available at http://ssrn.com/abstract=2694718.

Invited lecture: TC.2.01, Thu, 11:10 & Fri, 15:20

Peter **Tankov** (Université Paris-Diderot)

Asymptotic Methods for Optimal Tracking: Lower Bounds, Feedback Strategies and Applications in Finance

In this lecture, we shall present recently developed methods for approximate solution of stochastic control problems in the asymptotic regime where the costs for applying the control are small. We consider the problem of tracking a target whose dynamics is modeled by a continuous Itô semimartingale. The aim of the controller is to minimize both deviation from the target and tracking efforts.

We shall first establish the existence of asymptotic lower bounds for this problem, depending on the cost structure. These lower bounds can be related to the time-average control of Brownian motion, which is characterized as a deterministic linear programming problem. Furthermore, we shall provide a comprehensive list of examples for which the lower bound is sharp and is attained by an explicit feedback strategy. Finally, applications to various control problems arising in mathematical finance (option hedging in discrete time, utility maximization with transaction costs) will be discussed.

This lecture is based on the following papers:
[1] Jiatu Cai, Mathieu Rosenbaum and Peter Tankov. Asymptotic Lower Bounds for Optimal Tracking: a Linear Programming Approach. preprint, arXiv:1510.04295.
[2] Jiatu Cai, Mathieu Rosenbaum and Peter Tankov. Asymptotic Optimal Tracking: Feedback Strategies. preprint, arXiv:1603.09472.