

Monday June 21st

- 1.30-2.00 PM** Hedging Options in a Doubly Markov-Modulated Financial Market via Stochastic Flows - Ken Siu
- 2.05-2.35 PM** Information-based complexity in stochastic optimization - Teemu Pennanen
- 2.40-3.10 PM** Partial differential integral equation model for pricing American option under multi state regime switching with jumps - Muhammad Yousuf
- 3.15-3.45 PM** **Break**
- 3.50-4.20 PM** Pricing and Hedging Options on Assets with Options on Related Assets - Dilip Madan
- 4.25-4.55 PM** Merton Investment Problem for Hawkes Risk Model in Insurance - Anatoliy Swishchuk
- 5.00-5.30 PM** Polynomial Process and Polynomial Regression Model for French Electricity Prices - Zuming Sun



Tuesday June 22nd

1.30-2.00 PM **Wavelet-based forecasting of
Crude Oil Price with Denoising
ARMA Model - Prabhat Mittal**

2.05-2.35 PM **Regime Switching Entropic Risk
Measures on Crude Oil Pricing -
Babacar Seck**



Abstracts

**Prof. Ken Siu (ken.siu@mq.edu.au)
Macquarie University, Sydney, Australia**

Hedging Options in a Doubly Markov-Modulated Financial Market via Stochastic Flows

Hedging is an important topic in insurance and finance. In this paper, the hedging of a European-style contingent claim is studied in a continuous-time doubly Markov-modulated financial market, where the interest rate of a bond is modulated by an observable, continuous-time, finite-state, Markov chain and the appreciation rate of a risky share is modulated by a second continuous-time, finite-state, hidden Markov chain. The first chain describes the evolution of credit ratings of the bond over time while the second chain models the evolution of the hidden state of an underlying economy over time. Stochastic flows of diffeomorphisms are used to derive some hedge quantities, or Greeks, for the claim. A mixed filter-based and regime-switching Black–Scholes partial differential equation is obtained governing the price of the claim. It will be shown that the delta hedge ratio process obtained from stochastic flows is a risk-minimizing, admissible mean-self-financing portfolio process. Both the first-order and second-order Greeks will be considered.

**Prof. Teemu Pennanen (teemu.pennanen@kcl.ac.uk)
King's College, London, UK**

Information-based complexity in stochastic optimization

Information based complexity (IBC) studies the limits of solution accuracy obtainable with a given amount of information. IBC has been extensively studied in the context of numerical integration and optimization. We study IBC of stochastic optimization problems that are fundamental e. g. in financial mathematics and machine learning. Combining existing results on integration and optimization, we identify classes of convex stochastic optimization problems whose IBC is polynomial in the problem dimensions. Although simple, this seems to be the first tractability result in stochastic optimization.



Abstracts

Dr. Muhammad Yousuf (myousuf@kfupm.edu.sa)

King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia

Partial differential integral equation model for pricing American option under multi state regime switching with jumps

In this paper, we consider a two-dimensional partial differential integral equation (PDIE) model for pricing American option. A nonlinear rationality parameter function for two asset problems is introduced to deal with the free boundary. The rationality parameter function is added in the PDIEs used for pricing American option problems under multi-state regime switching with jumps. The resulting two dimensional nonlinear system of partial differential integral equation is then numerically solved. Based on real poles rational approximation, a strongly stable highly efficient and reliable method is developed to solve such complicated systems of PIDEs. The method is built in a predictor corrector style which makes it linearly implicit, therefore, avoids solving nonlinear systems of equations at each time step in all regimes. The method is seen to maintain the stability and convergence for large jump sizes and high volatility in each regime. The impact of regime switching on option prices corresponding to different values interest rate, volatility, and rationality parameter is computed, illustrated by graphs and given in the tables. Convergence results in each regime are presented and time evolution graphs are given to show the effectiveness and reliability of the method.

Prof. Dilip Madan (dmadan@rhsmith.umd.edu)

Robert H. Smith School of Business, University of Maryland, USA

Pricing and Hedging Options on Assets with Options on Related Assets

The question addressed is the pricing of options on the CBOE Skew index. The option pricing theory developed partially hedges risk by taking positions in the market for options on a related asset. The option is then priced at the cost of this hedge. The theory is applied to pricing VIX options hedged by SPY options and pricing options on JPM hedged by XLF options. The approach is then applied to illustrate the pricing of CBOE Skew Index options with a hedge in the market for SPY options. The Skew Index smile is then seen to imply the VIX and SKEW of the Skew Index itself. The pricing of VIX options with SPY as the related asset has the Gaussian copula underpricing options while the t-copula significantly overprices them. The multivariate bilateral gamma models are closer to market. The premia of cross asset hedge prices over the market price are observed to fall with moneyness and maturity and rise with the level of the VIX.



Abstracts

Prof. Anatoliy Swishchuk (aswish@ucalgary.ca)
University of Calgary, Alberta, Canada

Merton Investment Problem for Hawkes Risk Model in Insurance

Merton optimal investment and consumption stochastic problem is one of the most studied classical problem in finance (see [1,2]). In this talk, we will show how to solve Merton optimal investment stochastic control problem for Hawkes risk model $R(t)$ in insurance. Namely, we will show how to find an optimal investment for the risk model $R(t)$ based on general compound Hawkes process (GCHP) (see [3,4]), when an investor decides to invest some capital $A(t)$ in risky assets (e.g., stocks) and the rest, $(R(t)-A(t))$ in risk-free assets (e.g., bonds or bank account).

Zuming Sun (zuming.sun@ucalgary.ca)
University of Calgary, Alberta, Canada

Polynomial Process and Polynomial Regression Model for French Electricity Prices

Empirical experience reveals that electricity prices can be affected by the dynamics of residual demand, power generation capacity of each commodity and spot prices of each generation technology. In my work, we present a model involving a polynomial map of polynomial processes, a so called PMPP model, for electricity spot prices. Each reasonable underlying factor in PMPP model is modeled by a suitable polynomial process, such as the Ornstein-Uhlenbeck process, or geometric Brownian motion. The polynomial map is determined by regression, revealing the relationship between the underlying factors and spot prices. The PMPP model provides the advantage of cheap and convenient computation for forward prices because of the property of polynomial processes that the conditional expectations of polynomial function of the future state of polynomial process conditional on current state are given by polynomials of the current state. My work focuses on the French electricity market. The optimal PMPP model is selected by statistical criteria, and maximum likelihood estimation and Kalman filter are applied for model calibration. The primary results indicate that PMPP model can capture the electricity prices well, when compared with the classic structural model, and could be useful for risk management purposes.



Abstracts

**Dr. Prabhat Mittal (p.mittal@satyawatie.du.ac.in)
Satyawati College Eve. University of Delhi, India**

Wavelet-based forecasting of Crude Oil Price with Denoising ARMA Model

The uncertainty caused by high volatile crude oil prices and the higher level of deregulations worldwide have significant effects on economic growth of a country. The recent oil price shocks in March 2020 have resulted in a crash in the financial markets of most of the developing countries. The predictive measure with the traditional approaches assumes that the time series are linear and stationary over the long run and fails to explain the accuracy requirement in the short horizons. This paper presents an efficient algorithm based on ARMA denoising and taking advantage of the wavelet transformation in a nonlinear ensemble framework. The wavelet denoising based algorithm is used to decompose and extract the complex underlying structures and can reduce distortions occurring in the time series. The results show a significant improvement in the performance than the conventional techniques.

**Dr. Babacar Seck (bseck@uob.edu.bh)
University of Bahrain, Bahrain**

Regime Switching Entropic Risk Measures on Crude Oil Pricing

This talk presents a new type of risk measures, namely regime switching entropic risk measures, and study their applicability through simulations. The state of the economy is incorporated into the entropic risk formulation by using a Markov chain. Closed formulae of the risk measure are obtained for futures on crude oil derivatives. The applicability of these new types of risk measures is based on the study of the risk aversion parameter and the convenience yield. The numerical results show a term structure and a mean-reverting behavior of the convenience yield.

