Programme and Abstracts Book

Stochastic Analysis, Financial and Insurance Mathematics (SAFIM) Workshop with School

20-24 August, 2018

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HUMBOLDT-UNIVERSITÄT ZU BERLIN

Contents

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- Olivier Menoukeu Pamen (Chair), AIMS Ghana; University of Liverpool

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- Olivier Menoukeu Pamen, AIMS Ghana, University of Liverpool
- Peter Imkeller, Humboldt University Berlin

3 Participants

3.1 Invited Lecturers

- Protter,Philip, Columbia University, U.S.A
- Rootzén,Holger, Chalmers University of Technology, Sweden

3.2 Invited Speakers

- Alfred Müller, University of Siegen, Germany
- Beatrice Acciaio, London School of Economics, United Kingdom
- Corina Constantinescu, University of Liverpool, United Kingdom
- Dirk Becherer, Humboldt University Berlin, Germany
- Ernst Eberlein, University of Feiburg, Germany
- Monique Jeanblanc, University of Evry, France
- Ralf Wunderlich , BTU Cottbus-Senftenberg , Germany
- Saïd Hamadene, University of Maine, U.S.A
- Youssef Ouknine, Univerisity of Cadi Ayyad Marrakech, Mohammed VI polytechnic University at BenGrir, Morroco

4 Other Participants

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- Aseidu Louis, University of Ghana, Ghana
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- Ampomah, Obu-Amoah, University of Ghana, Ghana
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- Dono, Franklin Xavier , Ghana Atomic Energy Commission, Ghana
- Edeki, Sunday Onus, Covenant University, Nigeria
- Effah Nyarko, Bernard , BTU–Cottbus/ AIMS Ghana, Germany/Ghana
- Fadina, Tolulope Rhoda, Univeristy of Freiburg, Germany
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- Koffi, Abekah Huk Cedric, AIMS Ghana, Ghana
- Konzou, Essomanda, University of Lome, Togo
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- Mahama, Ishaque, University for Development Studies, Ghana
- Mahamah, Dan, Orinoco River Limited, Ghana
- Mawah Bernard, Pentecost University College, Ghana
- Minkah Richard, University of Ghana, Ghana
- Nansubuga, Martha, Humboldt University of Berlin, Germany
- Ngnotchouye T., Jean Medard, University of KwaZulu-Natal, South Africa
- Nortey, Ezekiel Nii Noye, University of Ghana, Ghana
- Nunes dos Reis, Goncalo Jose, University of Edinburgh, United Kingdom
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- Ogbogbo, Chisara Peace, University of Ghana, Ghana

- Okoro, Joshua, Landmark University, Nigeria
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- Owusu-Ansah, Emmanuel de-Graft Johnson ,Kwame Nkrumah University of Science & Technology, Ghana
- Salifu, Adeshie, University for Development Studies, Ghana
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- Schnurr, Alexander, University of Seigen, Germany
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- Takam, Paul Honore, BTU–Cottbus, Germany
- Twum, Ralph, University of Ghana, Ghana
- Wiredo, Nana, Nelson Mandela University, Ghana

4.1 Daily Programme

Monday 20th August

- 08:30-9:00 Registration; Opening: **Olivier Menoukeu Pamen,** AIMS, Ghana, University of Liverpool; **Peter Imkeller,** Humboldt University; **Lucy Quist,** President, AIMS, Ghana.

1. **Session 1:** Chair **(P. Imkeller)**
    - 09:00-10:00 **P. Protter,** "Microlending"
    - 10:00-10:45 **M. Jeanblanc,** "Thin random times and Decomposition of random times"
    - 10:45-11:15 Coffee Break

2. **Session 2:** Chair **(B. Acciaio)**

   - 11:15-12:15 **P. Protter,** "Microlending"
   - 12:15-13:00 **R. Wunderlich,** "High-Frequency Expert Opinions and Power Utility Maximization in a Market with Gaussian Drift"
   - 13:00-14:00 Lunch Break

3. **Session 3:** Chair **(K. Doku-Amponsah,)**

   - 14:00-14:45 **A. Müller,** "Expectiles, Omega ratios and stochastic dominance"
   - 14:45-15:30 **Y. Ouknine** "The smallest g-supermartingale and reflected backward stochastic differential equation with L^2 obstacle"
   - 15:30-16:00 Coffee break

4. **Session 4:** Chair **(G. J. Nunes dos Reis)**

   - 16:00-16:30 **E. A. Sidahmed,** " Formulation and Method of Solution of The Optimal Stopping Problems"
   - 16:30-17:00 **S. O. Edeki,** " Solution Method for the Generalized Ivancevic Option Pricing Model with a Nonzero Adaptive Market Potential"
   - 17:00-17:30 **S. E. Fadugba,** "Integral Transform Method for the Solution of Partial Differential Equation for the Price of American Options"
   - 17:30-18:00 Discussions
   - 18:00-19:30 Diner

Tuesday 21st August

1. **Session 1:** Chair **(R. Wunderlich)**

   - 09:00-10:00 **P. Protter,** "Microlending"
   - 10:00-10:45 **B. Acciaio,** "Dynamic Cournot-Nash equilibrium via causal optimal transport"
   - 10:45-11:15 Coffee Break

2. **Session 2:** Chair **(C. Constantinescu-Loeffen)**

   - 11:15-12:15 **P. Protter,** "Microlending"
   - 12:15-13:00 **E. Kemajou-Brown,** "Risk-sensitive Optimal Control under Regime Switching: An application"
   - 13:00-14:00 Lunch Break

3. **Session 3:** Chair **(E. Kemajou-Brown)**

   - 14:00-14:45 **K. Doku-Amponsah,** " Large deviation for evolutionary processes in random networking with applications"
   - 14:45-15:30 **A. Schnurr,** "The Fourth Characteristic of a Semimartingale"
   - 15:30-16:00 Coffee break

4. **Session 4:** Chair **(E. N. N. Nortey)**

   - 16:00-16:30 **T. R. Fadina,** "Affine processes under parameter uncertainty"
   - 16:30-17:00 **E. Sönmez,** "E. Max-linear models on infinite DAGs generated by Bernoulli bond percolation"

- 17:00-17:30 **D. W. Kuissi Kamdem,** "Stochastic optimal control and applications to indifference pricing: a maximum principle approach"
- 17:30-18:00 Discussions
- 18:00-19:30 Diner

Wednesday 22nd August

1. **Session 1:** Chair **(M. Jeanblanc)**
   - 09:00-10:00 **H. Rootzen,** "Extreme value statistics for financial risk handling"
   - 10:00-10:45 **C. Constantinescu-Loeffen,** "Recent applications of insurance risk theory"
   - 10:45-11:15 Coffee Break
2. **Session 2:** Chair **(A. Müller)**
   - 11:15-12:15 **H. Rootzen,** "Extreme value statistics for financial risk handling"
   - 12:15-13:00 **J. Guo,** "Optimal investment and reinsurance strategies under mean-variance criterion"
   - 13:00-14:00 Lunch Break
   - 14:00-18:00 Free Afternoon
   - 18:00-19:30 Diner

Thursday 23rd August

1. **Session 1:** Chair **(O. Menoukeu Pamen)**

   - 09:00-10:00 **H. Rootzen,** "Extreme value statistics for financial risk handling"
   - 10:00-10:45 **D. Becherer,** "Stochastic control problems for markets with finite liquidity: Optimal trading strategies, super-hedging and modelling of transient price impact."
   - 10:45-11:15 Coffee Break

2. **Session 2:** Chair **(Y. Ouknine)**

   - 11:15-12:15 **P. Protter,** "Microlending"
   - 12:15-13:00 **E. Eberlein,** "Multiple curve interest rate modelling allowing for negative rates"
   - 13:00-14:00 Lunch Break

3. **Session 3:** Chair **(D. Becherer)**

   - 14:00-14:45 **S. Hamadene,** "Weak formulation of mean-field control and game problems"
   - 14:45-15:30 **G. dos Reis,** " Mean field and N-Agent games for optimal investment under relative performance concerns and forward-utilities"
   - 15:30-16:00 Coffee break

4. **Session 4:** Chair **(E. A. Sidahmed)**

   - 16:00-16:30 **V. N. Feunou,** "Stability of the utility maximization problem"

- 16:30-17:00 **O. A. Ampomah,** "Modelling the effect of the Bagre Dam on the water levels of the Akosombo Dam: Time Series Intervention Analysis"
- 17:00-17:30 **J. M. T. Ngnotchouye,** "Differential games with pure state constraints and applications"
- 17:30-18:00 Discussions
- 18:00-19:30 Diner

Friday 24th August

1. **Session 1:** Chair **(S. Hamadene)**

   - 09:00-10:00 **H. Rootzen,** "Extreme value statistics for financial risk handling"
   - 10:00-10:45 **R. M. M. Mabela,** "Estimation of an asset European option price in the fuzzy Black-Scholes model by Zadeh's extension principle"
   - 10:45-11:15 Coffee Break

2. **Session 2:** Chair **(T. R. Fadina)**

   - 11:15-12:15 **H. Rootzen,** "Extreme value statistics for financial risk handling"
   - 12:15-13:00 **E. N. N. Nortey,** "Extremal Analysis of Monthly Rainfall using Bayesian Estimation"
   - 13:00-13:15 Concluding Remarks
   - 13:15-14:15 Lunch Break
   - 14:15-18:00 Free Afternoon
   - 18:00-19:30 Diner

5 List of Abstracts

5.1 Mini Courses

Microlending

Protter, Philip
Columbia University, U.S.A

Abstract

Microlending got its start in Bangladesh originally, championed by Muhammad Yunus, via the Grameen Bank. Yunus was awarded the Nobel Peace Prize in 2006, in recognition of his extraordinary achievement in the promotion and proof of concept of Microlending.What we will discuss is how to model, using mathematics, the working of Microlending. In other types of finance, particularly stock market high finance, mathematics has led to major advances. Not much mathematics has been devoted to the analysis of Microlending, and there are perhaps several reasons: the theory to date is not martingale based, which is a beautiful theory amenable to high finance. The second is that not a lot of money is involved, and researchers typically like to follow the money, in choosing their objects of study. The two primary mathematical tools used to model Microlending are the theory of Markov chains and Markov processes, ands game theory. Our emphasis will be on the former, and we will explain the basics of the theory of Markov chains and Markov processes in the course. Some of the issues will be making sure the system works, so that the bank does not go bankrupt or lose enough money to be put into jeopardy. What is clever about the system Yunus has developed is that it gives a method to lend small amounts of money without having first to evaluate the credit risk of the borrowers. This is important in some regions of the world where a system of credit risk, highly developed in North America and Europe, is poorly developed or nonexistent among the poorer segments of the population, as was the case in Bangladesh.The loans typically are small and of short duration, and by repaying the loans as promised, the borrowers earn their credit rating, and obtain sequential financing. To make this idea precise, one needs mathematical models.We will also treat the cost effectiveness of the Grameen

Bank, the canonical example of microfinance.We will keep the mathematical level at a low level to make it accessible to the audience, but sophisticated enough to lend insight into how the entire system works. Mathematical models also give the benefit of making results quantifiable.

Extreme Value Statistics for Financial Risk

Rootzén, Holger
Chalmers University of Technology, Sweden

Abstract

Extreme value statistics helps protecting us from devastating waves, floods, and windstorms, and contributes to material science, bioinformatics, medicine, and traffic safety and is widely used for risk management in finance and insurance. Participants in this course will learn about established extreme value methods for risk handling, get an introduction to the hot research area of multidimensional extreme value theory, and an overview of existing program packages in the area. After the course you will be able to use the latest extreme value statistics technology to help handling risks in finance and insurance and you will have a starting point if you want to enter into the exciting extreme value statistics research area.The first part of the course will introduce the well-established and much used statistical theory for extremes of one-dimensional variables. Topics include the block maxima and peaks over thresholds methods; threshold choice; maximum likelihood methods; and model diagnostics. The second part will survey some of the intensive research in multivariate extreme value statistics which happens right now. Multivariate block maxima methods have so far seen the most development. However, in more than one dimension, block maxima hide information of whether extremes occur at the same time or not, and likelihoods often become unwieldy in dimensions higher than 3 or 4. Instead peaks over threshold methods keep track of whether extremes occur at the same time or not, and are often at the center of interest for finance. I will show how multivariate peaks over thresholds models based on the multivariate generalized Pareto distribution can be more useful for financial risk handling than currently available one-dimensional estimates. These

models, perhaps surprisingly, have simpler and tractable likelihoods, and permit use of the entire standard maximum likelihood machinery for estimation, testing, and model checking. The course will include many examples on how to use the methods in finance and insurance: risk estimation for wind storm insurance; computation of Value at Risk and Expected Shortfall in finance; portfolio risk estimation,etc. Finally, I will introduce some of the existing program packages which make Extreme Value Statistics practically useful, including extRemes, SpatialExtremes, WAFO, RandomFields, and some MATLAB routines. Throughout, an important issue is how estimated risk should be presented and understood.

5.2 Plenary Talks

Expectiles, Omega Ratios and Stochastic Dominance

Alfred Müller
University of Siegen, Germany

Abstract

In the theory of risk measures expectiles have recently found increasing interest as they are the only risk measures that are coherent and elicitable. Comparing expectiles is mathematically equivalent to comparing Omega ratios, which are a well known performance measure for the comparison of the performance of investment strategies. In this talk we explain these two concepts and investigate their relation and consistency with respect to stochastic dominance rules. In particular we introduce a new stochastic order based on expectiles that turns out to have some unexpected properties. We also give conditions under which expectiles and Omega ratios are consistent with classical first and second order stochastic dominance and with respect to the recently introduced fractional stochastic dominance between first and second order. The talk is based on joint work with Fabio Bellini and Bernhard Klar.

Dynamic Cournot-Nash Equilibrium via Causal Optimal Transport.

Beatrice Acciaio
London School of Economics, U.K

Abstract

We study Cournot-Nash equilibrium problems in a dynamic setting, where each agent faces a cost that is composed by an idiosyncratic part depending on its own type and action, and a mean-field term depending on the actions distribution over all agents. We use tools from dynamic optimal transportation of non-anticipative nature in order to get a characterization of the equilibrium problems, along with existence and uniqueness results. The talk is based on a joint project with Julio Backhoff-Veraguas.

Recent Applications of Insurance Risk Theory

Corina Constantinescu
University of Liverpool, U.K

Abstract

In this talk we will recall the classical insurance risk models and techniques to derive ruin probabilities. Consequently we will show how the models and the techniques could be applied in different contexts.

Multiple Curve Interest Rate Modelling Allowing for Negative Rates.

Ernst Eberlein
University of Feiburg, Germany

Abstract

The global financial crisis which started in early August 2007 had a lasting effect on financial markets. In particular the fixed income markets changed in a fundamental way. As a consequence of a new perception of risk a number of interest rates, which until then had been roughly equivalent, drifted apart. The basic rates, which are relevant for the interbank market, became tenor-dependent after market participants became aware of credit, liquidity and funding risks in this market segment. These risks had been assumed to be negligible before. In the new reality classical modelling approaches which are based on arbitrage considerations assuming tenor-independence cannot reflect the market behaviour any more. More sophisticated approaches, so-called multiple curve models, are needed to take the increased diversity of risks into account. We develop a multiple curve forward process as well as a multiple curve forward rate (HJM-type) model. In both approaches time-inhomogeneous Lévy processes are used as drivers. Negative interest rates are taken into account in a natural way. We derive valuation formulas for standard interest rate financial products such as caps, floors, swaptions and digital interest rate options. A number of calibration results is presented where we also consider data in the setting of a two price economy, thus exploiting explicitly bid and ask quotes. This project is joint work with Christoph Gerhart (Freiburg) and Zorana Grbac (Paris).

Stochastic Control Problems for Markets with Finite Liquidity: Optimal Trading Strategies, Super-hedging and Modelling of Transient Price Impact

Dirk Becherer
Humboldt University of Berlin , Germany

Abstract

I give a survey of recent results for stochastic optimal control in models of financial markets where liquidity is finite, so that trading has a multiplicative and transient impact on prices. This is in contrast to the classical friction-less classical Black-Scholes theory in mathematical finance, which assumes liquidity to be unlimited or traders being small (i.e. having no price impact). As time permits, we discuss transient intertemporal price impact, optimal liquidation and super-hedging strategies, stochastic liquidity and modelling questions. (Presentation is based on papers with Todor Bilarev and Peter Frentrup, preprints available on arXiv.)

Risk-Sensitive Optimal Control Under Regime Switching: An Application

Elisabeth Kemajou-Brown
Morgan State University, U.S.A

Abstract

In this talk, we present a general stochastic maximum principle for a risk-sensitive type optimal control problem of Markov regime-switching jump-diffusion model. We apply the results to study a risk-sensitive benchmarked asset management problem for Markov regime-switching models. We assume the stock is modelled by a Markov regime-switching diffusion process and that, the benchmark depends on the economic factor. Our aims is to find the portfolio strategy that minimizes the risk sensitivity of an investor in such environment.

Optimal Investment and Reinsurance Strategies under Mean-Variance Criterion

Junyi Guo
Nankai University, China

Abstract

In this talk, optimal control problems of reinsurance and investment with mean-variance objectives will be discussed. Different approaches to solve the optimality problems will be presented and optimal strategies are analyzed. Especially, BSDE method in solving the problem will be given.

Thin Random Times and Decomposition of Random Times

Anna Aksamit, Tahir Choulli, Monique Jeanblanc*
University of Evry, France

Abstract

In a first part, we present a particular class of random times, called thin time, i.e., random times with graph included in a countable union of graphs of stopping times in the reference filtration $\mathcal{F}$. In particular, we show that any $\mathcal{F}$ martingale is a semimartingale in the filtration $\mathcal{F}$ progressively enlarged with and we give its decomposition. In a second part,we show that any random time can be uniquely decomposed in two parts as $\tau = \tau_1 \wedge \tau_2$ where τ_1 avoids stopping times in the reference filtration $\mathcal{F}$, and τ_2 is thin, and $\tau_1 \vee \tau_2 = \infty$. This decomposition is based on a study of the dual optional projection of τ , as the decomposition of a stopping time into accessible and totally inaccessible is based on the dual predictable projection. We prove that any martingale in the reference filtration is a semimartingale in the progressive enlargement with τ if and only if the same property holds for the progressive enlargement with τ_1 and we give its semimartingale representation. We establish in that the immersion property holds for τ if and only if it holds for τ_1. We provide a general model of default time, extending the models of Jiao and Li (modelling sovereign

risks) and Gehmlich and Schmidt (dynamic defaultable term structure modelling beyond intensity paradigm).

High-Frequency Expert Opinions and Power Utility Maximization in a Market with Gaussian Drift

Ralf Wunderlich
BTU Cottbus-Senftenberg, Germany

Abstract

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.

Weak Formulation of Mean-field Control and Game problems

Saïd Hamadene
University of Maine, U.S.A

Abstract

We deal with the weak formulation of the mean-field control problem and the mean-field zero-sum differential game as well. We show existence of an optimal control and a saddle-point for respectively the control problem and zero-sum differential game associated with payoff functionals of mean-field type, under dynamics driven by weak solutions of stochastic differential equations of meanfield type.

The Smallest g–Supermartingale and Reflected Backward Stochastic Differential Equation with L^2–Obstacle

Youssef Ouknine
Univerisity of Cadi Ayyad Marrakech, Morocco

Abstract

In his seminal work, Peng and Xu [1] studied RBSDE with irregular L^2– obstacle, by giving a generalized formulation of Skorohod reflecting condition. Our purpose in this paper is to relax this condition by solving the problem in the same way as for RBSDE with Lipschitz driver and an appropriate optional Barrier that is right upper semicontinuous [2]. We give the link between the Snell envelope and the Dirichlet envelope for a irregular payoff process. We also prove how the solution of the RBSDE with optional barrier that is upper right semicontinuous derived in [2] can be constructed by a penalization method. This is a joint work with Fares Alazemi and Siham Bouhadou.

Keywords: Reflected BSDE, strong Snell envelope, penalization method.

[1] S. Peng and M. Y. Xu, The smallest g-supermartingale and reflected BSDE with single and double L2-obstacles, Probabilits et Statistiques, 41, 605-630 (2005).

[2] Grigorova, M., Imkeller, P., Offen, E., Ouknine, Y., Quenez, M.-C. (2016): Reflected BSDEs when the obstacle is not right-continuous and optimal stopping, the Annals of Applied Probability, 27(5), 3153-3188.

5.3 Other Talks

The Fourth Characteristic of a Semimartinale

Schnurr, Alexander
University of Seigen, Germany

Abstract

We extend the class of semimartingales in a natural way. This allows us to incorporate processes having paths that leave the state space. By carefully distinguishing between two killing states, we are able to introduce a fourth semimartingale characteristic which generalizes the fourth part of the Levy quadruple. Since three characteristics have become canonical over the years, we motivate the fourth characteristic also by considering Feller processes. Analyzing their generator, we find anatural fourth component which does not have an analogue in the theory of semimartingales yet. Our fourth characterstic completes a classical picture and allows to incorporate affine process (with killing) and non-conservative solutions to martingale problems in the semimartingale framework. Using the probabilistic symbol, we analyze the close relationship between the generators of certain Markov processes with killing and their (now four) semimartingale characteristics.

Formulation and Method of Solution of the Optimal Stopping Problems

Sidahmed, Entisar Alrasheed
University of Bahri, Sudan

Abstract

The theory of optimal stopping usually concerned with the problem that choosing a specific time to take a particular action, these types of problems known as optimal stopping problems. The optimal stopping problems have different and many applications in stochastic analysis, control theory and finance. Usually the financial applications of the optimal stopping problem are used to maximize the expected reward function or minimize an expected cost over all stopping times. This talk concerned with the formulation and method of solution of the optimal stopping problem for continuous time stochastic differential equations and for the stochastic differential equations with jump component.

Extremal Analysis of Monthly Rainfall using Bayesian Estimation

Kingsley Kwakye, Ezekiel N. N. Nortey* & Christian A. Hesse
University of Ghana, Ghana

Abstract

The recent catastrophes associated with the increased flood incidents in Ghana is a clear indication that the short-term (24-hour) weather forecast and the general seasonal rainfall forecast for the entire country in March is either too late or lack detail to pre-empt damages. Most of the hydro meteorological researches in Ghana are concentrated on the generation structure, pattern, periodicity and seasonality of the rainfall data without paying much attention to a very important aspect of the data which is normally considered outliers and sometimes removed from further analysis. Considering the uncertainties about what level of rainfall (low or high) causes disaster and also when

to expect disasters, the study has analysed the high extreme rainfall data in Ghana using the Generalized Pareto Distribution (GPD) with Bayesian estimation. The increasing number of Bayesian researches in recent times and their successful accounts in estimation does not lie in the assumption that Bayesian researches always yield satisfactory results but in the appropriateness of prior information used before data sampling. Due to absence of expert knowledge on the shape and scale parameters in this case, two truly non-informative priors: Jeffreys and Maximal Data Information (MDI) priors were considered for the study. In all the rainfall stations the MDI prior performed better than the Jeffreys prior except for Sefwi-Bekwai synoptic site where both priors performed equally with $pa = 0.49$. We state conclusively from our Peak Over Threshold (POT) extremal analysis that, for each synoptic station in Ghana, it is possible to observe monthly rainfalls above the observed maximum monthly rainfall as provided by the data in the study. We therefore recommend that economic activities that require the construction of reservoirs such as hydroelectric electric power generation and farming activities should make provision for possible higher amounts of rainfall to ensure all-year production.

Keywords: Extremal Analysis, Bayesian estimation, Extremal Type Theorem (ETT), Generalised Pareto Distribution, Jeffreys Prior, Maximal Data Information Prior (MDI), Ratio of Uniforms (RoU).

Differential Games with Pure State Constraints and Applications

Ngnotchouye, Jean Medard
University of KwaZulu-Natal, South Africa

Abstract

This talk deals with the theory and applications of differential games with pure state constraints. An N-Players Differential game is a problem which consist of optimising the cost functional of each player subject to the dynamics of the game given by a control ordinary differential equations. We consider the case where the state of the game satisfies some additional algebraic equations called state constraints. We prove under some conditions a result on the existence of an open loop Nash equilibrium for such differential games and we present two applications in resource extraction and in advertising. We present also some numerical simulations supporting the analytical results.

Large Deviations for Evolutionary Processes of Random Networks with Application

Doku-Amponsah, Kwabena
University of Ghana Ghana

Abstract

In this paper we present the Multi-type Dynamic Random Network (MDRN). For the MDRN we define, from the empirical group measure, empirical cooperative measure and the empirical locality measure, process level measures. To be specific, we define fir the MDRN, the empirical type process, empirical co-operate process and empirical locality process. We also define an empirical locality flow and empirical locality current as functions of the empirical locality process. For this class of empirical processes, we discuss some large deviation principles . Some applications will be discussed in fields as Statistical Mechanics, Game Theory and Information Science.

Mean field and N-Agent games for optimal investment under relative performance concerns and forward-utilities

Dos Reis,Goncalo
University of Edinburgh, UK

Abstract

We report on recent progress in the analysis of a family of portfolio management problems under relative performance criteria and the forward utility paradigm, for fund managers having CARA utilities and trading in a common time horizon in log-normal markets. We construct explicit equilibrium strategies (contingent on solving the forward utility equation) for both the finite population games and the corresponding mean field games. We discuss issues related to indifference pricing.

Solution Method for the Generalized Ivancevic Option Pricing Model with a Nonzero Adaptive Market Potential

Edeki, Sunday Onus
Covenant University, Nigeria

Abstract

Option pricing has been a core theme in financial mathematics. The Ivancevic option pricing model (IOPM) is a nonlinear adaptive-wave alternative for the classical Black-Scholes option pricing model, representing a controlled Brownian motion in an adaptive setting relating to nonlinear Schrodinger equation. Despite the applicability and usefulness of the IOPM, analytical solutions of such model are barely found in literature. Therefore, this paper obtains analytical solutions of the generalized IOPM in terms of time-fractional calculus by means of a proposed semi-analytical method known as projected differential transform method (PDTM). Cases of nonzero adaptive market potential are considered. The proposed method is proven to be

direct, and effective as the obtained solutions tend rapidly to their exact forms.

Keywords: Option pricing, Ivancevic pricing model, nonlinear Black-Scholes model, option pricing, PDTM

Estimation of an Asset European Option Price

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Abstract

In this paper, we address the problem of pricing the assets in the fuzzy Black-Scholes model. Using Zadeh Extension Principle, we derive the membership function of the European call and put prices by fuzzifying the interest rate, the volatility and the theoretical value of the stock price.

Keywords : European Option, Fuzzy Black-Scholes Model, Zadehs Extension Principle.

Max–linear Models on Infinite DAGs Generated by Bernoulli Bond Percolation

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Abstract

We extend finite-dimensional max-linear models to models on infinite graphs, and investigate their relations to classical percolation theory, more precisely to nearest neighbor bond percolation. We focus on the plane square lattice Z^2 with edges to the nearest neighbours, where we direct all edges in a natural way (to the right or up) resulting in a directed acyclic graph (DAG) on Z^2. On this infinite DAG a random sub-DAG may be constructed by choosing vertices and edges between them at random. In a Bernoulli bond percolation DAG edges are independently declared open with probability $p \in (0, 1)$ and closed

otherwise. The random DAG consists then of the vertices and the open directed edges. We find for the subcritical case where $p \leq 1/2$ that two random variables of the max-linear model become independent with probability 1, whenever their distance tends to infinity. In contrast, for the supercritical case where $p > 1/2$ two random variables are dependent with positive probability, even when their node distance tends to infinity. We also consider changes in the dependence properties of random variables on a sub-DAG H of a finite or infinite graph on Z^2, when enlarging this subgraph. The method of enlargement consists of adding nodes and edges of Bernoulli percolation clusters. Here we start with X_i and X_j independent in H, and answer the question, whether they can become dependent in the enlarged graph. We evaluate critical probabilities such that X_i and X_j become dependent in the enlarged graph with positive probability or with probability 1. We find in particular that for every DAG H with finite number of nodes, in the enlarged graph, X_i and X_j always remain independent with positive probability. On the other hand, if H has nodes Z^2 and percolates everywhere; i.e. every connected component of H is infinite, then X_i and X_j become dependent with probability 1 in the enlarged graph.

Integral Transform Method for the Solution of Partial Differential Equation for the Price of American Basket Options

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Abstract

Many problems in financial mathematics entail the computation of a particular integral. In many cases, these integrals can be solved analytically and in some cases, they can be solved using numerical integration. In this paper the valuation of American basket option using the integral transform method namely, the Mellin transform method was presented. The Mellin transform method enables option equations to be solved directly in terms of market prices rather than log-prices,

providing a more natural setting to the problem of pricing. The integral representations for the price and the free boundary of American option on a basket of multi-stocks by means of the multidimensional Mellin transform method were derived. The valuation formula for the price of American option on a basket of two stocks was also obtained. It is assumed that the assets are driven by a geometric Wiener process which exhibit correlation and pay a continuous dividend yield.

Affine Processes under Parameter Uncertainty

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Abstract

We develop a one-dimensional notion of affine processes under parameter uncertainty, which we call non-linear affine processes. To be more precise, given a set Θ of parameters, we construct a corresponding non-linear expectation on the path space of continuous processes. By a general dynamic programming principle we link this non-linear expecation to a variational form of the Kolmogorov equation, where the generator of a single affine process is replaced by the supremum over all corresponding generators of affine processes with parameters in Θ. This non-linear affine process yields a tractable model for Knightian uncertainty, especially formodelling interest rate under ambiguity. As an application, we develop, a nonlinear version of the Itô-formula. This is a joint work with Ariel Neufeld (ETH Zrich)and Thorsten Scdmidt (University of Freiburg.

Stability of the Utility Maximization Problem

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Abstract

We consider the utility maximization problem in the framework of continuous market models for the stock price process and for utility functions defined on the positive real line. Under a mild BMO assumption on the market price of risk, we present stability results for the optimal wealth process and optimal trading strategy w.r.t. misspecification in the risk preference and initial capital. This talk is based on a joint work with Peter Imkeller.

Modelling the Effect of the Bagre Dam on the Water Levels of the Akosombo Dam: Time Series Intervention Analysis

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Abstract

The water level at a particular time determines the amount of hydro electrical energy generated by the Akosombo dam. The Akosombo dam serves as the main source of electrical energy in Ghana. This research work sought to estimate and assess the impact of the Bagre Dam as an intervention event on the Akosombo Dam. Daily water level data covering the period 1982 to 2002 which was obtained from the Volta River Authority (V.R.A), Ghana was used in carrying out this study. Empirical results from the study indicated that the pre intervention period of the data could be best modelled with a SARIMA$(1,1,0)\times(0,0,1)_{12}$ process. Further analysis shows that the residuals of the pre-intervention model follows a white noise process. The impact of the intervention event was estimated to be 0.5052 with a corresponding long term effect of 0.63142. The decay parameter was estimated to be 0.1999. However, both the impact parameter and

decay parameter were found not to be statistically significant. We recommend that the Volta River Authority must construct a reservoir to be able to store the excess water spillage from the Bagre Dam for the production of electricity by the Akosombo.

On Stochastic Optimal Control and Applications in Indifference Pricing: Maximum Principle

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Abstract

Problems of optimal consumption–investment appear in many applications in the financial and insurance industry. In the academic world, this is seen as a problem of optimization of the expected value of a functional of both the instantaneous consumption and/or the terminal wealth. In mathematical finance, the utility is such a functional.Here, we studied a consumption–investment problem for an agent with recursive utility. As an application, we consider an indifference pricing' problem. That is find a price at which an agent would have the same expected utility level by exercising a financial transaction as by not doing so. We used maximum principle and forward–backward stochastic differential equation to solve this problem.