University of Michigan
Department of Mathematics

Seminar & Events Bulletin: Financial/Actuarial Mathematics

08-01-2012 to 08-31-2013

Thursday, September 06, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Xiang Yu (UM) *Utility Maximization with Addictive Consumption Habit Formation in Incomplete Markets* -- 1360 East Hall

Thursday, September 13, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Sergey Nadtochiy (UM) *WEAK REFLECTION PRINCIPLE FOR DIFFUSIONS, WITH APPLICATIONS IN FINANCE AND PHYSICS* -- 1360 East Hall

Thursday, October 04, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Jenny Young (UM) *Life Insurance Purchasing to Reach a Bequest* -- 1360 East Hall

Thursday, October 11, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Kazutoshi Yamazaki (Osaka University) *Optimal Stopping for Spectrally Negative Levy Processes and Applications in Finance* -- 1360 East Hall

Thursday, October 18, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Peter Carr (Courant Institute and Morgan Stanley) *Risk, Return, and Ross Recovery* -- 1360 East Hall

Thursday, October 25, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Ramon van Handel (Princeton University) *Can one construct nonlinear conditional expectations?* -- 4096 East Hall

Thursday, November 01, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Jean-Pierre Fouque (UCSB) *Portfolio Optimization and Stochastic Volatility Asymptotics* -- 1360 East Hall

Thursday, November 15, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Konstantinos Spiliopoulos (Boston University) *Recent results on systemic risk in large financial networks* -- 1360 East Hall

Monday, December 10, 2012	
12:00pm-2:00pm	**Financial/Actuarial Mathematics** -- Zhou Zhou (UM) *Proposal Defense: On controller-stopper problems with jumps and its application to pricing American options* -- 2265 North Quad

Tuesday, December 11, 2012	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Patrick Cheridito (Princeton University) *Equilibrium pricing in incomplete markets under translation invariant preferences* -- 1360 East Hall

Seminar & Events Bulletin: Financial/Actuarial Mathematics

08-01-2012 to 08-31-2013

Thursday, January 10, 2013	
2:30pm-7:00pm	**Financial/Actuarial Mathematics** -- Ross Kravitz (UM) *Thesis Defense: Problems in Optimal Stopping and Control* -- 1360 East Hall

Friday, February 22, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Pierre Patie (Cornell University) *Fluctuation theory for completely asymmetric Markov processes* -- 1360 East Hall

Thursday, February 28, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Darinka Dentcheva (Stevens Institute of Technology) *Risk-averse optimization via stochastic order constraints* -- 1360 East Hall

Tuesday, March 12, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Steve Shreve (Carnegie Mellon University) *Diffusion scaling of a limit-order book model* -- 1360 East Hall

Thursday, March 21, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Igor Cialenco (Department of Applied Mathematics, Illinois Institute of Technology) *Dynamic Conic Finance* -- 1360 East Hall

Thursday, March 28, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Mykhaylo Shkolnikov (UC Berkeley) *Asymmetrically colliding Brownian particles in stochastic portfolio theory and beyond* -- 1360 East Hall

Thursday, April 04, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Jin Ma (USC) *Pathwise Stochastic Taylor Expansion and Forward Path-Dependent PDEs* -- 1360 East Hall

Thursday, April 11, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Thaleia Zariphopoulou (Oxford University and UT Austin.) *Postponed to Fall* -- 1360 East Hall

Tuesday, April 16, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Umut Cetin (London School of Economics) *Explicit construction of a dynamic Bessel bridge of dimension 3* -- 1096 East Hall

Thursday, April 18, 2013	
2:50pm-4:00pm	**Financial/Actuarial Mathematics** -- Umut Cetin (London School of Economics) *Risk aversion of market makers and asymmetric information* -- 1360 East Hall

Tuesday, April 23, 2013	
3:00pm-4:00pm	**Financial/Actuarial Mathematics** -- Sebastian Jaimungal (University of Toronto) *Robust Market Making* -- 1360 East Hall

Seminar & Events Bulletin: Financial/Actuarial Mathematics

08-01-2012 to 08-31-2013

Tuesday, April 30, 2013	
1:30am-3:30am	**Financial/Actuarial Mathematics** -- Yu-Jui Huang (UM) *Thesis Defense: Topics in Stochastic Control with Applications to Finance* -- 1096 East Hall

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08-01-2012 to 08-31-2013

Abstracts

Financial/Actuarial Mathematics
Thursday, September 06, 2012, 3:00pm-4:00pm
1360 East Hall
Xiang Yu (UM)
Utility Maximization with Addictive Consumption Habit Formation in Incomplete Markets

In this talk, we study the problem of continuous time expected utility maximization of consumption together with addictive habit formation in general incomplete semimartingale markets. Introducing the set of auxiliary state processes and the modified dual space, we embed our original problem into an abstract time-separable utility maximization problem with a shadow random endowment on the product space. We establish existence and uniqueness of the optimal solution using convex duality by defining the primal value function as depending on two variables, i.e., the initial wealth and the initial standard of living. We also provide market independent sufficient conditions both on the stochastic discounting processes and on the utility function for the well-posedness of our original optimization problem. Under the same assumptions, we can carefully modify the classical proofs in the approach of convex duality analysis when the auxiliary dual process is not necessarily integrable.

Financial/Actuarial Mathematics
Thursday, September 13, 2012, 3:00pm-4:00pm
1360 East Hall
Sergey Nadtochiy (UM)
WEAK REFLECTION PRINCIPLE FOR DIFFUSIONS, WITH APPLICATIONS IN FINANCE AND PHYSICS

See the attached

Financial/Actuarial Mathematics
Thursday, October 04, 2012, 3:00pm-4:00pm
1360 East Hall
Jenny Young (UM)
Life Insurance Purchasing to Reach a Bequest

We determine how an individual can use life insurance to meet a bequest goal. We assume that the individual's consumption is met by an income, such as a pension, life annuity, or Social Security. Then, we consider the wealth that the individual wants to devote towards heirs (separate from any wealth related to the afore-mentioned income) and find the optimal strategy for buying life insurance to maximize the probability of reaching a given bequest goal.

Joint work with Erhan Bayraktar.

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Financial/Actuarial Mathematics
Thursday, October 11, 2012, 3:00pm-4:00pm
1360 East Hall
Kazutoshi Yamazaki (Osaka University)
Optimal Stopping for Spectrally Negative Levy Processes and Applications in Finance

We consider a class of infinite-time horizon optimal stopping problems for spectrally negative Levy processes. Focusing on strategies of threshold type, we write explicit expressions for the corresponding expected payoffs via the scale function. We obtain and show the equivalence of the continuous/smooth fit condition and the first-order condition for maximization over threshold levels. Extensions to multiple-stopping and applications in Leland's endogenous default model are also discussed.

Financial/Actuarial Mathematics
Thursday, October 18, 2012, 3:00pm-4:00pm
1360 East Hall
Peter Carr (Courant Institute and Morgan Stanley)
Risk, Return, and Ross Recovery

The risk return relation is a staple of modern finance. When risk is measured by volatility, it is well known that option prices convey risk. In a parametric Markovian setting, risk-neutral transition probabilities can also be determined from option prices. Recently, Ross has shown that real-world transition probabilities of a Markovian state variable can be recovered from its risk-neutral transition probabilities along with a restriction on preferences. In this paper, we show how to recover real-world transition probabilities in a diffusion context in a preference-free manner. Our approach is instead based on restricting the form and dynamics of the numeraire portfolio. (Joint work with Jiming Yu.)

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Financial/Actuarial Mathematics
Thursday, October 25, 2012, 3:00pm-4:00pm
4096 East Hall
Ramon van Handel (Princeton University)
Can one construct nonlinear conditional expectations?

The theory of nonlinear expectations, particularly the G-expectations of S. Peng, has been popular in recent years. Partially inspired by risk measures and by stochastic control problems, a nonlinear expectation can be viewed as the worst-case expectation of a random variable under model uncertainty. One of the most basic problems that arise in this setting is the definition of nonlinear conditional expectations. Even in the simplest interesting case---martingales with volatility uncertainty---previous constructions can only define conditional expectations for (quasi)continuous random variables, which is hardly satisfactory both conceptually and in practice. The aim of this talk is to show how one can construct nonlinear conditional expectations for Borel random variables. While the construction is very simple, such conditional expectations are in general no longer Borel, but only universally measurable. Unfortunately, it is fundamentally impossible to construct conditional nonlinear expectations for universally measurable random variables, as will be illustrated by an unpleasant counterexample. Therefore, "nonlinear probability theory" is destined to remain much more limited than its linear counterpart that we all know and love. (Joint work with M. Nutz)

Financial/Actuarial Mathematics
Thursday, November 01, 2012, 3:00pm-4:00pm
1360 East Hall
Jean-Pierre Fouque (UCSB)
Portfolio Optimization and Stochastic Volatility Asymptotics

We study the Merton problem of portfolio optimization over a finite horizon when volatility is stochastic and fluctuating on different time scales. We develop a perturbation method for the associated nonlinear PDE and we show how to relate market data implied volatility skews to optimal strategies.

Joint work in progress with Ronnie Sircar and Thaleia Zariphopoulou.

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Financial/Actuarial Mathematics
Thursday, November 15, 2012, 3:00pm-4:00pm
1360 East Hall
Konstantinos Spiliopoulos (Boston University)
Recent results on systemic risk in large financial networks

The past several years have made clear the need to better understand the behavior of risk in large interconnected financial networks. Interconnections often make a system robust, but they can act as conduits for risk. In this talk, I will present recent results on modeling the dynamics of correlated default events in the financial market. An empirically motivated system of interacting point processes is introduced and we study how different types of risk, like contagion and exposure to systematic risk, compete and interact in large-scale systems. A law of large numbers for the loss from default is proven and used for approximating the distribution of the loss from default in large, potentially heterogeneous portfolios. Fluctuation analysis and conditional Gaussian approximations are used to improve the approximations. Numerical results illustrate the accuracy of the approximation. The results give insights into how different sources of default correlation interact to generate typical and atypical portfolio losses.

Financial/Actuarial Mathematics
Monday, December 10, 2012, 12:00pm-2:00pm
2265 North Quad
Zhou Zhou (UM)
Proposal Defense: On controller-stopper problems with jumps and its application to pricing American options

We consider controller-stopper problems in which the controlled processes can have jumps. The global filtration is represented by the Brownian filtration, enlarged by the filtration generated by the jump process. We assume that the Brownian motion and jump process are independent, and there exists a probability density function for the jump times and marks. Under these assumptions, we decompose the global controller-stopper problem into controller-stopper problems with respect to the Brownian filtration, which are determined by a backward induction. We apply our decomposition method to indifference pricing of American options under multiple default risk. The backward induction leads to a system of reflected backward stochastic differential equations (RBSDEs). We show there exists a solution to this RBSDE system and the solution provides a characterization of the value function.

Joint work with Erhan Bayraktar.

Financial/Actuarial Mathematics
Tuesday, December 11, 2012, 3:00pm-4:00pm
1360 East Hall
Patrick Cheridito (Princeton University)
Equilibrium pricing in incomplete markets under translation invariant preferences

We propose a general discrete-time framework for deriving equilibrium prices of financial securities. It allows for heterogeneous agents, unspanned random endowments and convex trading constraints. We give a dual characterization of equilibria and provide general results on their existence and uniqueness. In the special case where all agents have preferences of the same type, and in equilibrium, all random endowments are replicable by trading in the financial market, we show that a one-fund theorem holds and give an explicit expression for the equilibrium pricing kernel. If the underlying noise is generated by nitely many Bernoulli random walks, the equilibrium dynamics can be described by a system of coupled backward stochastic di fference equations, which in the continuous-time limit becomes a multidimensional backward stochastic di fferential equation. If the market is complete in equilibrium, the system of equations decouples, but if not, one needs to keep track of the prices and continuation values of all agents to solve it. Joint work with Ulrich Horst, Michael Kupper and Traian Pirvu.

Paper is available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1755610

Financial/Actuarial Mathematics
Thursday, January 10, 2013, 2:30pm-7:00pm
1360 East Hall
Ross Kravitz (UM)
Thesis Defense: Problems in Optimal Stopping and Control

I will describe the three problems that I studied in my thesis, and discuss two of them in some detail. The first problem comes from mathematical finance, and involves the stability of exponential utility maximization with respect to market perturbations. We use the theory of BMO martingales to obtain conditions under which stability is guaranteed. The second problem comes from mathematical statistics, and is a extension of the classical sequential analysis problem of verifying a statistical hypothesis with a minimum number of observations. We consider an infinite sequence of Brownian Motions which have drift equal to zero or one, which may only be observed one at a time. If our goal is to find a B.M. with drift one, how should we observe the channels, and at what confidence threshold should we stop observation?

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Financial/Actuarial Mathematics
Friday, February 22, 2013, 3:00pm-4:00pm
1360 East Hall
Pierre Patie (Cornell University)
Fluctuation theory for completely asymmetric Markov processes

We study the class of completely asymmetric standard processes living on an interval of the real line, that is for strong Markov processes having jumps only in one direction. This class of processes, which are a natural generalization of one dimensional-diffusions, arises naturally in risk theory. It also encompasses many interesting instances such as branching processes with immigration, spectrally negative LÃ©vy processesâ€¦ Under mild conditions, we present two original methodologies for characterizing the Laplace transform of their first exit times from an interval. We also discuss several potential theoretic properties and provide an expression of their resolvent densities. Finally, we illustrate our techniques by easily recovering the well-known fluctuation identities of spectrally negative LÃ©vy processes. The talk is based on joint work with Vincent Vigon (IRMA, Strasbourg, France)

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Financial/Actuarial Mathematics
Thursday, February 28, 2013, 3:00pm-4:00pm
1360 East Hall
Darinka Dentcheva (Stevens Institute of Technology)
Risk-averse optimization via stochastic order constraints

Stochastic orders formalize preferences among random outcomes and are widely used in statistics and economics. We focus on stochastic optimization problems involving stochastic order relations as constraints. These constraints relate performance functionals, depending on our decisions to benchmark random outcomes shaping the risk according to the distribution of the benchmark. 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. We prove that Lagrange multipliers associated with two different formulations of these constraints can be identified with utility functions, or with rank-dependent utility functions. Furthermore, we demonstrate that mean-risk models with law invariant coherent risk measures appear as Lagrangian relaxations of the problem with stochastic dominance constraints. The optimization models with stochastic order constraints provide a link between various approaches for risk-averse optimization.

The results contribute to the theory of composite optimization in vector spaces because the stochastic order relations are defined by a continuum of compositions of convex non-smooth functions with possibly non-convex smooth functions.

Implications for portfolio optimization will be discussed.

Financial/Actuarial Mathematics
Tuesday, March 12, 2013, 3:00pm-4:00pm
1360 East Hall
Steve Shreve (Carnegie Mellon University)
Diffusion scaling of a limit-order book model

With the movement of trading away from the trading floor onto electronic exchanges - and the accompanying rise in the volume of order submission - has come an increase in the need for tractable mathematical models of the whole limit order book. The problem is inherently high-dimensional and the most natural description of the dynamics of the order flows has them depend on the state of the book in a discontinuous way. We examine a popular discrete model from the literature and describe its limit under a diffusion scaling inspired by queueing theory. Interesting features include a process which is either "frozen" or diffusing according to whether another diffusion is positive or negative. This is joint work with Christopher Almost and John Lehoczky.

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Financial/Actuarial Mathematics
Thursday, March 21, 2013, 3:00pm-4:00pm
1360 East Hall
Igor Cialenco (Department of Applied Mathematics, Illinois Institute of Technology)
Dynamic Conic Finance

We develop a framework for narrowing the theoretical spread between ask prices and bid prices of derivative securities in models of discrete time markets with transaction costs using dynamic coherent acceptability indices studied in Bielecki, Cialenco, and Zhang (2010). Aside from the use of acceptability indices as a tool, our approach is very much rooted in the literature studying good deal bounds as a vehicle to narrow the no-arbitrage interval. We first formulate and prove a no-good-deal version of the fundamental theorem of asset pricing (FTAP) using a family of dynamic coherent risk measures. The obtained results generalize to dynamic market model set-up the version of FTAP proved in Cherny and Madan (2010) in the static conic finance framework. We use the market model setup suitable for dividend-paying securities in markets with transaction costs. Finally, we discuss some applications of this theory to path dependent options and compute the good-deal ask and bid prices generated by dynamic gain-loss ratio (a particular dynamic acceptability index).

Financial/Actuarial Mathematics
Thursday, March 28, 2013, 3:00pm-4:00pm
1360 East Hall
Mykhaylo Shkolnikov (UC Berkeley)
Asymmetrically colliding Brownian particles in stochastic portfolio theory and beyond

We will discuss systems of Brownian particles on the real line, which interact by splitting the local times of collisions among themselves in an asymmetric manner. These can be identified with the collections of ordered processes in a Brownian particle system, in which the drift coefficients, the diffusion coefficients, and the collision local times for the individual particles are assigned according to their ranks. Such processes can be viewed as generalizations of those arising in first-order models for equity markets in the context of stochastic portfolio theory, and are able to correct for several shortcomings of such models while being equally amenable to computations. We also show that, in addition to being of interest in their own right, such systems of Brownian particles arise as universal scaling limits of systems of jump processes on the integer lattice with local interactions. In particular, this result extends the convergence of TASEP to its continuous analogue.

This is joint work with Ioannis Karatzas and Soumik Pal.

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Financial/Actuarial Mathematics
Thursday, April 04, 2013, 3:00pm-4:00pm
1360 East Hall
Jin Ma (USC)
Pathwise Stochastic Taylor Expansion and Forward Path-Dependent PDEs

In this talk we first revisit the notion of pathwise stochastic Taylor ex- pansion, and prove a new result that extends our previous works to a more general setting, in terms of the newly developed notion of path-derivative initiated by Dupire. We will then show how this new form of pathwise Tay- lor expansion could lead to a notion of stochastic viscosity solution for a class of fully nonlinear SPDEs and the corresponding Path-dependent PDEs (PPDEs), without having to invoke the stochastic characteristics for the lo- calization. We will discuss the issues of consistency, stability, and comparison principles for the stochastic viscosity solutions. In the semilinear case, we show that the PPDE, whence the SPDE, is well-posed in our new framework.

This is a joint work with Rainer Buckdahn and Jianfeng Zhang.

Financial/Actuarial Mathematics
Thursday, April 11, 2013, 3:00pm-4:00pm
1360 East Hall
Thaleia Zariphopoulou (Oxford University and UT Austin.)
Postponed to Fall

Seminar & Events Bulletin: Financial/Actuarial Mathematics

08-01-2012 to 08-31-2013

Financial/Actuarial Mathematics
Tuesday, April 16, 2013, 3:00pm-4:00pm
1096 East Hall
Umut Cetin (London School of Economics)
Explicit construction of a dynamic Bessel bridge of dimension 3

Given a deterministically time-changed Brownian motion Z starting from 1, whose time-change V(t) satisfies V(t) > t for all t > 0, we perform an explicit construction of a process X, adapted to the filtration generated by Z and another independent Brownian motion, which is a Brownian motion in its own filtration and hits zero for the first time at V(T), where T := inf{t>0: Z_t =0}. Our construction relies on a combination of enlargement of filtration and filtering techniques. The resulting process X may be viewed as the analogue of a 3-dimensional Bessel bridge starting from 1 at time 0 and ending at 0 at the random time V(T). We call this a dynamic

Bessel bridge since V(T) is not known in advance. Our study is motivated by insider trading models with default risk, where the insider observes the firm's value continuously on time.

This is a joint work with L. Campi and A. Danilova.

Financial/Actuarial Mathematics
Thursday, April 18, 2013, 2:50pm-4:00pm
1360 East Hall
Umut Cetin (London School of Economics)
Risk aversion of market makers and asymmetric information

We analyse the equilibrium impact of market makers' risk aversion on the equilibrium in a speculative market consisting of a risk neutral informed trader and noise traders. The unwillingness of market makers to bear risk causes the informed trader to absorb large shocks in their inventories. The informed trader's optimal strategy is to drive the market price to its fundamental value while disguising her trades as the ones of an uninformed strategic trader. This results in a mean reverting demand, price reversal, and systematic changes in the market depth. We also find that an increase in risk aversion leads to lower market depth, less efficient prices, stronger price reversal and slower convergence to fundamental value. The endogenous value of private information, however, is non-monotonic in risk aversion.
Based on a joint work with A. Danilova.

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08-01-2012 to 08-31-2013

Financial/Actuarial Mathematics
Tuesday, April 23, 2013, 3:00pm-4:00pm
1360 East Hall
Sebastian Jaimungal (University of Toronto)
Robust Market Making

An agent who wishes to make markets by posting limit buy and sell orders is faced with modelling the arrival rate and volume of marker orders which hit/lift their posted orders. No model can capture the true behaviour of the marketâ€™s data generating process (DGP), hence, simplifying assumptions are often made. A natural question then arises: â€œhow can the agent account for the fact that they know their model is inaccurate?â€• i.e., how can uncertainty in the Knightian sense be addressed? In this talk, I formulate the question through a robust optimal control problem in which the agent is ambiguity averse to Poisson random measures. Specifically, the agent considers a reference measure (representing the simplified model) and all equivalent measures (representing candidate models) and penalizes them according to a quasi relative entropy. Surprisingly, the robust control problem can be reduced to solving a coupled non-linear system of ODEs, which in certain limiting cases can be solved exactly. The optimal postings show that the agent protects themselves from ambiguity in distinct ways depending from where the ambiguity stems. Interestingly, in some cases, the agent behaves as if they have perfect knowledge of the DGP but apply CARA utility; however, in general the ambiguity averse agent cannot be recast as a risk-averse one. Numerical experiments will illustrate several interesting economic insights into the problem.

This is joint work with Ã•lvaro Cartea (University College London) and Ryan Donnelly (University of Toronto)

Financial/Actuarial Mathematics
Tuesday, April 30, 2013, 1:30am-3:30am
1096 East Hall
Yu-Jui Huang (UM)
Thesis Defense: Topics in Stochastic Control with Applications to Finance

This thesis is devoted to PDE characterization for stochastic control problems when the classical methodology of dynamic programming does not work. Under the framework of viscosity solutions, a dynamic programming principle (DPP) serves as the tool to associate a (nonlinear) PDE to a stochastic control problem. Unfortunately, a DPP is in general difficult to prove, and may fail to be true in some cases. In this thesis, we investigate three different scenarios where classical dynamic programming does not work. The first one is quantile hedging in the presence of arbitrage, the second one is robust growth-optimal trading, and the third one is a stochastic differential game of control and stopping. In each of the cases, we propose methods to circumvent the lack of a classical DPP.