Università degli Studi di Padova

Conference

Frontiers in Stochastic Modelling for Finance

Book of Abstracts

Padua/Venice, Italy · 02–05 February 2016

Contents

1 Program

Tuesday, 02 February 2016

Venue: Palazzo Bo, room: Archivio Antico, Via 8 febbraio 1848, Padua

09:00–09:15	Registration
09:15–09:30	Opening
09:30–10:20	**N. Touzi** Stochastic control of path-dependent systems, application to the Principal-Agent problem
11:30–11:50	**M. Pontier** Infinite horizon impulse control problem with jumps using RBSDEs
10:50–11:30	Coffee break
11:30–12:00	**C. Zhou** Stochastic control for a class of nonlinear kernels and applications
12:00–12:30	**C. Labart** Simulation of BSDEs with jumps by Wiener chaos expansion
12:30–13:00	**S. Song** Construction of multi-default-time models
13:00–14:20	Lunch break
14:20–14:50	**M. Jeanblanc** Joint hitting-time densities for finite state Markov processes
14:50–15:20	**C. Sgarra** Optimal investment in markets with over and under-reaction to information
15:20–15:50	**N. Brunel** Sloppy differential equations can be estimated with optimal control
15:50–16:30	Coffee break
16:30–17:00	**C. Mancini** Truncated realized covariance when prices have infinite variation jumps
17:00–17:30	**M. Mougeot** Forecasting the French electrical consumption using sparse models and aggregation
17:30–18:00	**C. Alasseur** A structural model for electricity spot and forward for coupled markets

Wednesday, 03 February 2016

Venue: Torre Archimede, room: 1A150 (first floor), Via Trieste 63, Padua

09:00–09:50	**D. Filipović** Linear-rational term structure models
09:50–10:20	**J. Schoenmakers** Uniform approximation of the Cox-Ingersoll-Ross process
10:20–10:50	**C. Cuchiero** Affine multiple yield curve models
10:50–11:30	Coffee break
11:30–12:00	**Y. Jiao** Alpha-CIR model in sovereign interest rate modelling
12:00–12:30	**B. Øksendal** Insider games with asymmetric information
12:30–13:00	**C. Blanchet-Scalliet** Controlling the occupation time of a geometric martingale
13:00–14:20	Lunch break
14:20–14:50	**B. Bouchard** Perfect hedging of covered options under market impact
14:20–14:50	**A. Gloter** Study of the the pathwise weak error in the Euler approximation of the geometric Brownian motion
15:20– 15:50	**J. Lelong** Pricing american option using martingale bases
15:50–16:20	**A. Pascucci** The Taylor formula of implied volatility
16:20–17:00	Coffee break
17:00–17:30	**C. Ceci** The Föllmer-Schweizer decomposition under partial information and application to local risk-minimization
17:30–18:00	**A. Roch** Bubbles in discrete time
18:00–18:30	**C. Fontana** A new martingale representation result for initially enlarged filtrations

20:30	Conference dinner at “Caffé Pedrocchi”

Thursday, 04 February 2016

Venue: Torre Archimede, room: 1A150 (first floor), Via Trieste 63, Padua

09:00–09:50	**M. Zervos** Dynamic contracting under moral hazard
09:50–10:20	**C. Hillairet** Optimal contract with moral hazard in public private partnerships
10:20–10:50	**S. Villeneuve** Optimal exit under moral hazard
10:50–11:30	Coffee break
11:30–12:00	**H. Pham** Bellman equation and viscosity solutions for mean-field stochastic control problem
12:00–12:30	**L. Campi** Change of numeraire and martingale optimal transport
12:30–13:00	**M. Mnif** Path dependent optimal stopping
13:00–14:20	Lunch break
14:20–14:50	**S. Pulido** The Jacobi stochastic volatility model
14:50–15:20	**S. Tappe** The HJMM equation with real-world forward rate dynamics: existence and positivity
15:20–15:50	**D. Skovmand** Rational multi-curve models with counterparty- risk valuation adjustments
15:50–16:20	**A. Papapantoleon** Multivariate shortfall risk allocation and systemic risk
16:20–17:00	Coffee break
17:00–17:30	**J.-F. Chassagneux** Quantile hedging price of Bermudan options
17:30–18:00	**I. Kharroubi** Numerical approximation of HJB equations via BSDEs constrained
18:00–18:30	**T. Lim** Pricing of variable annuities in an incomplete market

Friday, 05 February 2016

Venue: Istituto Veneto di Scienze, Lettere ed Arti, Campo S. Stefano 2945, Venice

10:00–10:30	**S. Kou** EM algorithm and stochastic control
10:30–11:00	Coffee break
11:00–11:30	**M. Rutkowski** A BSDE approach to fair bilateral pricing under endogenous collateralization
11:30–12:00	**A. Capponi** Systemic risk: the dynamics under central clearing
12:00–12:30	**A. Sulem** Generalized Dynkin games and game options in imperfect financial markets
12:30–13:30	Lunch break
13:30–14:00	**M. Rosenbaum** Asymptotic lower bounds for optimal tracking: a linear programming Approach
14:00–14:30	**E. Barucci** Flow fund and asset allocation
14:30–15:00	**A. Alfonsi** Optimal execution in a Hawkes price model
15:00–15:15	Closing of the conference

2 Abstracts

Clémence Alasseur (EDF R&D – FIME, France)

A structural model for electricity spot and forward for coupled markets

A major trend on European electricity markets is integration. On November 2010, market coupling is launched on day-ahead market on zone CWE (Central West Europe) which gathers five countries (France, Germany, Netherlands, Belgium and Luxembourg). And lately, in 2014, market coupling has been extended to a much larger zone which represents around 75% of European demand. In 2013, during 15 % of time, spot price was unique on CWE region which means that no congestion occurred at interconnections and that market price was determined as if the five countries were only one. In 2014, market prices were the same in France and Germany around 50 % of time. As such, modeling electricity prices on a single country without considering market coupling prevents from fitting some key characteristics of the realized price signals. Price models are extensively used for risk management purpose to evaluate portfolio positions, value and risk indicators. To produce accurate indicators, price models must be coherent between the spot and the forward. As such, forward is often represented as the expectation of future spot prices and can always be estimated through Monte-Carlo methods. But, in order to use models in an operational context, this solution based on Monte-Carlo is not satisfactory because of implied computation effort. Efficient electricity price models for risk management must then be coherent between spot and forward and also present explicit formula for both prices.. We propose a new structural model for electricity spot and forward: the case of coupled markets on two zones with several fuels. We choose a structural approach in which enables to represent some key characteristics of spot prices. Our model has the particularity to consider two market zones and the limited interconnection linking the two. Explicit formulas are also available for forward prices which enable easy computation for both spot and forward prices. We give some illustrative results of spot and forward behavior and of transmission rights pricing.

Aurélien Alfonsi (Ecole Nationale des Ponts et Chaussées, France)

Optimal execution in a Hawkes price model

We study a linear price impact model including other liquidity takers, whose flow of orders follows a Hawkes process. The optimal execution problem is solved explicitly in this context, and the closed-formula optimal strategy describes in particular how one should react to the orders of other traders. This result enables us to discuss the viability of the market. Last, we will present a way to calibrate this model to market data and backtest the optimal execution strategy.

Emilio Barucci (Politecnico di Milano, Italy)

Flow fund and asset allocation

The effect of fund inflow/outflow on asset management is a hot research topic. In a path breaking contribution, Basak et al. (2008) showed that inflows/outflows related to the performance of the fund with respect to that of a benchmark generate risk shifting incentives in a finite range. This result contrasts with the one obtained by Carpenter (2000) considering an option like remuneration scheme which generates excess risk only in case of a poor performance. We model follow funds as a function of the ratio between the fund performance and that of the benchmark in a complete market environment over a finite horizon as in Chen and Pennacchi (2009). We consider several type of incentive scheme (option like, collar type), we derive the closed form solution for the optimal portfolio and we show that the result obtained in Basak et al. (2008) is not robust, we are more aligned with Carpenter (2000). Their analysis is probably affected by the kink in the payoff. We provide empirical evidence on mutual funds performance.

Christophette Blanchet-Scalliet (Ecole Centrale de Lyon, France)

Controlling the occupation time of a geometric martingale

We consider the problem of maximizing the expected amount of time a geometric Brownian martingale spends above a constant threshold up to a finite time horizon. We assume that at every time, the volatility of the martingale can be chosen to take any value between σ_1 and σ_2, where $0 < \sigma_1 < \sigma_2$.

It is plausible that the optimal control is of bang-bang type and consists in choosing the minimal volatility σ_1 when the process is above the threshold (winning region), and to choose the maximal volatility σ_2 when the process is below the threshold (loosing region). Intuitive explanation... The aim of the paper is to quantify the expected time the optimally controlled martingale spends above the threshold. To this end we compute the Laplace transform of the expected occupation time above the threshold, as function of time.

Bruno Bouchard (CEREMADE, Université Paris-Dauphine, France)

Perfect hedging of covered options under market impact

Within a financial model with linear price impact, we study the problem of hedging a covered European option under a gamma constraint. Using stochastic target and partial differential equation smoothing techniques, we prove that the super-replication price is the viscosity solution of a fully non-linear parabolic equation. When it admits a smooth solution, perfect hedging is feasible. In any case, we show how almost optimal strategies can be explicitly constructed.

Nicolas Brunel (ENSIIE - Université d'Evry Val D'Essonne, France)

Sloppy differential equations can be estimated with optimal control

Sloppy models are statistical models that have numerous number of parameters, that usually depends on them nonlinearly and implicitely. With the advent of computer models based on mechanical modeling for the description and simulation of complex systems (engineering, biology,...), some of these parameters are unknown but need to be estimated, while representing "things that are here". Differential Equations are typical examples where

sloppiness arises. Indeed, it is common that some paramaters influence weakly the trajectories generated for some regions of the state space. As a consequence, the inverse problem of parameter estimation becomes ill-posed, as the Fisher Information can be become degenerated. The parameters are hard to estimate accurately by standard technics (say by Maximum Likelihood), and moreover they become sensitive to model misspecification.

We focus on the case of Ordinary Differential Equations and we define an M-estimator based on a perturbed model. The parameter estimation becomes then the identification of the parameter that needs the smallest perturbation in the model in order to fit the data. Interestingly, this estimation problem can be turned into a deterministic optimal control problem that can be solved efficiently. We show that the corresponding criterion is smooth enough, so that we can derive root-n consistency and asymptotic normality. We discuss this approach for differently sloppy models, as in well and mis-specified cases.

Luciano Campi (London School of Economics, Great Britain)

Change of numeraire and martingale optimal transport

In this paper we apply change of numeraire techniques to the optimal transport approach for computing model-free prices of derivatives in a two periods model. In particular, we consider the optimal transport plan constructed in Hobson and Klimmek (2013) as well as the right and left monotone transference plans introduced in Beiglboeck and Juillet (2013) and further studied in Henri-Labordére and Touzi (2013). We show that, in the case of positive martingales a suitable change of numeraire applied to Hobson and Klimmek (2013) exchanges forward start straddles of type I and type II, so that the optimal coupling in the sub-hedging problems is the same for both types of options. Moreover, we also show that the right monotone transference plan can be viewed as a mirror coupling of its left counterpart under the change of numeraire. An application to stochastic volatility models is also provided. This is a joint paper with Ismail Laachir and Claude Martini.

Agostino Capponi (Columbia University, United States of America)

Systemic risk: the dynamics under central clearing

We develop a tractable model to resemble asset value processes of financial institutions, trading with the central clearinghouse for risk mitigating purposes. Each institution allocates assets between his loan book and trade account. The volatility of the traded portfolio depends both on his and the aggregate amount of trading capital. We show that there exists a unique equilibrium allocation profile when institutions adjust positions with the clearinghouse to perfectly hedge risk stemming from their loan books. We then analyze the dynamic equilibrium path. This shows a buildup of systemic risk, manifested through the increase of market concentration.

Claudia Ceci (Università degli Studi di Chieti-Pescara, Italy)

The Föllmer-Schweizer decomposition under partial information and application to local risk-minimization

The aim is to derive and characterize the Föllmer–Schweizer decomposition of a square integrable random variable with respect to a given semimartingale under restricted information. This is an orthogonal decomposition having a relevant application in finance. Indeed, in the complete information framework, under suitable assumptions, the integrand with respect

to the given semimartingale in the decomposition of the square integrable random variable representing the discounted payoff of a given European type contingent claim, provides its locally risk-minimizing hedging strategy in the incomplete financial market driven by the underlying semimartingale. In a partial information setting, where agents have a limitative knowledge on the market, the Föllmer–Schweizer decomposition under restricted information plays an analogous role. We discuss both the cases where the random variable is observable, i.e. it is adapted to the available information level and where it is not observable. Moreover, for partially observable Markovian models, we characterize the integrand of theFöllmer–Schweizer decomposition by means of a filtering approach. The case of unobservable random variable also requires to investigate the relationship between theFöllmer–Schweizer decomposition under partial observation of the given random variable and that of its projection with respect to the information flow at time T.

The talk is based on the following papers:

- C.Ceci–K.Colaneri–A.Cretarola: *Local risk-minimization under restricted information on asset prices* http://arxiv.org/abs/1312.4385 Electronic Journal of Probability, 20, 2015, no. 96, 1-30. ISSN: 1083-6489 DOI: 10.1214/EJP.v20-3204

- C.Ceci–K.Colaneri–A.Cretarola: *The Föllmer–Schweizer decomposition under restricted information and financial applications*, in progress.

Jean-François Chassagneux (Université Paris Diderot, France)

Quantile hedging price of Bermudan options

In a markovian framework, we study the quantile hedging price of bermudan options, in a linear and semilinear setting. We characterise it as the solution to a cascade of non-linear PDEs for which we prove a comparison theorem. In the linear setting, we obtain a dual representation for the quantile hedging price. I will also discuss the question of the numerical approximation of this quantile hedging price. This talk is based on joint works with Bruno Bouchard and Geraldine Bouveret.

Christa Cuchiero (Universität Wien, Austria)

Affine multiple yield curve models

We propose a flexible and tractable specification based on affine processes to model multiple yield curves. More precisely, we model the OIS short rate and logarithmic multiplicative spreads between LIBOR rates and simply compounded OIS rates as affine functions of a common affine process. This approach thus constitutes a natural extension of classical affine short rate models, which allows for the possibility of ordered spreads (with respect to the tenor's length) and tractable pricing formulas also in the multi-curve setting. In order to exactly fit the initial term structure of OIS bonds and spreads, we also provide a deterministic shift extension. Finally, we show how our approach is related to other multi-curve models based on affine processes.

The talk is based on joint work with Claudio Fontana and Alessandro Gnoatto.

Damir Filipović (Ecole Polytechnique Fédérale de Lausanne and Swiss Finance Institute, Switzerland)

Linear-rational term structure models

We introduce the class of linear-rational term structure models, where the state price density is modeled such that bond prices become linear-rational functions of the current state. This class is highly tractable with several distinct advantages: i) ensures nonnegative interest rates, ii) easily accommodates unspanned factors affecting volatility and risk premiums, and iii) admits semi-analytical solutions to swaptions. A parsimonious model specification within the linear-rational class has a very good fit to both interest rate swaps and swaptions since 1997 and captures many features of term structure, volatility, and risk premium dynamics—including when interest rates are close to the zero lower bound.

Claudio Fontana (Université Paris Diderot, France)

A new martingale representation result for initially enlarged filtrations

We provide a general account of the martingale representation property in filtrations initially enlarged with a random variable L. We prove that the martingale representation property can always be transferred to the enlarged filtration as long as the classical density hypothesis of Jacod (1985) holds. This generalizes the existing martingale representation results and does not rely on the equivalence between the conditional and the unconditional law of L. The results are illustrated in the context of hedging contingent claims under insider information.

Arnaud Gloter (Université d'Evry Val d'Essonne, France)

Study of the the pathwise weak error in the Euler approximation of the geometric Brownian motion

It is well known that the strong error approximation, in the space of continuous paths equipped with the supremum norm, between a diffusion process, with smooth coefficients, and its Euler approximation with step $1/n$ is $O(n^{-1/2})$ and that the weak error estimation between the marginal laws, at the terminal time T, is $O(n^{-1})$. An analysis of the weak trajectorial error has been developed by Alfonsi, Jourdain and Kohatsu-Higa, through the study of the $p-$Wasserstein distance between the two processes. For a one-dimensional diffusion, they obtained an intermediate rate for the pathwise Wasserstein distance of order $n^{-2/3+\varepsilon}$. Using the Komlós, Major and Tusnády construction, we improve this bound in the case of the geometric Brownian motion and we obtain a rate of order $\log n/n$.

Caroline Hillairet (ENSAE ParisTech, France)

Optimal contract with moral hazard in public private partnerships

Public-Private Partnership (PPP) is a contract between a public entity and a consortium, in which the public outsources the construction and the maintenance of an equipment (hospital, university, prison...). One drawback of this contract is that the public may not be able to observe the effort of the consortium but only its impact on the social welfare of the project. We aim to characterize the optimal contract for a PPP in this setting of asymmetric information between the two parties. This leads to a principal-agent problem with moral hazard. Considering a wider set of information for the public and using martingale arguments in the spirit of Sannikov, the maximisation problem can be reduced to a classic stochastic

control problem, that is solved numerically. It is then proved that for the optimal contract, the effort of the consortium is explicitly characterized. In particular, it is shown that the optimal rent is not a linear function of the effort, contrary to some models of the economic literature on PPP contracts.
This is a joint work with I. Hajjej, M. Mnif and M. Pontier.

Monique Jeanblanc (Université d'Evry Val d'Essonne, France)

Joint hitting-time densities for finite state Markov processes

For a finite state Markov process and a finite collection $\{\Gamma_k, k \in K\}$ of subsets of its state space, let τ_k be the first time the process visits the set Γ_k. We derive explicit/recursive formulas for the joint density and tail probabilities of the family of stopping times $\{\tau_k, k \in K\}$. In particular, we provide a general solution to the problem that was studied (Assaf et. al., Multivariate phase-type distributions, Operations Research 32 (1984), no. 3, 688-702) in the context of multivariate phase-type distributions. We give a numerical example and indicate the relevance of our results to credit risk modeling. Joint work with with T. Bielecki and D.Sezer

Ying Jiao (ISFA, Université Claude-Bernard Lyon 1, France)

alpha-CIR model in sovereign interest rate modelling

Motivated by the current sovereign risk environment where a global low interest rate trend and a local high variation co-exist, we propose an interest model, which is based on the alpha-stable processes and generalizes the classical CIR model. We apply the model to interest rate derivatives and analyze the role of the supplementary parameter alpha. This is a joint work with Chunhua Ma (Nankai University) and Simone Scotti (Paris Diderot University).

Idris Kharroubi (Université Paris Dauphine, France)

Numerical approximation of HJB equations via BSDEs constrained

We propose a new probabilistic numerical scheme for fully nonlinear equation of Hamilton-Jacobi-Bellman (HJB) type associated to stochastic control problem, which is based on the Feynman-Kac recent representation by means of control randomization and backward stochastic differential equation with nonpositive jumps. We study a discrete time approximation for the minimal solution to this class of BSDE when the time step goes to zero, which provides both an approximation for the value function and for an optimal control in feedback form. We obtain a convergence rate without any ellipticity condition on the controlled diffusion coefficient.

Steve Kou (National University of Singapore, Singapore)

EM algorithm and stochastic control

We propose a Monte Carlo simulation based approach, called the dynamic EM algorithm, to solve stochastic control problems. In the special case of just searching for an optimal parameter, the algorithm simply becomes the classical Expectation-Maximization (EM) algorithm in statistics. The new algorithm extends the existing literature as follows: (1) We

do not assume any particular dynamics of the stochastic processes such as diffusion or jump diffusions. (2) We show the monotonicity of performance improvement in every iteration, which leads to the convergence results. (3) We focus on finite-time horizon problems, where the optimal policy is not necessarily stationary. Various applications are given, such as real business cycle, stochastic growth, and airline network revenue management. This is a joint work with Paul Glasserman, Xianhua Peng, and Xingbo Xu.

Céline Labart (Université Savoie Mont-Blanc, France)

Simulation of BSDEs with jumps by Wiener chaos expansion

We present an algorithm to solve BSDEs with jumps based on Wiener Chaos Expansion and Picard's iterations. This paper extends the results given in Briand-Labart (2014) to the case of BSDEs with jumps. We get a forward scheme where the conditional expectations are easily computed thanks to chaos decomposition formulas. Concerning the error, we derive explicit bounds with respect to the number of chaos, the discretization time step and the number of Monte Carlo simulations. We also present numerical experiments.

Jérôme Lelong (Université de Grenoble Alpes, France)

Pricing american option using martingale bases

In this work, we propose an algorithm to price American options by directly solving the dual minimization problem introduced by Rogers. Our approach relies on approximating the set of uniformly integrable martingales by a finite dimensional Wiener chaos expansion. In high dimensional problems, we advise not to use this dual price directly but instead to use the approximation of the martingale part of the Snell envelope computed in the dual problem as a control variate in a policy iteration approach. To enable a more direct and efficient use of parallel programming, we replace the traditional regression step by a decomposition on an orthogonal family of martingales.

Thomas Lim (ENSIIE-Université d'Evry Val D'Essonne, France)

Pricing of variable annuities in an incomplete market

We study the valuation of variable annuities for an insurer. We concentrate on two types of these contracts, namely guaranteed minimum death benefits and guaranteed minimum living benefits that allow the insured to withdraw money from the associated account. Here, the price of variable annuities corresponds to a fee, fixed at the beginning of the contract, that is continuously taken from the associated account. We use a utility indifference approach to determine the indifference fee rate.

Cecilia Mancini (Università degli Studi di Firenze, Italy)

Truncated realized covariance when prices have infinite variation jumps

The speed of convergence of the Truncated Realized Covariance (TRC) to the Integrated Covariation between the Brownian parts of two semimartingales is heavily influenced by the presence of infinite activity jumps with infinite variation (iV), through both the degree of dependence and the jump activity indices of the two small jumps processes. To show this, marginal stable-like small jumps with a parametric dependence structure are considered.

The estimator is efficient in only some cases of iV jumps.

The result of this paper is relevant in financial economics, since by the TRC it is possible to separately estimate the common jumps among two assets, which has important implications in risk management and contagion modeling.

Mohamed Mnif (Ecole Nationale d'Ingénieurs de Tunis, Tunisia)

Path dependent optimal stopping

In this talk, we are interested in the optimal stopping problem for path dependent options. We characterize the value function as the unique viscosity solution for the associated path dependent variational inequality. We also focus on the convergence of a probabilistic numerical scheme. We show that it satisfies monotonicity stability and consistency properties.

Mathilde Mougeot (Université Paris Diderot, France)

Forecasting the French electrical consumption using sparse models and aggregation

Managing and developing the electricity transport network is essential to provide quality electricity on a continuous basis to all consumers.

We investigate here sparse functional regression models to forecast electricity consumption. The consumption time series is analyzed through intra-day load curves of 24 hours sampled each 30mn. Using a non parametric model, we first show that each curve can be approximated by a sparse linear combination of functions of a dictionary composed of both specific well elaborated endogenous functions and exogenous functions provided by weather conditions [1, 2].

The forecasting strategy begins with an information retrieval task. Several sparse prediction models are provided by different 'experts'. Each expert computes a model based on a dedicated strategy for choosing the most accurate selection of dictionary variables and estimation of the linear combination. The final forecast is computed using an aggregation of these different forecasters, with exponential weights [3].

We elaborate and test this method in the setting of predicting the national French intra day load curves, over a period of time of 7 years on a large data basis, including daily French electrical consumptions as well as many meteorological inputs, calendar statements and functional dictionaries. The results on the national French intra day load curve strongly show the benefits of using a sparse functional model to forecast the electricity consumption.

References

[1] M. Mougeot, D. Picard, and K. Tribouley, "Learning out of leaders", J. R. Stat. Soc. Ser. B Stat. Methodol., 2012.

[2] M. Mougeot, D. Picard, K. Tribouley, V. Lefieux, and L. Teyssier-Maillard "Sparse approximation and fit of intraday load curves in a high dimensional framework Advances in Adaptive Data Analysis, 5, 2013.

[3] M. Mougeot, D. Picard, V. Lefieux, and L. Teyssier-Maillard "Forecasting intra day load curves using sparse functional regression in Lecture Notes in Statistics, Springer, Modeling and Stochatic Learning for Forecasting in High Dimension, in press.

Bernt Øksendal (Universitetet i Oslo, Norway)

Insider games with asymmetric information

We study stochastic differential games of jump diffusions, where the players have access to inside information. Our approach is based on anticipative stochastic calculus, white noise, Hida-Malliavin calculus, forward integrals and the Donsker delta functional. We obtain a characterization of Nash equilibria of such games in terms of the corresponding Hamiltonians. This is used to study applications to insider games in finance, specifically optimal insider consumption and optimal insider portfolio under model uncertainty.
Based on joint works with Olfa Draouil, University of Tunis El Manar.

Antonis Papapantoleon (Technische Universität Berlin, Germany)

Multivariate shortfall risk allocation and systemic risk

The ongoing concern about systemic risk since the outburst of the global financial crisis has highlighted the need for risk measures at the level of sets of interconnected financial components, such as portfolios, institutions or members of clearing houses. The two main issues in systemic risk measurement are the computation of an overall reserve level and its allocation to the different components according to their systemic relevance. We develop a pragmatic approach to systemic risk measurement and allocation based on multivariate shortfall risk measures, where acceptable allocations are first computed and then aggregated so as to minimize costs. We analyze the sensitivity of the risk allocations to various factors and highlight its relevance as an indicator of systemic risk. Moreover, we provide and test various numerical schemes to assess the risk allocation in high dimensions. This talk is based on joint work with Yannick Armenti, Stephane Crepey and Samuel Drapeau.

Andrea Pascucci (Università degli Studi di Bologna, Italy)

The Taylor formula of implied volatility

In a Markovian market model driven by a generic d-dimensional diffusion, we study the behavior, near expiry and ATM, of the sensitivities of the implied volatility surface with respect to log-strike and maturity. In particular, we recover explicit limits of the derivatives of the implied volatility in a parabolic region, close to ATM. Such limits yield the explicit Taylor formula for the implied volatility. The analysis is carried out under the weak assumption that the generator of the diffusion is locally elliptic, in order to include most of the models of interest in mathematical finance.

Huyên Pham (Université Paris Diderot, France)

Bellman equation and viscosity solutions for mean-field stochastic control problem

We consider the stochastic optimal control problem of McKean-Vlasov stochastic differential equation. By using feedback controls, we reformulate the problem into a deterministic control

problem with solely the marginal distribution as controlled state variable, and prove that dynamic programming principle holds in its general form. Then, by relying on the notion of differentiability with respect to probability measures recently introduced by P.L. Lions, and a special Itô formula for stochastic flows of probability measures, we derive the (dynamic programming) Bellman equation for mean-field stochastic control problem. This Bellman equation reduces to the classical finite dimensional partial differential equation in the case of no mean-field interaction. We prove a verification theorem in our McKean-Vlasov framework, and give explicit solutions to the Bellman equation for the linear quadratic mean-field control problem, with applications to the mean-variance portfolio selection and a systemic risk model. Finally, we introduce a notion of viscosity solutions for the Bellman equation in the space of probability measures, and show the viscosity property of the value function to the McKean-Vlasov control problem.

Monique Pontier (Institut Mathématique de Toulouse, France)

Infinite horizon impulse control problem with jumps using RBSDEs

We establish existence results for adapted solutions of infinite horizon doubly reflected backward stochastic differential equations with jumps. We apply these results to get the existence of an optimal impulse control strategy for an infinite horizon impulse control problem. The properties of the Snell envelope reduce our problem to the existence of a pair of right continuous left limited processes. Finally, we give some numerical results.

Sergio Pulido Nino (ENSIIE - Université d'Evry Val d'Essonne, France)

The Jacobi stochastic volatility model

We introduce a novel stochastic volatility model, where the squared volatility could be bounded and follows a Jacobi process. This model comprises the Heston model as a limiting case. The price of a European call option admits a closed form series representation. This representation involves the moments of the log price of the asset, which are given in terms of a linear ordinary differential equation. We demonstrate that the numerical computations are robust and perform particularly well. In addition, we present theoretical bounds for the error in the price approximation. The proposed pricing method has important implications as it could be applied to a wide range of European type claims. This is joint work with Damien Ackerer and Damir Filipovic.

Alexandre Roch (Université du Québec à Montréal, Canada)

Bubbles in discrete time

Recent papers have highlighted the relation between local martingales and bubbles. However, it is well known that in discrete time, local martingales are true martingales so there cannot exist bubbles. In this work, I define the notion of asymptotic markets and extend the theory of bubbles in discrete markets in a way which is consistent with the definition in continuous time. I prove an asset pricing and superreplication theorem, I show how to compute the size of bubbles, and determine the presence of bubbles in a number of discrete models.

Mathieu Rosenbaum (Université Marie et Pierre Curie, France)

Asymptotic lower bounds for optimal tracking: a linear programming approach

We consider the problem of tracking a target whose dynamics is modeled by a continuous Ito semi-martingale. The aim is to minimize both deviation from the target and tracking efforts. We 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. A comprehensive list of examples with explicit expressions for the lower bounds is provided.

Marek Rutkowski (The University of Sydney, Australia)

A BSDE approach to fair bilateral pricing under endogenous collateralization

Nie and Rutkowski (2014) examined fair bilateral pricing in models with funding costs and an exogenously given collateral. The main goal of this work is to extend their results to the case of an endogenous margin account, that is, the collateral that may depend on the contract's value for the hedger and/or the counterparty. Comparison theorems for BSDEs from Nie and Rutkowski (2014) are used to derive the bounds for unilateral prices and to study the range for fair bilateral prices in a general semimartingale model. For the case of the negotiated collateral, the backward stochastic viability property introduced by Buckdahn et al. (2000) is employed to examine the bounds for fair bilateral prices of European claims in a diffusion-type model.

As a by-product, we generalize also in several respects the option pricing results from Bergman (1995), Mercurio (2013) and Piterbarg (2010). First, we consider general collateralized contracts with a stream of cash flows, rather only than path-independent European claims. Second, we examine not only the case where the collateral is set by one party, but also the case of a collateral negotiated between the counterparties. Third, we study not only the Bergman model with differing lending and borrowing cash rates, but also a trading model with idiosyncratic funding costs for risky assets, dubbed the model with partial netting.

John Schoenmakers (Weierstrass-Institut für Angewandte Analysis und Stochastik, Germany)

Uniform approximation of the Cox-Ingersoll-Ross process

We present two recently developed methods for uniform approximation of the trajectories of the Cox-Ingersoll-Ross (CIR) process. The first method is based on the Doss-Sussmann formalism. By simulating first-passage times of the increments of a Wiener process to the boundary of an interval and solving an ODE, we uniformly approximate the trajectories of the CIR process. The second approach is based on solving Sturm-Liouville problems related to certain initial-boundary value problems. At a sequence of random times the approximate trajectories will be even exact. In between, the approximations will be uniformly close to the exact trajectory.

From a conceptual point of view the proposed method gives a better quality of approximation in a path-wise sense than standard, or even exact simulation of the CIR dynamics at some deterministic time grid.

Carlo Sgarra (Politecnico di Milano, Italy)

Optimal investment in markets with over and under-reaction to information

In this paper we introduce a new jump-diffusion model for stock prices, which takes into account over and under-reaction of the market to incoming news. The jumps' impact on the assets dynamics is twofold: on one hand we use a Poisson process as a driver to obtain discontinuous trajectories and on the other hand the presence of jumps in the drift, via a shot noise process, allows to incorporate "fade-away" effects, meaning that the effects of these abrupt changes fade away as time goes by. Our model is a partial information one: the drift direction after a jump is not accessible to standard investors immediately after the jump. We focus on a maximization of expected utility from terminal wealth problem, providing, in a logarithmic utility setting, the optimal investment strategy in explicit form, both under full (i.e., from the insider point of view) and under partial information (i.e., from the standard investor viewpoint). We test our results on real market data relative to Enron and Ahold. The three main contributions of this paper are: the introduction of a new market model dealing with over and under-reaction to news, the explicit computation of the optimal filter dynamics using an approach based on enlargement of filtrations and the application of the optimal portfolio allocation rule to real market data in both full and partial information setting.

David Skovmand (Københavns Universitet, Denmark)

Rational multi-curve models with counterparty-risk valuation adjustments

We develop a multi-curve term structure setup in which the modelling ingredients are expressed by rational functionals of Markov processes. We calibrate to LIBOR swaptions data and show that a rational two-factor lognormal multi-curve model is sufficient to match market data with accuracy. We elucidate the relationship between the models developed and calibrated under a risk-neutral measure Q and their consistent equivalence class under the real-world probability measure P. The consistent P-pricing models are applied to compute the risk exposures which may be required to comply with regulatory obligations. In order to compute counterparty-risk valuation adjustments, such as CVA, we show how default intensity processes with rational form can be derived. We flesh out our study by applying the results to a basis swap contract.

Shiqi Song (Université Evry Val d'Essonne, France)

Construction of multi-default-time models

Two important properties are to be considered about multi-default-time models. The first one is that the successive arrivals of default events should not destroy the viability. Otherwise, the models are meaningless. The second one is the martingale representation property. In this talk, we discuss the construction of multi-default-time models which satisfy these two properties.

Agnès Sulem (Institut National de Recherche en Informatique et en Automatique, France)

Generalized Dynkin games and game options in imperfect financial markets

We study pricing and hedging issues for game options in an imperfect financial market with default. In this setting, the pricing system is expressed as a nonlinear expectation induced by a nonlinear BSDE with jump. A large class of imperfections can fit in our framework, including different borrowing and lending interest rates, taxes on profits from risky investments, or the case of a large investor. We prove that the superhedging price of a game option coincides with the value function of a corresponding generalized Dynkin game. We then address the case of ambiguity on the model, – for example an ambiguity on the default probability –, and characterize the superhedging price of a game option as the value function of a mixed generalized Dynkin game. We prove the existence of a cancellation time and a trading strategy allowing the seller to be super-hedged, whatever the model.
Preprint available at `https://hal.inria.fr/hal-01243603`

Stefan Tappe (Leibniz Universität Hannover, Germany)

The HJMM equation with real-world forward rate dynamics: existence and positivity

In this talk, we investigate the Heath-Jarrow-Morton-Musiela (HJMM) equation for modeling interest rates in a market of zero coupon bonds. We will study the HJMM equation with real-world forward rate dynamics in the spirit of the Benchmark Approach. Our goal is to examine existence and positivity of solutions under suitable regularity conditions on the volatilities. For this purpose, we will have a closer look at general stochastic partial differential equations, and present an existence- and uniqueness result as well as an invariance result for closed convex cones.

Nizar Touzi (Ecole Polytechnique, France)

Stochastic control of path-dependent systems, application to the Principal-Agent problem

We consider a general formulation of the Principal-Agent problem from Contract Theory, on a finite horizon. We show how to reduce the problem to a stochastic control problem which may be analyzed by the standard tools of control theory. In particular, Agent's value function appears naturally as a controlled state variable for the Principal's problem. Our argument relies on the Backward Stochastic Differential Equations approach to non-Markovian stochastic control, and more specifically, on the most recent extensions to the second order case.

Stéphane Villeneuve (Ecole d'Economie de Toulouse, TSE, France)

Optimal exit under moral hazard

We extend the standard model of optimal exit when a firm's asset owned by a risk-neutral principal is contracted out to a risk-neutral agent to manage. We characterize the optimal contract implementing effort at any time and prove that for a very profitable firm, it is better off o let the agent shirk.

Mihail Zervos (London School of Economics, Great Britain)

Dynamic contracting under moral hazard

We consider a contracting problem that a firm faces in the presence of managerial moral hazard and stochastic cashflows. We first develop a general contracting setting. We then restrict attention to contracts that admit appropriate state space representations. In the latter context, we establish the link between the optimal contract and the solution to a suitable stochastic control problem.

Chao Zhou (National University of Singapore, Singapore)

Stochastic control for a class of nonlinear kernels and applications

A stochastic control problem for a class of nonlinear stochastic kernels is studied. We prove a dynamic programming principle (DPP) for the value function by a measurable selection argument and consider several applications of the DPP. This is a joint work with Dylan POSSAMAI and Xiaolu TAN

3 List of participants

- Clémence Alasseur (EDF R&D, FIME, France)
- Aurélien Alfonsi (Ecole Nationale des Ponts et Chaussées, France)
- Luisa Andreis (Università degli Studi di Padova, Italy)
- Martino Bardi (Università degli Studi di Padova, Italy)
- Emilio Barucci (Politecnico di Milano, Italy)
- Christophette Blanchet (Ecole Centrale de Lyon, France)
- Bruno Bouchard (Université Paris Dauphine, France)
- Nicolas Brunel (ENSIIE - Université d'Evry Val D'Essonne, France)
- Giorgia Callegaro (Università degli Studi di Padova, Italy)
- Antonella Calzolari (Università degli Studi di Roma 2, Italy)
- Agostino Capponi (Columbia University, United States of America)
- Luciano Campi (London School of Economics, Great Britain)
- Alekos Cecchin (Università degli Studi di Padova, Italy)
- Claudia Ceci (Università degli Studi di Chieti Pescara, Italy)
- Jean-Francois Chassagneux (Université Paris Diderot, France)
- Etienne Chevalier (Université d'Evry Val D'Essonne, France)
- Carlo Ciccarella (Ecole Polytechnique Fédérale de Lausanne, Switzerland)
- Stéphane Crépey (Université d'Evry Val D'Essonne, France)
- Christa Cuchiero (Universität Wien, Austria)
- Paolo Dai Pra (Università degli Studi di Padova, Italy)
- Cristina Di Girolami (Università degli Studi di Chieti Pescara, Italy)
- Giovanni Di Masi (Università degli Studi di Padova, Italy)
- Laure Elie (Université Paris Diderot, France)
- Omar El Euch (Université Pierre et Marie Curie, France)
- Nicole El Karoui (Université Pierre et Marie Curie, France)
- Salvatore Federico (Università degli Studi di Firenze, Italy)

- Damir Filipović (EPFL and Swiss Finance Institute, Switzerland)
- Markus Fischer (Università degli Studi di Padova, Italy)
- Claudio Fontana (Université Paris Diderot, France)
- Arnaud Gloter (Université d'Evry Val D'Essonne, France)
- Martino Grasselli (Università degli Studi di Padova, Italy)
- Zorana Grbac (Université Paris Diderot, France)
- Caroline Hillairet (ENSAE ParisTech, France)
- Monique Jeanblanc (Université d'Evry Val D'Essonne, France)
- Ying Jiao (ISFA, (Université Claude-Bernard Lyon 1, France)
- Sarah Kaakai (Université Pierre et Marie Curie, France)
- Idris Kharroubi (Université Paris Dauphine, France)
- Steven Kou (National University of Singapore, Singapore)
- Martin Larsson (Eidgenössische Technische Hochschule Zürich, Switzerland)
- Céline Labart (Université Savoie Mont-Blanc, France)
- Anthony Le Cavil (Ecole Nationale Supérieure de Techniques Avancées, France)
- Jérôme Lelong (Université de Grenoble Alpes, France)
- Thomas Lim (ENSIIE -Université d'Evry Val D'Essonne, France)
- Vathana Ly Vath (ENSIIE - Université d'Evry Val D'Essonne, France)
- Cecilia Mancini (Università degli Studi di Firenze, Italy)
- Mohamed Mnif (Ecole Nationale d'Ingénieurs de Tunis, Tunisia)
- Mathilde Mougeot (Université Paris Diderot, France)
- Saad Mouti (Université Pierre et Marie Curie, France)
- Bernt Øksendal (Universitetet i Oslo, Norway)
- Antonis Papapantoleon (Technische Universität Berlin, Germany)
- Andrea Pascucci (Università degli Studi di Bologna, Italy)
- Huyên Pham (Université Paris Diderot, France)
- Marco Piccirilli (Università degli Studi di Padova, Italy)
- Monique Pontier (Institut Mathématique de Toulouse, France)

- Sergio Pulido (ENSIIE - Université d'Evry Val D'Essonne, France)
- Florian Rasamoely (ENSIIE - Université d'Evry Val D'Essonne, France)
- Alexandre Roch (Université du Québec á Montréal, Canada)
- Mathieu Rosenbaum (Université Pierre et Marie Curie, France)
- Wolfgang Runggaldier (Università degli Studi di Padova, Italy)
- Marek Rutkowski (The University of Sydney, Australia)
- Pamela Saliba (Université Pierre et Marie Curie, France)
- John Schoenmakers (WIAS, Germany)
- Simone Scotti (Université Paris Diderot, France)
- Carlo Sgarra (Politecnico di Milano, Italy)
- David Skovmand (Københavns Universitet, Denmark)
- Shiqi Song (Université d'Evry Val D'Essonne, France)
- Agnès Sulem (INRIA, Paris)
- Stefan Tappe (Leibniz Universität Hannover, Germany)
- Peter Tankov (Université Paris Diderot, France)
- Barbara Torti (Università degli Studi di Roma 2, Italy)
- Nizar Touzi (Ecole Polytechnique, France)
- Daniele Tovazzi (Università degli Studi di Padova, Italy)
- Tiziano Vargiolu (Università degli Studi di Padova, Italy)
- Stéphane Villeneuve (Ecole d'Economie de Toulouse, TSE, France)
- Mihaïl Zervos (London School of Economics, Great Britain)
- Chao Zhou (National University of Singapore, Singapore)

4 Practical information

- **Conference venues in Padua and Venice**:

  Tuesday Main building of Padova University: Palazzo Bo, room: Archivio Antico, Via 8 febbraio 1848, Padua

  Wednesday and Thurday Department of Mathematics: Torre Archimede, room: 1A150 (first floor), Via Trieste 63, Padua

  Friday Istituto Veneto di Scienze, Lettere ed Arti, Campo S. Stefano 2945, Venice

- **Train from Padova to Venice**:

  Venice station : The name of Venice station is **Venezia Santa Lucia** (sometimes Venezia S. Lucia). Please be careful, the train stops a first time at the station Venezia Mestre before the rail bridge.

  Train name : the trains called **Regionale Veloce** take 27 min between Padova and Venezia S. Lucia. The trains called **Regionale** take almost 1 hour. High speed trains, named **FrecciaArgento** or **FrecciaBianca**, require a reservation and take 26 min.

  Schedule from Padova to Venice : Trains Regionale Veloce are scheduled at 07:51, 08:21, 08:51 and so on each half hour.

  Schedule from Venice to Padova : Trains Regionale Veloce are scheduled at 16:42, 17:12 and 17:42 and so on each half hour until 21:42. The last train, a Regionale, starts at 22:35 and stops at Padova at 23:24.

  Website : Trenitalia is the Italian rail company, http://www.trenitalia.com/tcom-en

- **How to move in Venice**: You can find out how to reach your destination, by foot or with the public transport (Vaporetto) by consulting google maps.

- **How to go to the Istituto Veneto di Scienze**:

  by foot : getting from the station to the building Palazzo Cavallari Franchetti is easy and rapid (20 min), see the plan.

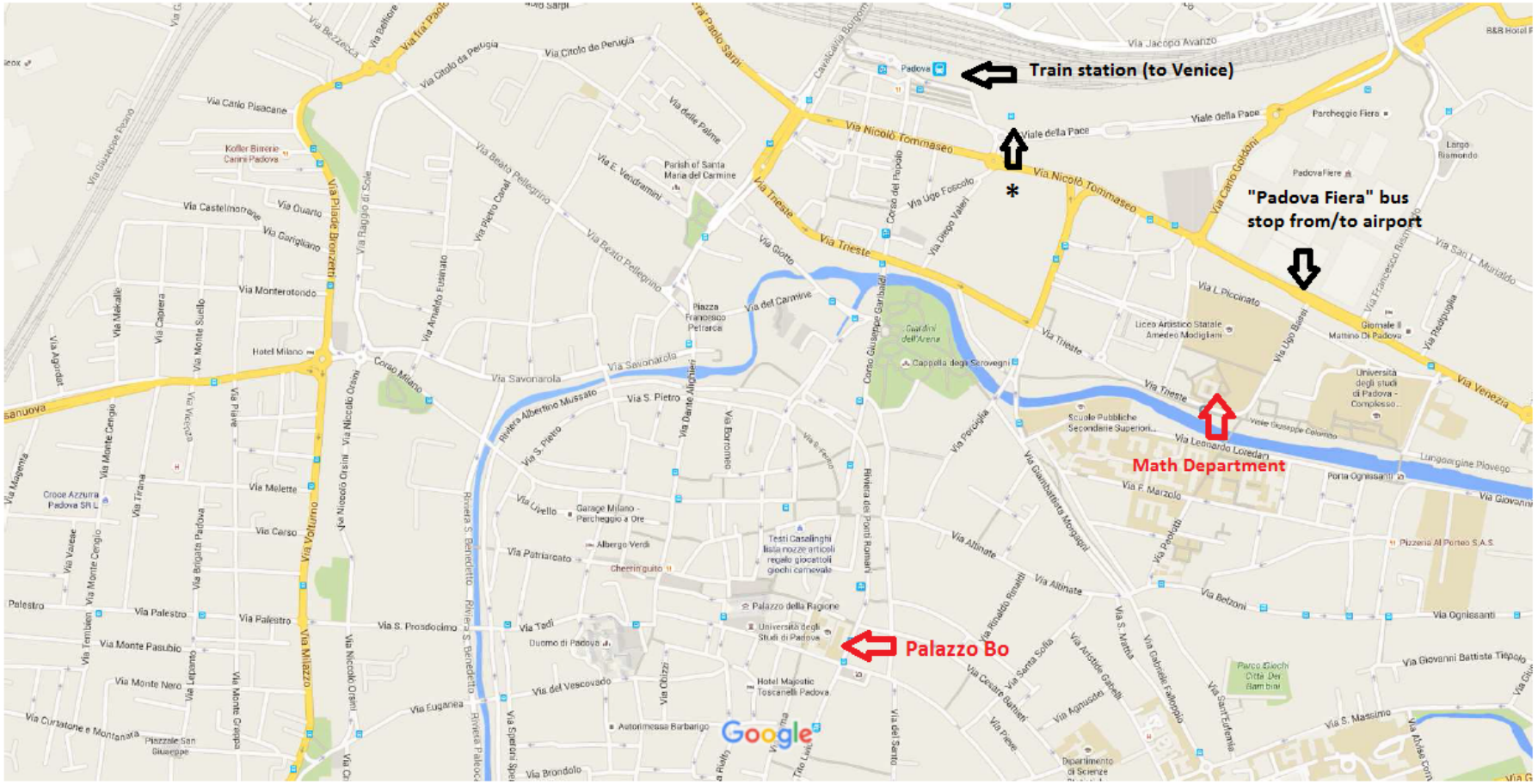
  by boat : take Vaporetto 1 at stop Ferrovia E toward Lido and go out at Accademia. The building Palazzo Cavallari Franchetti is on the other side of Canal Grande.

- **Connection with the airport** The Arancio (orange) line connects Piazza San Marco and Venice Airport passing through the Canal Grande with different intermediate stops. http://www.alilaguna.it/en/linea-arancio

- **Internet wireless connection.** In the first three days, as we are in the University buildings, they are all covered by Eduroam. Thus, if you have a device (laptop, smart phone, etc.) already configured for Eduroam at your home institution, you can freely access the Internet. We will also provide temporary access account to other wireless connections.

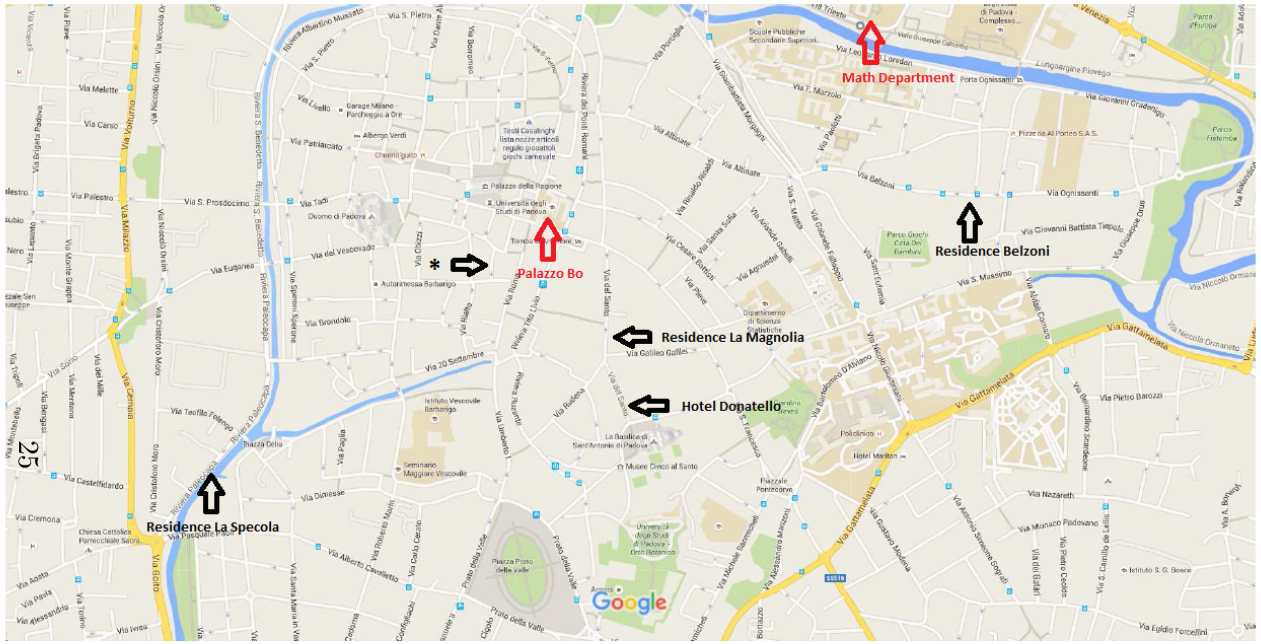
- **Conference dinner at Caffé Pedrocchi**, Via VIII Febbraio, 15, 35122 Padova PD, Italia, http://www.caffepedrocchi.it/

- **Some Restaurants**:
  - Gourmetteria (region and Italian food), always open, Via Zabarella 23, near Palazzo Bo: http://www.gourmetteria.com/
  - Osteria dal capo (Italian food), closed on Sunday, Via degli Obizzi 2, near the cathedral: http://www.osteriadalcapo.it/
  - Enoteca dei Tadi (Italian food), closed on Monday, Via dei Tadi, 16, between La Specola and the cathedral: http://www.enotecadeitadi.it/
  - Osteria l'Anfora (regional food), closed on Sunday, Via dei Soncin 13, between the cathedral and Piazza delle Erbe.
  - Fiorital (seafood), closed on Sunday, Via Rezzonico 8, 35131, between the Math department and the train station: http://www.fiorital.com/it/index/fiorital_padova
- **Some Pizzeria**:
  - Pizzeria Rossopomodoro (Naples' style), always open, Via Santa Lucia 68, near Piazza delle Erbe: http://www.rossopomodoro.it/ristoranti/PADOVA/padova
  - Pizzeria Duomo, closed on Monday, Via San Gregorio Barbarigo, 18, near the cathedral: http://www.pizzeriaduomo.it/

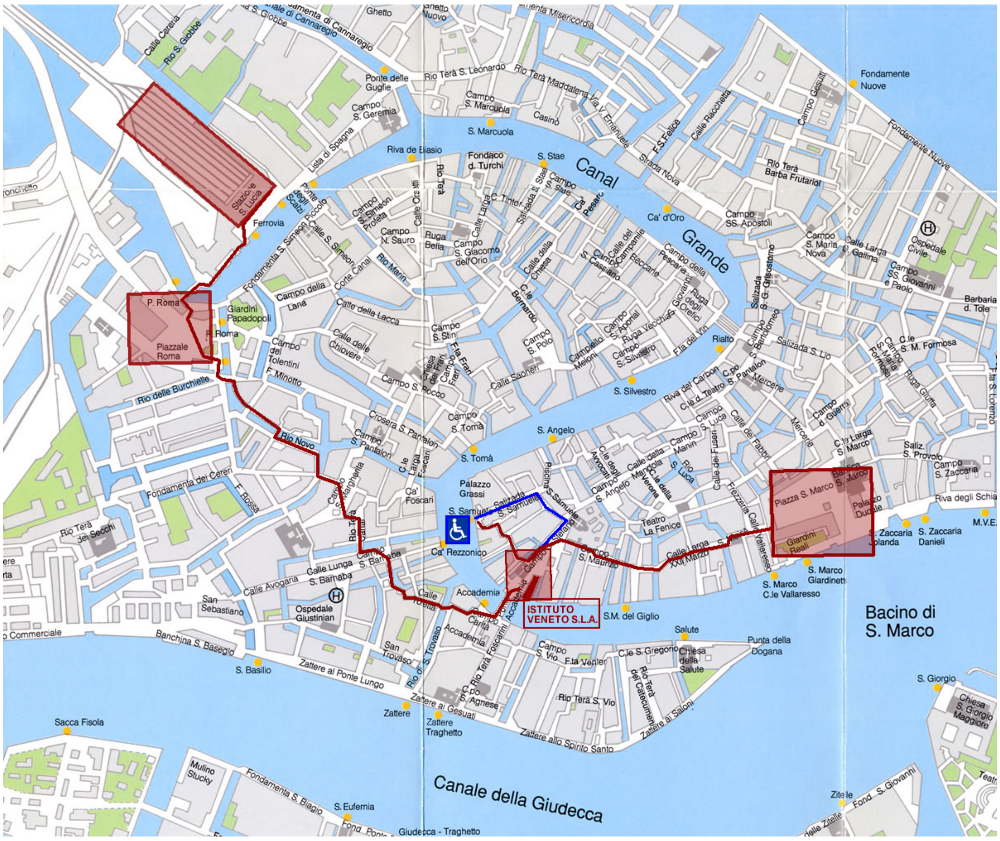


* "Padova Autostazione" bus stop from/to airport

Google Maps Padova PD

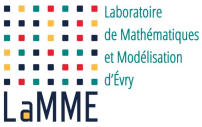


(*) **Hotel Toscanelli, Via dell'Arco 2, 35122 Padova**


ISTITUTO VENETO S.L.A.
Canal Grande
Bacino di S. Marco
Canale della Giudecca
Piazzale Roma
Piazza S. Marco
Accademia
Rialto
Ferrovia
S. Samuele
Ca' Rezzonico
Palazzo Grassi
Zattere
S. Giorgio
Salute

5 Sponsors

LaMME



ENSIIE Evry Strasbourg

Université d'Evry Val d'Essonne

Dipartimento di Matematica

Università di Padova

Centre Levi Cases

Chaire Marchés en Mutation

Institut Louis Bachelier

FIME

Istituto Nazionale di Alta Matematica