Recent Advancements in the Theory and Practice of Credit Derivatives

September 28-30, 2009

Laboratoire J.A. Dieudonné, CNRS et Université de Nice Sophia Antipolis

On Monday and Thuesday, the Conference takes place in the Grand Château building of the University, salle du Théâtre. On Wednesday, it takes place in the Salle de Conférences of the Dieudonné building (see the Practical Informations page on the website of the conference for further details).

Lecturers.

- Aurélien Alfonsi (CERMICS, Ecole des Ponts)
- Rama Cont (Université Paris VI-VII)
- Areski Cousin (ISFA, Université de Lyon)
- Pierre Del Moral (INRIA Bordeaux)
- Ruediger Frey (Universitaet Leipzig)
- Greg Gupton (Fitch Solutions)
- Monique Jeanblanc (Université d'Evry)
- Jean-Pierre Lardy (JPLC - CRIS)
- Alex Lipton (Imperial College and BofA - Merrill Lynch)
- Andrei Lopatin (Numerix)
- Rafael Mendoza-Arriaga (University of Texas at Austin)
- Philippos Papadopoulos (ABN-AMRO)
- Michael Pykhtin (BofA)
- Marek Rutkowski (University of New South Wales)
- David Saunders (University of Waterloo)
- Daniel Schiemert (Fitch Ratings)
- Marco Tarenghi (Banca Leonardo)
- Roberto Torresetti (BBVA)
- Julien Turc (Société Générale)

Schedule

Monday	Tuesday	Wednesday
9:30-10:00 *Welcoming Coffee*	9:15-10:15 **Frey**	9:15-10:15 **Alfonsi**
10:00-10:15 **Introductory Talks**	10:15-11:15 **Del Moral**	10:15-11:15 **Pykhtin**
10:15-11:15 **Jeanblanc**	*Coffee*	*Coffee*
11:15-12:15 **Schiemert**	11:30-12:30 **Saunders**	11:30-12:30 **Lipton**
lunch 12:30	*lunch 13:00*	*lunch 13:00*
14:00-15:00 **Lardy**	14:15-15:15 **Lopatin**	14:15-15:15 **Rutkowski**
15:00-16:00 **Turc**	15:15-16:15 **Torresetti**	15:15-16:15 **Cont**
Coffee	*Coffee*	*Coffee*
16:20-17:20 **Papadopoulos**	16:30-17:30 **Mendoza**	16:30-17:30 **Cousin**
17:20-18:30 **Gupton***	17:30-18:30 **Tarenghi**	
	20:00 *Conference diner*	

*Panel Session under the direction of G. Gupton: Lessons from the crisis in Valuation, Risk Management, Counterparty and Liquidity Risks, and Credit Ratings.

Titles + Abstracts

Aurélien Alfonsi, CERMICS, Ecole des Ponts
A closed-form extension to the Black-Cox model

ABSTRACT. In the Black-Cox model, a firm makes default when its value hits an exponential barrier. Here, we propose an hybrid model that generalizes this framework. The default intensity can take two different values and switches when the firm value crosses the barrier. Of course, the intensity level is higher below the barrier. We get an analytic formula for the Laplace transform of the default time and present numerical methods to get back its distribution. Last, we explain how this model can calibrate Credit Default Swap prices and show its tractability on different kind of data.

Rama CONT, CNRS and Columbia University
Dynamic hedging of portfolio credit derivatives

ABSTRACT. (With Yu Hang KAN, Columbia University). We study hedging of index CDO tranches with the underlying CDS contracts and the index in various aggregate loss models which account for default contagion and spread risk, using various top-down and bottom-up model specifications. Market incompleteness precludes perfect hedging and suggest comparing various strategies in terms of residual risk. In particular, we compare sensitivity-based hedging with hedging strategies based on quadratic risk minimization. Numerical results obtained in models calibrated to iTraxx and CDX market data reveal significant differences in the hedge ratios and show, unlike what had been previously suggested in the literature by comparing copula-based models, that hedging strategies are subject to substantial model risk. Finally, we perform an empirical comparison of hedging performance using ITRAXX and CDX time series. Our study reveals in particular that

-hedging with the index in a top-down model may outperform hedging with individual CDS in a bottom-up models

- delta-hedging of spread risk using a Gaussian Copula model does not appear to be an effective hedging strategy, especially after the onset of subprime crisis.

This talk is based on:

R Cont, R Deguest, Y.H, Kan (2009) Default Intensities implied by CDO Spreads: Inversion Formula and Model Calibration, http://ssrn.com/abstract=1447979

R Cont, Y.H. Kan (2008) Dynamic hedging of credit derivatives, http://ssrn.com/abstract=1349847

R Cont, A Minca (2008) Recovering portfolio default intensities implied by CDO tranches, http://ssrn.com/abstract=1104855

Areski Cousin, ISFA, Université de Lyon
Dynamic hedging of CDO tranches in Markovian contagion models

ABSTRACT. In this presentation, we address the hedging issue of CDO tranches in a market model that connect the pricing to the cost of the hedge. In our framework, default intensities are adapted to the global filtration of default times and simultaneous defaults are precluded. We show that CDO tranches can be perfectly replicated by dynamically trading the underlying individual CDS and a risk-free asset. Unsurprisingly, the possibility of perfect hedging is associated with a martingale representation theorem. Subsequently, we exhibit a risk-neutral measure under which the short term credit spreads are the intensities associated with the corresponding default times. However, the implementation of actual hedging strategies requires some extra assumptions. We rely upon a homogeneous Markovian contagion model where CDO tranches can be replicated using the CDS index and the risk-free asset. Numerical implementation can be carried out fairly easily thanks to a recombining tree describing the dynamics of the aggregate loss. We then compare the hedging strategies obtained in the contagion model with other results provided in the literature.

Pierre del Moral, INRIA Bordeaux
Particle simulation of rare event probabilities

ABSTRACT. To obtain efficient rare event simulation algorithms is crucial for the credit risk modelling. The lack of such algorithms is one of the reasons for the success of one-factor Gaussian models, whose shortcomings are now well-known. We discuss here rare event simulation for a fixed probability law. We provide two versions of our algorithm, and discuss the convergence properties and implementation issues.

Rüdiger Frey, Leipzig Universität
Credit Innovation:Pricing and Hedging of Credit Derivatives via the Innovations Approach to Nonlinear Filtering

ABSTRACT. We propose a new, information-based approach for modelling the dynamic evolution of a portfolio of credit risky securities. In our setup market prices of traded credit derivatives are given by the solution of a nonlinear filtering problem. The innovations approach to nonlinear filtering is used to solve this problem and to derive the dynamics of market prices. Moreover, the practical application of the model is discussed: we analyze model calibration, the pricing of exotic credit derivatives and the computation of risk-minimizing hedging strategies and present results from a numerical case study.

Jean-Pierre Lardy, JPLC
On the origins of the crisis and suggestions for further research

ABSTRACT. We review several of the factual failures that the crisis has revealed and try to analyse the root cause for these. Credit rating, regulation, models, accounting, leverage, risk management and other aspects are reviewed. In each case, we survey the solutions currently proposed as well as suggest directions for further research.

Alex Lipton, Bank of America Merrill Lynch
Credit value adjustment for credit default swaps

ABSTRACT. (With Artur Sepp) We present a multi-dimensional jump-diffusion version of a structural default model and show how to use it in order to estimate the credit value adjustment for a credit default swap. We develop novel analytical and numerical methods for solving the corresponding boundary value problem with a special emphasis on the role of negative asset value jumps. Using recent market data, we describe some specific examples.

Andrei Lopatin, Numerix
A simple dynamic model for pricing and hedging heterogeneous CDOs

ABSTRACT. We present a simple bottom-up dynamic credit model that can be calibrated simultaneously to the market quotes on CDO tranches and individual CDSs constituting the credit portfolio. The model is most suitable for the purpose of evaluating the hedge ratios of CDO tranches with respect to the underlying credit names. Default intensities of individual assets are modeled as deterministic functions of time and the total number of defaults accumulated in the portfolio. To overcome numerical difficulties, we suggest a semi-analytic approximation that is justified by the large number of portfolio members. We calibrate the model to the recent market quotes on CDO tranches and individual CDSs and find the hedge ratios of tranches. Results are compared with those obtained within the static Gaussian Copula model.

Rafael Mendoza-Arriaga, The University of Texas at Austin
Unified Credit-Equity Modeling

ABSTRACT. In this presentation we present a novel class of hybrid credit-equity models with state dependent jumps, local-stochastic volatility and default intensity based on time changes of Markov processes with killing. We model the defaultable stock price process as a time changed Markov diffusion process with state-dependent local volatility and killing rate (default intensity). We develop two analytical approaches to the pricing of credit and equity derivatives in this class of models. The two approaches are based on the Laplace transform inversion and the spectral expansion approach, respectively. To illustrate our general framework, we time change the jump-to-default extended CEV model (JDCEV) of Carr and Linetsky (2006) and obtain a rich class of analytically tractable models with jumps, local-stochastic volatility and default intensity. These models can be used to jointly price and hedge equity and credit derivatives.

Philipos Papadopoulos, ABN-AMRO
Market implied valuation of Collateralized Loan Obligations

ABSTRACT. The primary market for the debt tranches of cash CLOs has been historically a ratings based, buy-and-hold market, with little secondary trading activity. With the onset of the credit crisis this market structure created significant valuation difficulties. In this work we adopt the hypothesis that an observable, derivatives based, tranche market exists and we build a framework for deriving implied valuations for the various elements of the cashflow CLO structure.

Michael Pykhtin Bank of America
Modeling Counterparty Credit Exposure in the Presence of Margin Agreements

ABSTRACT. Modeling credit exposure of a financial institution to a counterparty usually requires Monte Carlo simulation of the trade values at future time points. To determine exposure in the presence of a margin agreement, one needs to know the collateral amount available at the same simulation time point. However, collateral at any simulation time point depends on the portfolio value at an earlier time point because of the margin period of risk. To simulate collateralized exposure at a single (primary) time point, one usually simulates the portfolio value at two time points: the primary and the look-back. Thus the total simulation time is doubled. We present a semi-analytical method for calculating expected exposure profiles in the presence of margin agreements that does not require simulating trade values at the look-back time points. This method accounts for both reduction of exposure from receiving collateral and increase of exposure from posting collateral. The method can be easily implemented within an existing system that simulates uncollateralized exposure without a noticeable increase of the simulation time. Potential applications of the method include pricing and hedging of counterparty credit risk and calculating economic and regulatory capital.

Marek Rutkowski University of New South Wales
Valuation of Credit Default Swaptions and Credit Default Index Swaptions

ABSTRACT. We provide simple and rigorous derivations of valuation formulae for credit default swaptions and credit default index swaptions. Results of [1] cover as special cases several pricing formulae that were previously established by Jamshidian [5], Pedersen [7], Brigo and Morini [3], and Morini and Brigo [6]. The valuation results are shown to be independent of a particular convention regarding the specification of the fee and protection legs, so that they can also be used for valuation of other credit derivatives exhibiting similar features, for instance, options on CDO tranches. The main tool is a judicious choice of the reference filtration and a suitable specification of the risk-neutral dynamics for the pre-default loss-adjusted fair market spread. A suitable choice of a market model for CDS spreads will also be discussed (see Brigo [2] and Li and Rutkowski [4]).

References
- [1] A. Armstrong and M. Rutkowski: Valuation of credit default index swaps and swaptions. Forthcoming in *International Journal of Theoretical and Applied Finance.*
- [2] D. Brigo: Candidate market models and the calibrated CIR++ stochastic intensity model for credit default swap options and callable floaters. In: *Proceedings of the 4th ICS Conference*, Tokyo, March 18-19, 2004.
- [3] D. Brigo and M. Morini: CDS market formulas and models. Working paper, Banca IMI, 2005.
- [4] L. Li and M. Rutkowski: Market models for swap rates and CDS spreads. Working paper, School of Mathematics and Statistics, UNSW, 2009.
- [5] F. Jamshidian: Valuation of credit default swaps and swaptions. *Finance and Stochastics* 8 (2004), 343–371.
- [6] M. Morini and D. Brigo: No-armageddon measure for arbitrage-free pricing of index options in a credit crisis. Working paper, Banca IMI and Fitch Solutions, 2007.
- [7] C.M. Pedersen: Valuation of portfolio credit default swaptions. *Quantitative Credit Research*, Lehman Brothers, November 2003.

David Saunders, University of Waterloo
Pricing and Hedging CLOs with Implied Factor Models

ABSTRACT. (With Jovan Nedeljovik and Dan Rosen) The current financial crisis has underscored the need for transparent and robust methods for valuing and hedging structured credit portfolios. First-generation models, such as the Gaussian copula-based methods have well documented practical and theoretical limitations. In this paper, we demonstrate the practical application of the weighted Monte Carlo methodology to value and compute sensitivities and risk statistics for CLO portfolios and CLO-squared structures. The model extends the full bottom-up approach of Rosen and Saunders (2009) for pricing bespoke CDOs to include cancellability and stochastic LGDs in a natural way. The performance of the model is analyzed throughout a three-month period during the credit crisis in 2008. The model calibrates very well to observed prices for the CDXHY and LCDX indices, and provides stable implied distributions for the systematic factor. Furthermore, it gives robust, consistent prices and sensitivities for CLOs and CLO-squared transactions, even during this very volatile period.

Daniel Schiemert, Fitch Ratings
Stochastic Recovery Specifications for Calibration and Pricing of CDOs

ABSTRACT. The recent market moves in the CDS index tranches triggered calibration challenges for various CDO pricing models. One challenge is introducing an effective Stochastic Recovery (SR) formulation. Under possibly general SR, we investigate spread dispersion and a model-free expected loss construction as possible drivers for calibration failures. We use the single name CDS consistency for the SR as a condition for arbitrage boundaries. As the most recent SR setups suggested by the sell side are mainly implemented in the base correlation framework, we summarize base correlation, briefly explaining why it is still used in the market despite its shortcomings. Under this paradigm, we examine SR models suggested by the sell side. Since under SR the calibrated base correlation curve is expected to flatten with respect to the case with fixed recovery, we investigate whether this feature is beneficial for avoiding arbitrage in the expected tranche loss curves. Finally, we discuss the impact of SR on popular deal types and comment on recent suggested trading strategies for CDOs.

Marco Tarenghi, Banca Leonardo
CDS calibration with tractable Structural Models with an application to Equity swap valuation under counterparty risk

ABSTRACT. In this paper we develop structural first passage models (AT1P and SBTV) with time-varying volatility and characterized by high tractability. The models can be calibrated exactly to credit spreads using efficient closed-form formulas for default probabilities. In these models default events are caused by the value of the firm assets hitting a safety threshold, which depends on the financial situation of the company and on market conditions. In AT1P this default barrier is deterministic. Instead SBTV assumes two possible scenarios for the initial level of the default barrier, for taking into account uncertainty on balance sheet information and in particular risk of fraud. We apply the models to exact calibration of Lehman Credit Default Swap (CDS) data during the months preceding default. In some cases these models show more calibration capability than a reduced-form model. The results we obtain with AT1P and SBTV have reasonable economic interpretation, and are particularly realistic when SBTV is considered. These results are analyzed in relation with the progressive unfolding of news on Lehman crisis, and compared to the results we obtain for a company with higher credit quality. We also provide a typical example of a case where the calibrated structural model can be used for credit pricing in a much more convenient way than a calibrated reduced form model: The pricing of counterparty risk in an equity return swap. Finally we show how the model can be used for the joint default risk of more companies, controlling both cyclical default correlation and contagion, with an application to First-to-Default.

Roberto Torresetti, BBVA
Structured Finance Rating Criteria: CPDOs and the Impact of Assuming a Loss Distribution featuring Modes

ABSTRACT. We put the rating criteria of CPDO in the context of the literature of competition, differences of opinion and selection bias in the credit rating industry. We review the standard criteria adopted by rating agencies to assess the riskiness of CPDOs introducing one important modification: a loss distribution in the objective measure with modes. We hint at the evidence found in literature that we believe points in the direction of modes in the loss distribution being not just a risk premium associated to senior tranches. In the framework of our GPCL model, Brigo et al. (2007), we estimate the size of the modes in the loss distribution under the objective measure. We show that the riskiness of CPDOs is substantially impacted (increased) by the introduction of the bump feature in the loss distribution. In the same spirit of Linden et al. (2007), we also assess the CPDO riskiness stressing conservatively the criteria. We also show that the price of the gap-risk option embedded in CPDO structure increases considerably under the GPCL approach.