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Updated as of 6 August 2019
Implied stochastic volatility models

YACINE AIT-SAHALIA

Princeton University, USA

ABSTRACT

This paper proposes to build “implied stochastic volatility models” designed to fit option-implied volatility data, and implements a method to construct such models. The method is based on explicitly linking shape characteristics of the implied volatility surface to the specification of the stochastic volatility model. We propose and implement parametric and nonparametric versions of implied stochastic volatility models.
Quantile forecasting based on a multivariate hysteretic autoregressive model with GARCH Errors and time-varying correlations

Cathy W.S. Chen\textsuperscript{a}, Hong Than-Thi\textsuperscript{a}, Mike K.P. So\textsuperscript{b}, and Songsak Sriboonchitta\textsuperscript{c}

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\textsuperscript{b} Hong Kong University of Science and Technology, Hong Kong
\textsuperscript{c} Chiang Mai University, Thailand

ABSTRACT

To understand and predict chronological dependence in the second-order moments of asset returns, we consider a multivariate hysteretic autoregressive (HAR) model with GARCH specification and time-varying correlations, by providing a new way to describe a nonlinear dynamic structure of the target time series. The hysteresis variable governs the nonlinear dynamics of the proposed model in which the regime switch can be delayed if the hysteresis variable lies in a hysteresis zone. The proposed model combines three useful model components for modeling economic and financial data: (1) the multivariate HAR model, (2) the multivariate hysteretic volatility models, and (3) a dynamic conditional correlation structure. We incorporate an adapted multivariate Student-t innovation based on a scale mixture normal presentation in the HAR model to tolerate for dependence and different shaped innovation components. We carry out multivariate volatilities, Value-at-Risk, and marginal expected shortfall based on a Bayesian sampling scheme through adaptive Markov chain Monte Carlo (MCMC) methods, which allow us to statistically estimate all unknown model parameters and forecasts simultaneously. We illustrate the proposed methods herein by using both simulated and real examples and measure for industry downside tail risk jointly.

Keywords: Hysteresis; MCMC method; scale mixture of normal distributions; multivariate Student-t distribution; Marginal expected shortfall; Value-at-Risk; Out-of-sample forecasting.
Central limit theorems for sets of probability measures

ZENGJING CHEN
Shandong University, China

ABSTRACT
In this paper, we present two Central Limit Theorems (CLTs) for models where random events are describable by nonsingleton sets of probability measures. Such sets arise in economics and finance as the subjective prior beliefs of an agent within a model who does not have sufficient information to justify reliance on a single probability measure, in mathematical statistics and econometrics where they represent the predictions of the theory being tested or estimated empirically and where predictions are multivalued because the theory is incomplete and as representations of indeterminate objective realities. We refer to such situations as featuring “ambiguity”.
Joint work with Larry G. Epstein
Systematic and discretionary hedge funds: classification and performance comparison

HUI-CHING CHUANG

Yuan Ze University, Taiwan

ABSTRACT

In this paper we introduce an approach to building classifiers that bifurcate hedge funds into systematic and discretionary funds and evaluate their performance. This approach makes use of textual analysis and statistical learning methods that are free from subjective judgement of investment strategies. In our empirical study, we find that a random forest classifier yields the highest accuracy ratio, and that the funds classified as systematic, on average, result in higher raw returns, Sharpe ratios, and factor-adjusted returns than their discretionary counterparts. A bootstrap analysis also shows that the standardized alphas of a large portion of systematic and discretionary funds are statistically significantly different from zero, suggesting such performance is due to fund managers’ authentic investment skills, rather than their luck. Nonetheless, we find that systematic Equity Hedge funds are to be preferred to their discretionary counterparts because the standardized alphas of the former stochastically dominate those of the latter.
Proxy CDS curves for individual corporates globally

JIN-CHUAN DUAN
National University of Singapore, Singapore

ABSTRACT

Corporate credit default swap (CDS) premium is the market price of credit risk posed by a corporate obligor. Although corporate CDS are commonly used for risk benchmarking in accounting and credit risk management, liquid CDS are limited to under 500 corporate names globally. CDS users must either confine their usage to this limited subset or resort to aggregates derived from the liquid CDS in different industry/rating combinations. This paper offers an intuitive, practical and robust predictive regression model linking liquid USD-denominated CDS premiums of different tenors to a set of obligor-specific attributes, and with the model one can generate proxy CDS curves for corporates without liquid or traded CDS. One key attribute is the actuarial spread that reflects the actuarial value of a CDS contract and is made available by the Credit Research Initiative of National University of Singapore for all exchange-listed firms globally. Other attributes in the predictive regression model include investment vs. speculative grades based on an obligor’s credit rating, and some general credit environment variables such as the April 2009 CDS Big Bang, among others. This predictive regression, constructed with the historical record on 405 corporate CDS names, enables daily production of proxy CDS curves on over 35,000 currently active exchange-listed corporates globally.
Tutorial on the first and second fundamental theorem of quantitative risk management

PAUL EMBRECHTS

ETH Zürich, Switzerland

ABSTRACT

I very much hope that participants to this 4-hour tutorial will think beforehand what their candidates for a First and Second FT of QRM would/could be. Rather than lifting the “veil of secrecy” at this point, I can say so much as that I will guide the participants through some key results of the book: “A.J. McNeil, R. Frey and P. Embrechts (2015) Quantitative Risk Management: Concepts, Techniques and Tools. Princeton University Press”, see also www.qrmtutorial.org for an accompanying website. For this tutorial, I more specifically think of “a methodological excursion through the land of risk management while keeping practical relevance always in sight”.
Risk-sharing, robustness and regulation

PAUL EMBRECHTS

ETH Zürich, Switzerland

ABSTRACT

In this talk I will summarize some recent work on the concept of risk-sharing, discuss in particular properties like robustness, moral hazard and equilibrium pricing and finally highlight consequences for capital regulation for the financial and insurance industry.
Some risk measures on Wiener space

HANS FÖLLMER

Humboldt-Universität zu Berlin, Germany

ABSTRACT

We discuss some convex risk measures on Wiener space that are defined in terms of different Wasserstein metrics and different notions of relative entropy. Their comparison involves Talagrand’s optimal transport inequality for Gaussian measures, in particular a new refined version in terms of specific relative entropy. The focus will be on the sensitivity of such risk measures to the fine structure of Brownian motion, in particular to the behaviour of quadratic variation.
Model-uncertain value-at-risk, expected shortfall and sharpe ratio, using stochastic approximation

Emmanuel Gobet
École Polytechnique, France

ABSTRACT

VaR, ES, SR have as a common point the property of being the limit of Stochastic Approximation algorithm. In this work we discuss how to quantity the model uncertainty in these types of limits when some model parameters are unknown and modelled as random variables. The random limits are decomposed into chaos which coefficients are computed recursively. The resulting algorithm is an SA algorithm in increasing dimension. Convergence results are established and experimental results are investigated.

Joint works with Stephane Crepey, Gersende Fort, Uladzislau Stazhynski and Linda Chamakh
Modeling and tracking bubbles

CHRISTIAN HAFNER

Université Catholique de Louvain, Belgium

ABSTRACT

Markets with imperfect information are often characterized by bubble-like behaviour and returns that are not martingale differences. Classification into bubble and non-bubble periods is far from clear once heteroscedasticity and non-normality are taken into account. We propose and compare alternative score-driven models capable of tracking financial bubbles and typical volatility patterns. We discuss properties, estimation, inference and diagnostic tests of the models. In an application to a set of cryptocurrencies, we confirm the importance of a bubble component. Possible extensions include the multivariate case with a common bubble component, and models with links between the bubble and volatility.

Joint work with Andrew Harvey
Pricing cryptocurrency options: the case of CRIX and Bitcoin

Cathy YH Chen\textsuperscript{a}, Wolfgang Karl Härdle\textsuperscript{a,b}, Ai Jun Hou\textsuperscript{c}, and Weining Wang\textsuperscript{a}

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\textsuperscript{b}Singapore Management University, Singapore
\textsuperscript{c}Stockholm University, Sweden

ABSTRACT

The CRIX (CRyptocurrency IndeX) has been constructed based on a number of cryptos and provides a high coverage of market liquidity, hum.berlin/crix. The cryptocurrency market is a new asset market and attracts a lot of investors recently. Surprisingly a market for contingent claims had not been built up yet. A reason is certainly the lack of pricing tools that are based on solid financial econometric tools. Here a first step towards pricing of derivatives of this new asset class is presented. After a careful econometric pre-analysis we motivate an affine jump diffusion model, i.e., the SVCJ (Stochastic Volatility with Correlated Jumps) model. We calibrate SVCJ by MCMC and obtain interpretable jump processes and then via simulation price options. The jumps present in the cryptocurrency fluctuations are an essential component. Concrete examples are given to establish an OCRIX exchange platform trading options on CRIX.
Limits to arbitrage in markets with stochastic settlement latency

NIKOLAUS HAUTSCH

University of Vienna, Austria

ABSTRACT

Distributed ledger technologies rely on consensus protocols confronting traders with random waiting times until the transfer of ownership is accomplished. This time-consuming settlement process exposes arbitrageurs to price risk and imposes limits to arbitrage. We derive theoretical arbitrage boundaries under general assumptions and show that they increase with expected latency, latency uncertainty, spot volatility, and risk aversion. Using high-frequency data from the Bitcoin network, we estimate arbitrage boundaries due to settlement latency of on average 124 basis points, covering 88% of the observed cross-exchange price differences. We document cross-exchange flows chasing arbitrage opportunities only if we account for transaction cost and settlement latency. Settlement through decentralized systems thus induces non-trivial frictions affecting market efficiency and price formation.
“High-Frequency Econometrics“

Singapore, August 29, 2019

Abstract
This short course introduces to financial high-frequency data, presents the concepts of integrated variation and realized variance and discusses models for ex post variance estimators. In the second part of the course, the role and effects of market microstructure noise on variance estimators will be presented. This includes a deeper discussion of novel insights on local mispricing, noise endogeneity and concepts from market microstructure theory. In the last part of the course, high-frequency based estimators of large-dimensional asset return covariances and their use in portfolio allocation problems will be presented. Particular emphasis will be given on the role of transaction costs and the link between turnover penalization and covariance shrinkage.

Course Outline

1. The Realized Variance
   1.1. High-Frequency Data
   1.2. The Concept of Realized Variance
   1.3. Modelling Realized Variances

2. Noise-Adjusted Variance Estimators
   2.1. Market Microstructure Noise
   2.2. Kernel-Based Estimators
   2.3. Local Mispricing and Noise

3. Large-Scale Portfolio Allocation
   3.1. Realized Covariance Estimation
   3.2. Realized Kernels
   3.3. Portfolio Optimization under Transaction Costs

Literature

Kernels to Measure the Ex Post Variation of Equity Prices in the Presence of Noise”, *Econometrica*, 76, 1481-1536.


Mean-risk portfolio choice with weighted VaR and law-invariant coherent risk measures

HANQING JIN

University of Oxford, UK

ABSTRACT

We study a continuous-time mean-risk portfolio choice problem in which an agent, with or without the bankruptcy constraint, chooses among the portfolios that achieve an exogenously given expected terminal wealth target with the objective of minimizing the risk of his portfolio. The risk is measured either by a so-called weighted value-at-risk risk measure, which is a generalization of value-at-risk and conditional value-at-risk, or by a law-invariant coherent risk measure.
Massive entry of renewal energies, strategic behavior and risk analysis for network electricity markets

ALEJANDRO JOFRÉ

Universidad de Chile, Chile

ABSTRACT
In this talk we describe some of the key issues in the operational and strategic decisions when an energy system or market is stressed by a massive entry of nonconventional renewal energy production (NREP), such as the case of the Independent System Operator (ISO), the producer reactions, trade-off between cheap and uncertain generation sources and the risk analysis of producers versus generators and consumers. We use a combination of game theory, stochastic optimization and risk analysis techniques for modeling and trying to understand some of the behaviors and perturbations induced by the entry of NREP.
Simultaneous volatility and skewness risk in asset pricing

KIAN GUAN LIM

Singapore Management University, Singapore

ABSTRACT

The contribution in this paper is two-fold. Firstly, we propose a multiple criteria framework (MCF) for generalizing the traditional two-moment CAPM to a market portfolio that contains optimal balance of variance and skewness. Only in the extreme case of zero skewness does this portfolio converge to the Sharpe-Lintner market portfolio. Our model decomposes effective portfolio variance into two parts, an undesirable total variance part and a desirable positive variability part. Minimization is taken with respect not to total variance as in the Sharpe-Lintner CAPM, but to the total variance less the positive variability. Positive covariability reduces risk premium, and has a similar effect compared to positive skewness or upper partial moment. The empirical results in our MCF model indicate good performance of the model. Secondly, and more importantly, the model produces easily computable optimal portfolios accounting simultaneously for negative variance contribution but positive skewness contributions to a risk-averse representative agent. We employ the model to explain the idiosyncratic volatility and negative premium puzzle in the literature. This is accomplished under rational equilibrium asset pricing without imposing additional linear regression specifications.
Demographic distribution and bond pricing with a semi-parametric arbitrage-free yield curve model

LINLIN NIU
Xiamen University, China

ABSTRACT
Life cycle consumption and savings decision of individuals determine the aggregate savings and interest rate level through the demographic structure of population. We build a semi-parametric affine arbitrage-free yield curve model, to incorporate a slow moving determinant of interest rate levels explained by the evolving age distribution and its expectation. Estimating the model with US data from 1950s to present, we find the extracted long term determinant captures the smooth trend in US Treasury yields. The business cycle component is well explained by a VAR with macro or latent variables. At the medium to long horizons, it produces better out-of-sample forecast performance than the traditional autoregressive model without time-varying means or with simple demographic index as explanatory variable.
Basket credit derivatives pricing in a Markov chain model with interacting intensities and contagion risk

XIAOSONG QIAN
Soochow University, China

ABSTRACT
We analyze basket credit derivative contracts (BCDS and BCLN) with counterparty risk using a markov chain interacting intensities with contagion model. We assume the default intensities of the protection seller and the references are affected by an external shock event and contagion risk. The arrival of the shock event is a Cox process whose stochastic intensity is an affine diffusion process with jumps. We derive a recursive formula for the joint default probability of reference assets. The pricing formulas of BCDS and BCLN are presented. We also examine how the correlated default risks between the protection seller and the underlying entity may affect the premium rates.
Recent advances on market making regulation

**Mathieu Rosenbaum**

*École Polytechnique, France*

**ABSTRACT**

In this talk, we present recent tools enabling regulators and exchanges to set relevant operating rules for financial markets, notably at the microstructure level. We first introduce the issue of optimal make-take fees, which consists in finding suitable contracts between market makers and exchanges to ensure the attractiveness of markets. Mathematically speaking, we formulate this question in term of a principal-agent problem that we solve in an original way. Then we present a new methodology allowing us for a ranking of market makers according to the quality of the liquidity they provide. In this approach, we use a very general modelling of limit order books via non-linear and state dependent Hawkes-like processes for which new ergodic properties are proved. This talk is based on joint works with Omar El Euch, Thibaut Mastrolia, Othmane Mounjid, Pamela Saliba and Nizar Touzi.
Mean-variance hedging without information

MARTIN SCHWEIZER

ETH Zürich, Switzerland

ABSTRACT

Our goal is to solve the problems of mean-variance hedging (MVH) and mean-variance portfolio selection (MVPS) under restricted information. We work in a setting where the underlying price process $S$ is a semimartingale, and a smaller filtration $G$ models the information available for constructing trading strategies. We concentrate on the zero-information case where $G = F^{det}$, which means that trading strategies must be deterministic functions. If we assume that $S$ is a time-dependent affine transformation of a square-integrable martingale, we can give explicit solutions to the MVH and MVPS problems. Explicit formulas are obtained for hedging European call options in the Bachelier and Black-Scholes models. This is based on joint work with Danijel Zivoi and Mario Sikic.
Backtesting, prequential analysis and prediction process

HIDEATSU TSUKAHARA

Seijo University, Japan

ABSTRACT

In the prequential framework, data are observed sequentially in time, and at each time it is required to make a prediction about the distribution of the next observation conditional on the past, based on the data up to that point. Sometime later, we need to check whether the sequence of our forecasts are consistent with that of observations. This ex-post examination of predictive performance is called a backtesting in finance. Through the recent controversy on backtestability issue, we now know that, depending on which aspect of the conditional distribution we try to predict, we are faced with varying difficulty in devising backtesting procedures. In this talk, some attempts are made to extend Davis’ calibration concept to larger classes of statistical functions (with values in an abstract space). Comparison of two probability forecasting systems under absolute continuity condition may be interpreted in terms of the corresponding prediction processes which always possess Markov property, and we explore its implications. Computation for a few simple examples from time series analysis will be shown to exemplify the theory. Finally, the possibility of extensions to the case with auxiliary random variables (covariates) and to the continuous-time case will be discussed.
News co-occurrence, attention spillover, and return predictability

LI GUO\textsuperscript{a}, LIN PENG\textsuperscript{b}, YUBO TAO\textsuperscript{a}, AND JUN TU\textsuperscript{a}

\textsuperscript{a}Singapore Management University, Singapore
\textsuperscript{b}Baruch College - The City University of New York, USA

ABSTRACT

We examine the effect of investor attention spillover on stock return predictability. Using a novel measure, the News Network Triggered Attention index (NNTA), we find that NNTA negatively predicts market returns with a monthly in(out)-of-sample R-square of 5.97\% (5.80\%). In the cross-section, a long-short portfolio based on news co-occurrence generates a significant monthly alpha of 68 basis points. The results are robust to the inclusion of alternative attention proxies, sentiment measures, other news- and information-based predictors, across recession and expansion periods. We further validate the attention spillover effect by showing that news co-mentioning leads to greater increases in Google and Bloomberg search volumes than unconditional news coverage. Our findings suggest that attention spillover in a news-based network can lead to significant stock market overvaluations, and especially when arbitrage is limited.
Using generalized estimating equations to estimate nonlinear models with spatial data

WEINING WANG

City, University of London, UK

ABSTRACT

In this paper, we study estimation of nonlinear models with cross sectional data using two-step generalized estimating equations (GEE) in the quasi-maximum likelihood estimation (QMLE) framework. In the interest of improving efficiency, we propose a grouping estimator to account for the potential spatial correlation in the underlying innovations. We use a Poisson model and a Negative Binomial II model for count data and a Probit model for binary response data to demonstrate the GEE procedure. Under mild weak dependency assumptions, results on estimation consistency and asymptotic normality are provided. Monte Carlo simulations show efficiency gain of our approach in comparison of different estimation methods for count data and binary response data. Finally we apply the GEE approach to study the determinants of the inflow foreign direct investment (FDI) to China.
Autoencoder asset pricing models

DACHENG XIU

The University of Chicago Booth School of Business, USA

ABSTRACT

We propose a new latent factor conditional asset pricing model. Like Kelly, Pruitt, and Su (2019), our model allows for latent factors and factor exposures that depend on covariates such as asset characteristics. But, unlike the linearity assumption of KPS, we model factor exposures as a flexible nonlinear function of covariates. Our model retrofits the workhorse unsupervised dimension reduction device from the machine learning literature - autoencoder neural networks - to incorporate information from covariates along with returns themselves. This delivers estimates of nonlinear conditional exposures and the associated latent factors. Furthermore, our machine learning framework imposes the economic restriction of no-arbitrage. Our autoencoder asset pricing model delivers out-of-sample pricing errors that are far smaller (and generally insignificant) compared to other leading factor models.
Double machine learning with gradient boosting and its application to the big N audit quality effect

JUI-CHUNG (RAY) YANG\textsuperscript{a}, HUI-CHING CHUANG\textsuperscript{b}, AND CHUNG-MING KUAN\textsuperscript{c}

\textsuperscript{a}National Tsing Hua University, Taiwan
\textsuperscript{b}Yuan Ze University, Taiwan
\textsuperscript{c}National Taiwan University, Taiwan

ABSTRACT

In this paper, we study the double machine learning (DML) approach of Chernozhukov et al. (2018) for estimating average treatment effect and apply this approach to examine the Big N audit quality effect in the accounting literature. This approach relies on machine learning methods and is suitable when a high dimensional nuisance function with many covariates is present in the model. This approach does not suffer from the “regularization bias” when a learning method with a proper convergence rate is used. We demonstrate by simulations that, for the DML approach, the gradient boosting method is to be preferred to other learning methods, such as regression tree and random forest. We then apply this approach with gradient boosting to estimate the Big N effect.

We find that Big N auditors have a positive effect on audit quality and that this effect is not only statistically significant but also economically important. We also show that, in contrast to the results of propensity score matching, our estimates of said effect are quite robust to the hyper-parameters in the gradient boosting algorithm.

Keywords: Audit Quality, Average Treatment Effect, Big N Effect, Double Machine Learning, Gradient Boosting, Performance-Matched Discretionary Accruals

JEL Classification: C14, C31, M42
Hermite expansion for transition densities of irreducible diffusions with an application to option pricing

NIAN YANG
Nanjing University, China

ABSTRACT

A diffusion is said to be reducible if there exists a one-to-one transformation of the diffusion into a new one whose diffusion matrix is the identity diffusion matrix, otherwise it is irreducible (Ait-Sahalia, 2008). Ait-Sahalia (2002) uses Hermite polynomials as orthogonal basis to expand the transition density of the transformed process, because it is “closer” to a standard normal than that of the original process. However, most multivariate diffusions such as the stochastic volatility models are irreducible. As pointed out by Ait-Sahalia (2008), the straight Hermite expansion will not in general converge for irreducible diffusions.

In this paper we manage to develop the convergent Hermite expansion for transition densities of irreducible diffusions. By introducing a quasi-Lamperti transform unitizing the process’ diffusion matrix at the initial time, we can expand the transition density of the transformed process using Hermite polynomials as the orthogonal basis. Then we derive explicit recursive formulas for the expansion coefficients using the Ito-Taylor expansion method, and prove the convergence of the expansion as the time interval shrinks to zero. Moreover, we show that the newly derived Hermite expansion unifies some existing methods including the pathwise expansion of Li (2013) and the Ito-Taylor expansion of Yang, Chen, and Wan (2019). Hence we theoretically justify the conjecture of Yang, Chen, and Wan (2019) that the pathwise and Ito-Taylor expansions are equivalent up to an appropriate way collecting terms. In addition, we demonstrate the advantage of Hermite expansion by deriving explicit recursive expansion formulas for European option prices under irreducible diffusions. Numerical experiments illustrate the accuracy and effectiveness of our approach.

This is a joint work with Xiangwei Wan from Shanghai Jiao Tong University.
Convex duality in portfolio theory

QIJI ZHU

Western Michigan University, USA

ABSTRACT

Portfolio problems can be phased in terms of convex programing problems. The related dual problems often have interesting financial meanings. We illustrate the role of convex duality in portfolio theory using a simple one period model and points to many interesting directions for further exploration.