Princeton-Humboldt Conference

Program & Abstracts

November 1-2, 2013. Princeton

Friday, November 1st, 2013

8:30 - 8:55 Breakfast

8:55 - 9:00 Opening remarks

9:00 - 9:30 Marc Hallin (Princeton)
Signal Detection in High Dimension: testing sphericity against spiked alternatives.
We consider the problem of testing the null hypothesis of sphericity for a high-dimensional covariance matrix against the alternative of a finite (unspecified) number of symmetry-breaking directions (multispiked alternatives). Simple analytical expressions are derived for the asymptotic power envelope and the asymptotic powers of existing tests. These asymptotic powers are shown to lie very substantially below the power envelope. In contrast, the asymptotic power of the likelihood ratio test is shown to be uniformly close to the same.

[Joint work with Marcelo Moreira and Alexei Onatski]

9:30 - 10:00 Brenda Lopez (Humboldt)
A consistent two-factor model for pricing temperature derivatives
The market price of risk (MPR) is an important parameter of the associated equivalent martingale measure (EMM) and it is of high scientific interest for financial risk analysis and for better economic modeling of fair valuation of risk. In this paper we use a consistent factor model for pricing temperature derivatives that incorporates the forward looking information available in

the market by specifying a model for the complete forecast curve. With the information available in the market, historical and forecast temperature data, we calibrate the MPR of temperature futures derivatives written on temperature indices traded at the Chicago Mercantile Exchange (CME). The factor model surprising shows that the behaviour of the implied MPR for futures traded in and out of the measurement period is more stable compared with the other estimates in the literature.
[Joint work with Andeas Groll and Thilo Meyer-Brandis]

10:00 - 10:30 Warren Powell (Princeton)
Approximate dynamic programming for the control of grid-level energy storage.

Energy storage (batteries, water reservoirs, compressed air, and deferred demand) is used to smooth different forms of variability and uncertainty on the grid. Variability arises in the form of predictable daily patterns of demand, temperature, wind and solar energy, and prices. Uncertainty arises in the form of deviations from forecasts, which include Gaussian noise (temperature variations), heavy-tailed price variations, infrequent equipment failures (generation or transmission), and temporal shifts (storms arriving earlier or later than expected). I will contrast different algorithmic strategies that fall under the broad umbrella of approximate dynamic programming, including least squares policy iteration, direct policy search, approximate policy iteration (using a variety of approximation strategies), and approximate value iteration exploiting convexity, all of which will be compared against optimal benchmarks.

10:30 - 11:00 Coffee break

11:00 - 11:30 Jianqing Fan (Princeton)
Large Panel Test of Factor Pricing Models

We consider testing the mean-variance efficiency in the context of a high-dimensional multi-factor model, with the number of assets much larger than the time-series dimension. Most of the existing tests are based on a quadratic form of estimated alphas. Under high dimensionality, however, they all suffer from low powers because the accumulation of a large amount of estimation errors overrides the signals of the true nonzero alphas. To resolve this issue, we propose a new test that deals with high-dimensional hypothesis testing problems, called "power enhancement". A screening statistic is introduced to screen off most of the estimation errors and consistently select stocks with significant alphas. We develop a feasible standardized Wald statistic using a consistent estimator of the high-dimensional weight matrix based on thresholding. In addition, by attaching the screening statistic to the traditional quadratic-form tests, our proposed test significantly enhances the power of the Wald-type tests under most of the alternatives, while keeping a correct asymptotic size. Finally, the proposed methods are applied to the securities in the S&P 500 index as an empirical application. The empirical study shows that market inefficiency is primarily caused by a small portion of mispriced stocks, instead of aggregated alphas. Moreover,

most of the significant alphas are due to extra returns (underpriced).
[Joint work with Yuan Liao and Jiawei Yao]

11:30 - 12:00 Maria Grith (Humboldt)
Options Implied Stock Return Distributions

A pricing kernel specification reflecting market preferences in a model with state variable and reference point formation is implemented to adjust the risk neutral density of the stock return dynamics. This yields the density of the returns under the physical measure, which captures market expectations. The novelty of the method is that it allows for the non-monotonicity of the pricing kernel which might lead to improved forecasts of the physical density. Based on the DAX Index and option data at EUREX we investigate the existence of the empirical pricing kernel puzzle, i.e. a locally increasing pricing kernel, and estimate the physical density of the DAX Index returns. The results show that our method provides better forecasts of the physical densities across different maturities as compared to methods using strictly decreasing pricing kernel specification.
[Joint work with Ioana Duca and Wolfgang K. Härdle]

12:00 - 2:00 Lunch

2:00 - 2:30 Thorsten Dickhaus (WIAS, Berlin)
Bootstrap methods for simultaneous statistical inference in dynamic factor models

Dynamic factor models (DFMs) are popular tools in econometrics to describe the dynamics of a multi-dimensional time series by a lower-dimensional set of (possibly latent) common factors. The resulting error or remainder terms are referred to as specific factors. Based on the theory of multiple statistical hypothesis testing, we propose the usage of vectors of Wald statistics for addressing various problems of simultaneous statistical inference in DFMs, assuming that the model is identified and model restrictions are testable. In particular, we demonstrate how the problems "Which of the specific factors have a non-trivial autocorrelation structure?" and "Which of the common factors have a lagged influence on which component of the observable process?" can be addressed by our methodology. Since it is well-known that convergence of Wald statistics to their limiting chi-square distribution is rather slow, we discuss consistent model-based bootstrap methods for approximating the joint finite-sample distribution of the vector of Wald statistics in DFMs.
[Joint work with Markus Pauly]

2:30 - 3:00 Ostap Okhrin (Humboldt)
Efficient and Sparse Estimation of Copula-based Models for Multivariate Time Series

This paper provides a novel approach to use maximum likelihood (ML) estimation in the con-

text of copula-based models for multivariate time series. The approach relies on a simple iterative algorithm connecting the estimation of the copula component of the log likelihood with the estimation of the time series component and vice versa. In this spirit, the procedure combines the simplicity of ordinary ML estimation with the flexibility of copula-based models. This is applicable to several types of models, e.g., vector autoregressive moving average (VARMA), copula-GARCH or vector multiplicative error (VMEM) models. The consistency and asymptotic normality of the iteratively updated estimator is established for each iteration step. For a large number of iterations, the estimator converges to the maximum likelihood estimator. In addition, the procedure is extended to obtain sparse estimates in high-dimensions by modifying the initial estimation in order to reduce the model complexity.
[Joint work with Alexander Ristig and Nikolaus Hautsch]

3:00 - 3:30 Andreas Andresen (WIAS, Berlin)
Finite sample analysis of maximum likelihood estimators and convergence of the alternating procedure.

V. Spokoiny's "Parametric estimation. Finite sample theory" (2011) presents a way to analyse the finite sample deviation behaviour of maximum likelihood estimators. The talk explains the main ideas of these results and how the local quadratic bracketing device of that paper allows to extend the results to profile estimators in semi parametric models. Further it is shown how the local quadratic bracketing device and the bounds for parametric maximum likelihood estimators from Spokoiny (2011) could serve as tools to derive a general convergence result for the alternating procedure to approximate the profile maximum likelihood estimator.

3:30 - 4:00 Coffee break

4:00 - 4:30 Markus Bibinger (Humboldt)
Estimating the quadratic covariation matrix from noisy observations: local method of moments and efficiency

We provide a lower bound for the variance of estimation of the quadratic covariation matrix of a continuous-time martingale from discrete high-frequency observations which are subject to microstructure noise and asynchronicity. It is demonstrated that a local parametric generalized method of moments approach renders an asymptotically efficient estimator attaining the lower bound. We establish a central limit theorem, also under model misspecification in a standard continuous semi-martingale setup. A nonparametric estimator for the instantaneous covolatility matrix is obtained implicitly.

4:30 - 5:00 Mengdi Wang (Princeton)
Stochastic Methods for Convex Optimization with "Difficult" Constraints

Convex optimization problems involving large-scale data or expected values are challenging, es-

pecially when these difficulties are associated with the constraint set. We propose random algorithms for such problems, and focus on special structures that lend themselves to sampling, such as when the constraint is the intersection of many simpler sets, involves a system of inequalities, or involves expected values, and/or the objective function is an expected value, etc. We propose a class of new methods that combine elements of successive projection, stochastic gradient descent and proximal point algorithm. This class of methods also contain as special cases many known algorithms. We use a unified analytic framework to prove their almost sure convergence and the rate of convergence. Our framework allows the random algorithms to be applied with various sampling schemes (i.i.d, Markov, sequential, etc), which are suitable for applications involving distributed implementation, large data set, computing equilibriums, or statistical learning.

Saturday, November 2nd, 2013

8:30 - 9:00 Breakfast

9:00 - 9:30 Zach Feinstein (Princeton)
Risk measure scalarization and time consistency in illiquid markets.

Set-valued risk measures have been proposed to consider risk in markets with transaction costs. In this talk we will discuss a scalarization technique of such functions and consider time consistency of these scalarized risk measures.

9:30 - 10:00 Ulrich Horst (Humboldt)
A Non-Markovian Liquidation Problem and Backward SPDEs with Singular Terminal Conditions

We establish existence and regularity of solutions results for a class of backward stochastic partial differential equations with singular terminal condition. The equation describes the value function of non-Markovian stochastic control optimal problem in which the terminal state of the controlled process is pre-specified. The analysis of such control problems is motivated by models of optimal portfolio liquidation.

10:00 - 10:30 John Mulvey (Princeton)
A Portfolio of Tactics.

We construct a portfolio of well-established investment tactics via commodity futures markets. The goal is to improve diversification benefits and to harvest rebalancing gains. Commodity markets are ideal for attaining this goal due to their high volatility, lack of arbitrage in the term structure, relative independence of returns, and ease of shorting. The approach is evaluated with respect to historical back tests, and robustness by means of a stochastic programming model for optimizing risk-adjusted performance.
[Joint work with Max Goer]

10:30 - 11:00 Coffee break

11:00 - 11:30 Gökhan Cebiroglu (Humboldt)
Can Contracting and Trading Frictions explain the Empirical Pricing Kernel Puzzle?

A majority of trading and investment decisions is taken by intermediaries, fund managers and agents, not by the individual investor itself. Hence, utilities derived from the empirical pricing kernel, to a substantial degree, reflect fund managers' preferences. In this model, I show that the utilitarian implications of such a setup can be enormous. Precisely, when principal investors delegate investment decisions to fund managers, the empirical pricing kernel is non-monotonous

and hump-shaped. This is known as the empirical pricing kernel puzzle (c.f. Aït-Sahalia and Lo (2000), Journal of Econometrics 94: 951; and Jackwerth (2000), The Review of Financial Studies 13(2), 43351.). In this framework the hump-shape arises from contracting frictions and the compensation scheme that has been agreed between the principal and its agent. For instance, I show that the width of the non-concavity region is determined by liquidation costs, while the height of the hump is related to the manager's incentive package.

11:30 - 12:00 Ronnie Sircar (Princeton)
Analysis of Leveraged ETF Options

Financial Crisis notwithstanding, new products continue to be developed in financial markets to try and enhance portfolio returns through leverage. Exchange-traded funds (ETFs) are products that track the returns on various financial quantities. Leveraged ETFs (LETFs) promise a fixed leverage ratio with respect to a given underlying asset or index. We analyze options (puts and calls) written on various LETFs. Since different LETFs are supposed to track the same underlying index or ETF, these funds and their associated options have very similar sources of randomness. This gives rise to the question of consistent pricing of options on ETFs and LETFs. Specifically, we discuss the dynamics of leveraged ETFs and analyze the implied volatility surfaces derived from options prices on leveraged and unleveraged ETFs through multiscale stochastic volatility models. We present empirical evidence of potential price discrepancies among ETF options with different leverage ratios. We also introduce a moneyness scaling formula that links option implied volatilities between leveraged and unleveraged ETFs.
[Joint work with Tim Leung]

12:00 - 2:00 Lunch

2:00 - 2:30 Piotr Majer (Humboldt)
Portfolio Decisions and Corresponding Brain Actions

Decision making is a complex process of integrating and comparing various aspects of choice options. Understanding the activation pattern in the human brain during decisions under risk and neural processes underlying (risky) investment decisions are cardinal goals in neuroeconomics. In this paper, functional magnetic resonance imaging (fMRI) data from an investment decision study is analyzed. We propose a new method for identifying the activated brain regions. Our analysis is focused on the brain clusters rather than voxels units. Thus, we achieve a higher signal to noise ratio within the unit tested and a smaller number of hypotheses tests compared with the GLM method. The brain parecllation is done by spatially constrained Ncut spectral clustering. The information within each cluster is extracted by model-free DSFM dimension reduction technique and tested for activation. Our method allows for the analysis of the higher moments of the signal. Further, the risk attitudes of all subjects is classified based on the estimated low-dimensional time series. Our classification analysis successfully confirms the estimated risk

attitudes derived directly from subjects' decision behavior.
[Joint work with Peter N.C.Mohr, Hauke R. Heekeren and Wolfgang K. Härdle]

2:30 - 3:00 Dan Christina Wang (Princeton)
Estimation of the Leverage Effect in Jump Processes

The leverage effect describes the (usually) negative correlation between stock returns and volatility. By defining the leverage effect parameter as the quadratic covariation between the log price and volatility processes, we studied the nonparametric estimation of the leverage effect when jumps present in both log price and volatility processes. When jumps present, the leverage effect contains a continuous and a discontinuous components. we proposed consistent estimators for the continuous and discontinuous components of the leverage effect respectively, and also the joint total leverage effect. The central limit theorems of the leverage effect estimators are derived and the simulation results corroborate the theoretical finding. We further considered the estimation when market microstructure noise presents in the log price process. The estimator in the noisy case is constructed based on an pre-averaging idea. CLT of the estimator is carefully studied and simulation results corroborating the theoretical finding are presented.

3:00 - 3:30 Weining Wang (Humboldt)
Hidden Markov structures for Dynamic Copulae

Understanding the dynamics of a high dimensional non-normal dependency structure is a challenging task. A multivariate Gaussian or mixed normal time varying models are limited in capturing important types of data features such as heavy tails, asymmetry, and nonlinear dependencies. This research aims at tackling this problem by building up a hidden Markov model (HMM) for hierarchical Archimedean copulae (HAC). The HAC constitute a wide class of models for high dimensional dependencies, and HMM is a statistical technique for describing regime switching dynamics. HMM applied to HAC flexibly models high dimensional non-Gaussian time series. In this paper we apply the expectation maximization (EM) algorithm for parameter estimation. Consistency results for both parameters and HAC structures are established in an HMM framework. The model is calibrated to exchange rate data with a VaR application. This example is motivated by a local adaptive analysis that yields a time varying HAC model. We compare the forecasting performance with other classical dynamic models. In another, second, application we model a rainfall process. This task is of particular theoretical and practical interest because of the specific structure and required untypical treatment of precipitation data.

3:30 - 4:00 Coffee break

4:00 - 4:30 Kevin Webster (Princeton)
Structural relationships on a limit order book

High Frequency transactions represent an ever growing proportion of all financial trades. Most

markets have now switched to an electronic order book system. We study such an exchange structure and propose continuous time equations which generalize the self-financing relationships in frictionless markets to electronic markets with limit order books. We start from a microscopic trade-by-trade description of the market that includes a number of stylized facts: bid-ask spread of the same order of magnitude as price changes, price impact and recovery as well as incorporating both market orders and limit orders. These facts lead to constraints on the class of self-financing portfolio equations which differ from the ones used in other papers. To gain tractability, we take the diffusion limit of this microscopic model to conclude with similar constraints on self-financing portfolios in a continuous time setting. We apply the main result to the study of market making on liquid instruments.

4:30 - 5:00 Matt Lorig (Princeton)

Pricing Variance Swaps on Time-Changed Markov Processes

We prove that the variance swap rate is just the price of a co-terminal European-style contract when the underlying is modeled as an exponential Markov process, time-changed by an arbitrary continuous stochastic clock, which has arbitrary correlation with the driving Markov process. The payoff function of the European contract that prices the variance swap satisfies an ordinary integro-differential equation, which depends only on the dynamics of the Markov process, not on the clock. We present examples of Markov processes whose payoff function can be computed explicitly. When the Markov process is a Lvy process, the European contract has a log-style payoff, which recovers the results Carr, Lee, and Wu (2011).

[Joint work with Peter Carr and Roger Lee]