AKSOE 14: Financial Markets and Risk Management III

Time: Thursday 14:00–17:45 Location: H8

AKSOE 14.1 Thu 14:00 H8

Noise Reduction by Power Mapping for Improved Portfolio Optimization — •Rudi Schäfer, Nils Fredrik Nilsson, and Thomas Guhr — Mathematical physics, LTH, Lund university, P.O. Box 118, 22 100 Lund, Sweden

To construct an optimal portfolio it is of vital interest to know the correlations between different stocks. However, due to the finiteness of recorded time series the true correlations are covered by a considerable amount of noise [1]. This leads to a systematic underestimation of risk.

In 2003 Guhr and Kälber [2] introduced the *power mapping* to suppress this noise and thereby effectively "prolong" the time series. This method raises the absolute value of each matrix element to a power q while preserving the sign. There is a trade-off between suppressing the noise and destroying the true correlations in the matrix. We use the Markowitz portfolio optimization as a criterion for finding the optimal value for q. In particular, we investigate how this value is effected by changing the underlying correlation structure and the tail behavior of the random processes used to simulate the stock prices.

[1] L. Laloux *et al*, Phys. Rev. Lett. 83, 1467 (1999)
[2] T. Guhr, B. Kälber, J. Phys. A 36, 3009 (2003)

AKSOE 14.2 Thu 14:30 H8

Downside Risk metrics for Hedge Funds: an empirical and a theoretical approach — •Josep Perelló — Departament de Física Fonamental, Universitat de Barcelona, Spain

Hedge Funds are considered as one of the portfolio management sectors which shows a fastest growing for the past decade. An optimal Hedge Fund management requires an appropriate risk metrics. The classic CAPM theory and its Ratio Sharpe fail to capture some crucial aspects due to the strong non-Gaussian character of Hedge Funds statistics. A possible way out to this problem while keeping CAPM simplicity is the so-called Downside Risk analysis. One important benefit lies in distinguishing between good and bad returns, that is: returns greater or lower than investor's goal. We revisit most popular Downside Risk indicators and provide new analytical results on them. We compute these risk measures by taking the Credit Suisse/Tremont Investable Hedge Fund Index Data. A rather unusual transversal lecture of the existing Downside Risk measures is also provided. We study the Gaussian, the Laplace and the power law distributions in the Downside Risk framework and comment their abilities to get a proper picture of the Hedge Fund universe.

AKSOE 14.3 Thu 15:00 H8

An evolving Potts model of financial markets with threefold imput agents — •Georges Harras and Didier Sornette — ETH Zürich, Chair of Entrepreneurial Risks, Zürich, Switzerland

We study a model of financial price dynamics based on the Potts model with trading agents which, at every time step, can act in three possible ways: sell, buy or remain inactive. The price dynamics result from the aggregation of these actions. The agents base their decision on three different kinds of information: personal information, public information (news) and information from their neighbors (imitation). The impact of these latter two on the decision making process are coupled to their past prediction power and evolve in time. Our model is able to reproduce the major stylized facts, relating them to the subtle interplay of the endogenous factors and exogenous information.

AKSOE 14.4 Thu 15:30 H8

Endogenous drawdown outliers in the limit-order-book — •Gilles Daniel and Didier Sornette — ETH Zürich, Chair of Entrepreneurial Risks, Zürich, Switzerland

We investigate by means of computer simulations the intra-day dynamics of stock markets. The main statistical properties of price changes exhibited by real markets can be recovered with a zero-intelligence model of agents. Their origin is found in the subtle interplay between limit orders, which supply liquidity, and market and cancellation orders, which remove it.

We then propose a parsimonious model of self-referential agents grounded on documented behavioral finance, in which rational bubbles can emerge, grow and burst endogenously, with no need for a reference to an exogenous fundamental value, and no need for communication between agents. These bubbles and crashes correspond to a regime shift in the system, are quantified by robust measures of drawdowns, and can be distinguished from the rest of the distribution of returns: they are statistical outliers. Thus the statistics reveals the existence of transient collective organizations of the self-referential agents which create particular market phases associated with the bubbles and crashes. These results are very similar to previous studies on the statistics of drawdowns in real financial time series, suggesting a common origin.

15 min. break

AKSOE 14.5 Thu 16:15 H8

Scaling behavior of Student-Lévy processes — •Oliver Grothe[1] and Rafael Schmidt[2] — [1]Research Training Group Risk Management, University of Cologne, Germany — [2]Department of Economic and Social Statistics, University of Cologne, Germany

Student's t-distributions are widely used in financial studies as fat-tailed alternatives to normal distributions. However, as Student's t-distributions are not invariant under convolution, there are no Lévy processes with Student's t-marginals at all time points. As Oliveira et al. (2000) show, the convolution of two Student's t-distributions can well be approximated by Student's t-distributions with other parameters. Extending their approximation to a generalized Student-Levy process, however, violates the typical variance scaling property of the process. Following Heyde and Leonenko (2005), we focus on Lévy processes with Student's t-marginals at certain time points. We show, that a Student's t-approximation for the marginals is also suitable for other time horizons, while not exact. Using this approximation, we are able to describe the scaling behavior of the resulting generalized Student-Lévy processes. We provide an application of our approximation in the context of modelling high-frequency price returns.

AKSOE 14.6 Thu 16:45 H8

Correlation matrices of synthetic continuous time random walks — •Daniel Fulger[1], Enrico Scalas[2], and Guido Germano[1] — [1]Philipps-University Marburg, 35032 Marburg, Germany — [2]Amedeo Avogadro University of East Piedmont, 15100 Alessandria, Italy

We present a method for the simulation of anomalous diffusion processes governed by time and space fractional differential equations. Processes of this kind are used e.g. to model high-frequency financial time series. The method is based on Monte Carlo simulation of continuous time random walks with Mittag-Leffler distributed waiting times and Lévy distributed jumps. Our new combination of fast techniques for the generation of Mittag-Leffler and Lévy deviates outruns previous simulation methods by orders of magnitude. This enables to generate a great number of synthetic time series in a short time and thus to perform on a large scale a new kind of null-hypothesis tests within random matrix theory, that is a useful theory to analyze and de-noise time series employing empirical correlation matrices. The latter are also important in financial risk analysis.

AKSOE 14.7 Thu 17:15 H8

Theoretical predictions and empirical observations of eigenvalue spectra of time-lagged correlation matrices — •Christoly Biely[1,2] and Stefan Thurner[1,2] — [1]Complex Systems Research Group, HNO, Medical University of Vienna, Währinger Gürtel 18-20, A-1090 Vienna, Austria — [2]Atominstitut d. österr. Universitäten, Stadionallee 2, A-1020 Vienna, Austria

Recently, the study of eigenvalue spectra of financial correlation matrices has attracted considerable interest due to its applications in financial engineering. We contribute a theoretical understanding of the case of time-lagged correlation matrices, which can be seen as real, asymmetric matrices with a special structure superimposed due to the shifting of the individual time-series: We prove that the respective eigenvalue spectra are circular symmetric in the complex plane under the assumption of time-series being (finite) Brownian random walks. Further, we solve the problem of determining their radial eigenvalue density via an inverse Abel-Transform of the solution of the eigenvalue density of the symmetrized problem. We then compare the theoretical results with empirical 5 minute returns of the S&P500 and discuss

the observed deviations. Non-trivial patterns such as 'causal industry sectors' and non-random structures indicated by eigenvalues departing from the theoretical spectrum are discussed in some detail.