Warwick MathSys MSc Project Proposal

Title: Modelling Long Range Correlations in Asset Returns

Internal Supervisors:

    Prof Robin Ball (R.C.Ball@warwick.ac.uk)

External Supervisors:

    Dr Marcus Ong (marcus.ong@spectraanalytics.com)

    Dr Dan Sprague (dan.sprague@spectraanalytics.com)

Project Description

Traditional models of asset pricing, such as random walks, have assumed that asset returns are martingales (or semi-martingales) where knowledge of historical returns does not increase the ability to predict the expectation of future returns. This implies that there is no long memory to the process. Whilst this may be appropriate for the expectation it is inconsistent with empirical findings for higher order moments such as volatility clustering and multifractality **[Cont, 2001]** and the persistence in the auto-information function **[Ong, 2015]**.

We have developed a new model to simulate high dimensional multivariate data for asset returns using MCMC and a heavy tailed distribution known as a q-Gaussian; this is a re-parametrisation of the student t-distribution **[Ong & Sprague, 2015]**. We would like to develop this model to incorporate long range auto and cross-correlations.

We are particularly interested in incorporating the model within a multifractal framework. Models such as the Multifractal Random Walk (MRW) **[Bacry, 2001]** have shown particular promise. Another approach would be to use Gaussian Processes. Should time permit, we would also like to investigate the predictive properties of the multifractal spectrum.

This research has important implications for asset pricing and risk management. Should the research prove successful there is the opportunity to be included in our publication and the work may be used in a new systemic stress testing initiative for the Bank of England. We would also be interested in extending this project for PhD research.

References

1) Bacry, E., Delour, J. & Muzy, J.F., A Multifractal Random Walk, Phys. Rev. E64, 2001
2) Cont R., Empirical Properties of Asset Returns: Stylized Facts & Statistical Issues, Quantitative Finance 1(2), 2001, 223-236.
3) Liu R., Multivariate Multifractal Models: Estimation of Parameters and Applications to Risk Management, University of Keil, Thesis, 2008
4) Ong M.A., Financial Time Series Analysis & Multifractal Replication, Mini-project, 2011
5) Ong M.A., An Information theoretic analysis of stock returns, volatility and trading volumes, Journal of Applied Economics, Vol. 47, Iss. 36, 2015
6) Ong M.A. & Sprague D., Modelling Implied Volatility Dynamics using Multivariate q-Gaussian Distributions, Working Paper, 2015