PhD opportunities in London Metropolitan University.

September 8, 2010

Ref 3.9 - Data Mining Models for Flexible Modeling of the Location, Scale and Shape Parameters of a Response Distribution

Contact Person: Dr Mikis Stasinopoulos (email: ⟨d.stasinopoulos@londonmet.ac.uk⟩)

The objective of this research project is to incorporate data mining models within generalized additive models for location, scale and shape (GAMLSS). The data mining models will include neural network, support vector machine and decision tree and boosting models, see Hastie *et al.* 2009. Data mining models are currently very limited in the distributions they allow for the response variable and model only the mean. GAMLSS provides a very general and flexible model for a response variable. The distribution of the response variable in GAMLSS is selected by the user from a very wide range of available distributions including highly skewed and kurtotic continuous and discrete distributions. GAMLSS includes distributions with up to four parameters, denoted by μ, σ, ν and τ , which usually represent the location (e.g. mean), scale (e.g. standard deviation), and skewness and kurtosis shape parameters respectively. All the parameters of the response variable distribution can currently be modelled within GAMLSS using parametric and/or nonparametric smooth functions of explanatory variables. This project will extend this flexibility to incorporate within GAMLSS data mining models for all the parameters, thus allowing more flexible modeling of the location, scale and shape parameters. The student should have a good honours degree or MSc in Mathematics or Statistics or a related area.

Hastie T., Tibshirani R. and Friedman J. (2009) *Elements of statistical learning: Data Mining, Inference, and Prediction*. Springer, New York.

Rigby, R. A. and Stasinopoulos, D. M. (2005). Generalized additive models for location, scale and shape, (with discussion). *Appl. Statist.*, 54: 507-554.

Ref 3.10 - Comparison, Evaluation and Development of Stochastic Volatility Models

Contact Person: Dr Mikis Stasinopoulos (email: ⟨d.stasinopoulos@londonmet.ac.uk⟩)

The volatility of the markets plays an important role in evaluating derivatives. The volatility of a specific stock is related to the variance of the particular stochastic process assumed for modelling the relevant stock. The most common stochastic process used is a Wiener process which assumes that differences in stock values follow a normal distribution. This assumption in practice has been found to be unrealistic with data series often indicating skewness (not incorporated in the normal distribution assumption) and kurtosis (usually larger that the one implied by the normal distribution assumption. i.e. lepto-kurtosis). The generalized additive models for location scale and shape (GAMLSS), Rigby and Stasinopoulos (2005), are regression type of models in which the distribution of the response variable can be both skew and kurtotic therefore suitable for modelling stock returns. The most common statistical model for modelling stochastic volatility is the Generalised Autoregressive Conditional Heteroskedastic (GARCH) model, see Bollerslev et al. (1994), and models related to it such as the APARCH model introduced by Ding et al. (1993). An alternative model for volatility is the multi-fractals models (MF) proposed by Mandelbrot (1997). This project will compare and evaluate the GARCH, APARCH, MF and GAMLSS models and develop them further. The student should have a good honours degree or M.Sc. in Mathematics or Statistics or a related area.

Bollerslev T., Engle R.F. and Nelson D.B., (1994); ARCH Model, Handbook of Econometrics

Mandelbrot B. B. (2001) Scaling in financial prices: I. Tails and dependence, Quantitative Finance, Volume 1, Issue 1 January 2001 , pages 113-123.

Rigby, R. A. and Stasinopoulos, D. M. (2005). Generalized additive models for location, scale and shape, (with discussion). Appl. Statist., 54: 507ï£¡554.

Energy-Economy-Investment Modelling

Contact Person: Dr Vlasios Voudouris (email: ⟨v.voudouris@londonmet.ac.uk⟩)

Applications for a PhD work are invited in the area of Energy-Economy-Investment Modelling. The applications should be within the scope of the ACEGES project (http://www.londonmet.ac.uk/lmbs/research/cibs/cibs-scenario-planning/cibs-scenario-planni

In particular, we encourage applications that aim to investigate the relationships between:

1. Spot price of crude oil,
2. Expectations of future oil prices
3. Price of crude oil futures
4. Oil futures spread (defined as the percent deviation of the oil futures price from the spot price of oil)
5. Oil trade.

The overall research aim is to investigate what determines the spot and futures price of crude oil, trade between countries and the importance of the evolution of the price of oil in explaining oil production and trade of OPEC and non-OPEC countries.

Applicants are expected to have a Master's degree with a strong quantitative, econometric, financial mathematics, mathematical or statistical focus. Programming experience in Java and/or R is desirable but not essential.

Hamilton, J. (2003), What is an Oil Shock? *Journal of Econometrics*, vol. 113(2), 363-398

Alquist, R and Kilian, L. (2001) (2010), What Do We Learn from the Price of Crude Oil Futures? *Journal of Applied Econometrics*, 25(4), 539-573.

Kaufmann, R.K (2005). (1991), Oil production in the lower 48 states: Reconciling curve fitting and econometric models. *Resources and Energy*, 13(1), 111-127