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Combining estimating functions for volatility

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ABSTRACT

Accurate estimates of volatility are needed in risk management. Generalized autoregressive conditional heteroscedastic (GARCH) models and random coefficient autoregressive (RCA) models have been used for volatility modelling. Following Heyde [1997. Quasi-likelihood and its Applications. Springer, New York], volatility estimates are obtained by combining two different estimating functions. It turns out that the combined estimating function for the parameter in autoregressive processes with GARCH errors and RCA models contains maximum information. The combination of the least squares (LS) estimating function and the least absolute deviation (LAD) estimating function with application to GARCH model error identification is discussed as an application.

1. Introduction

Recently there has been growing interest in using nonlinear time series models in finance and economics (see Granger, 1998; He and Tërasvirta, 1999a, b among others). Inference for nonlinear time series had been studied in Thavaneswaran and Abraham (1988) and in Thavaneswaran and Heyde (1999) using estimating function theory. A nonlinear model was proposed in Abraham and Thavaneswaran (1991) and using nonlinear state space formulation, filtering and smoothing had been studied (see Granger, 1998 for more details). Many financial series such as returns on stocks and foreign exchange rates, exhibit leptokurtosis and time-varying volatility. These two features have been the subject of extensive studies ever since (Nicholls and Quinn, 1982; Engle, 1982) reported them. The random coefficient autoregressive (RCA) models, the autoregressive conditional heteroscedastic (ARCH) models (see Engle, 1982; Engle and González-Rivera, 1991) and the generalized autoregressive conditional heteroscedastic (GARCH) models of Bollerslev (1986), provide a convenient framework to study time-varying volatility in financial markets. In Thavaneswaran et al. (2005) and in Leipus and Surgallis (2003), the correlation properties for RCA–GARCH models have been studied in detail. In addition to GARCH models, estimates of volatility can also be obtained using historical volatility, implied volatility derived from option pricing formulas (see Anh and Inoue, 2005, for example) and stochastic volatility models (for example, see Taylor, 1994). For continuous-time stochastic volatility models that allow for long-range dependence, see Anh et al. (2002). In this paper, discussion centers on estimating the model parameter for the class of GARCH and RCA volatility models using combined estimating function theory.

Thavaneswaran and Heyde (1999) had compared the information contained in the least squares (LS) and least absolute deviation (LAD) estimating functions for the autoregressive parameter of a first order autoregressive process $y_t = \theta y_{t-1} + a_t$. The aforementioned authors had demonstrated that the LAD estimating function is more efficient than the ordinary LS estimating function if the distribution of the error term a_t is such that $4f^2(0) \geqslant 1/\sigma^2$ where σ^2 is the variance of the error term and $f(x)$ is

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