Introduction

In his paper ‘All in a family: Nesting symmetric and asymmetric GARCH models’, Hentschel develops a a family of models of generalized autoregressive heteroskedasticity

(GARCH) that encompasses all the popular existing GARCH models. The nesting shows that the models are connected within themselves, and can be arrived by manipulating appropriate parameters. However, as the theory goes, practical solutions for the models are not simple due to non-linearity involved. Hence, iterative procedure is adopted.

This project attempts to develop a coded computer model for the same on Octave platform which can be run and used for testing and selection of appropriate model. It also highlights the problems faced and possible solution in developing a practical model from the theory.

Description

Autoregressive Conditional Heteroskedasticity (ARCH) models is class of models which is used to account for error terms which are believed to be a function of previous time periods’ error terms. Usually, the model specifies variance as a weighted sum of squares of previous periods’ error terms. The ARCH models are specified as ARCH (q), where q is the length of ARCH lags.

Gnenralized Autoregressive Conditional Heteroskedasticity (GARCH) are more general class of models which allow for a much more flexible lag structure. While in ARCH models, the error terms follow an AR process, which limits the effect of the lag to the time period specified, sometimes the error structure warrants a much longer lag structure for the conditional variance equation. GARCH models take care of this by specifying the conditional error variance as an ARMA structure of past sample variances and conditional variances.

ARCH models were introduced by Engle (1982) and were generalized by Bollerslev (1986) as GARCH models. Post GARCH models introduction, the models have been modified multiple times to explain the reality more accurately. The equity returns are strongly asymmetric. Negative returns are followed by larger increases in volatility than equally large positive returns, which is referred to now as ‘leverage effect’ (Black, 1976). An asymmetric GARCH model is required to model this requirement. EGARCH process introduced by Nelson (1991), the quadratic GARCH process of Sentana (1991) and Engle (1990), and the TGARCH model of Zakoian (1991) are among the popular asymmetric GARCH models.

However, the GARCH models do not seem to be linked to each other. Hentshel (1995), in his paper provides a unifying framework in which the models can be viewed and tested.

According to Henstshel, the conditional variance, the lagged variance and the error term for a unit lag case i.e. p=1=1, are related as:

Here *ht* represents the conditional variance of the error term *et* which is the unconditional error for the equation:

And

Here, *f(υt)* term controls impact of the shocks *υt* on the transformed conditional variance *ht-1*.

For instance, in case of b-GARCH *f(υt)* = *υt2*.