

## Abstract

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Volatility is an important feature of the financial markets. This study focuses on volatility modelling of overnight, trading day, and daily returns series. Daily returns series are usually calculated based on closing prices. In this study, the daily returns series are split into overnight (close to open) and trading day (open to close) returns series. We propose two models which attempt to incorporate the interrelationship of these *two* series. Apart from the timing differences in the *two* series, in most cases, trading mechanisms are also different in 'close to open' and 'open to close' periods. These differences lead to a contrast in characteristics of the *two* returns series. Hence, jointly modelling overnight and trading day returns series captures the individual series characteristics as well as the dynamic relationship.

We first introduce a periodic Generalised Autoregressive Conditional Heteroskedasticity (GARCH) model for the overnight and trading day returns. The model captures the relationship between the *two* series through mean and variance equations. The properties, estimation of the parameters, and applications of the model are discussed in detail. The basic model is then extended by specifying the Pearson Type IV family in the residual series. This family of distributions allows us to capture different skewness and kurtosis of overnight and trading day returns. We have used maximum likelihood estimation (MLE) and quasi maximum likelihood estimation (QMLE) for the

inference. A simulation study is performed to evaluate the finite sample properties of QMLE.

Next, we propose a second model that is more parsimonious. The first model suffers from the curse of dimensionality as the lag specification increases. The properties of the model and its parameter estimation procedure are discussed. Under this setup, we can write the daily series as an AR-GARCH model.

The proposed models are tested on five different stock indices. It is found that the interrelationship of the *two* series is significant in all indices. This implies that the expected return or the volatility of one series is influenced by that of the other. We use the one-lag-ahead Value at Risk (VaR) forecasts to compare the models. We compare the VaR forecasts of overnight, trading day, and daily returns series. The summary on VaR violations shows that the Pearson-Periodic GARCH is a more robust and accurate VaR estimation method.