Chapter 7

Conclusions and Future Research

The thesis has covered various aspects of modelling and analysis of stochastic volatility and conditional durations in finance. The main objective of analysing financial time series is to model the volatility and forecast its future values. Time series analysis based on Box and Jenkins methods are the most popular approaches when the models are linear and errors are Gaussian. This is considered to be unrealistic in many areas of economics and finance as the distribution of conditional variances are non-Gaussian. As a result, several models have been introduced in the literature to study the behaviour of financial time series. One of the requirements for suggesting new models for stochastic volatility is the existence of class of models for generating non-negative sequences of dependent random variables for generating volatilities. In this thesis, we mainly studied the properties of some non-Gaussian time series models and examined their suitability for modelling stochastic volatility and conditional durations in finance.
With an idea to introduce SV models induced by non-Gaussian volatility sequences, we have proposed a stationary sequence of non-negative random variables with Birnbaum-Saunders marginal distributions. The properties of the model and its estimation procedures have been discussed, and a simulation study has been carried out to evaluate the efficiency of the proposed estimation method. To illustrate the application of the proposed model and the associated estimation method, we have analysed two real data sets. The proposed model provides an additional choice for analysing non-negative time series data. We could establish the asymptotic properties of the estimators for BS-AR(1) model using its Markovian behaviour. Establishing such properties for BS-ARMA models require the development of related theory for non-linear time series models. Construction of BS-ARMA models of higher order and a study of their statistical properties will be of great interest and we hope to consider this for our future work.

The BS distribution is typically applied to positive data with varying degrees of asymmetry and kurtosis and can be used as an alternative to the log-normal and log-skew-normal models. In the fourth chapter, we proposed a SV model generated by first order BS Markov process as an alternative to normal-lognormal SV model. The model parameters are estimated using the method of moments and efficient importance sampling method as the likelihood function is intractable. A simulation experiment is conducted to check the performance of the estimators. The model is used to analyse two sets of data and found that it captures the stylized factors of the financial time series. The problems related to model performance comparison with the existing SV models in terms of in sample fit and out-of-sample forecasting need a separate study. We plan to take this up as our future research.
In Chapter 5, the asymmetric Laplace distribution is used for modelling financial data, which exhibits asymmetry, sharp peaks and heavier tails than normal distribution. We proposed a stationary first order asymmetric Laplace autoregressive model to generate log-volatilities instead of Gaussian AR(1) model. Then we considered stochastic volatility model when the marginal distribution of log-volatility process have an asymmetric Laplace distribution, rather than the Gaussian distribution usually employed. The properties of the AL-SV model and its estimation procedures based on method of moments have been discussed along with a simulation study to evaluate the efficiency of the proposed estimation method. In the empirical study, we adopt AL-SV model to fit the daily returns of exchange rate and future price data. The data analysis illustrates that the AL-SV model is able to capture the skewness and excess kurtosis we observe in financial return series. But we have to come up with more efficient method of estimation and diagnosis procedures for effective use of this model. One practical approach in this context is to develop Bayesian inference procedures. Numerical estimation methods such as Gibbs sampler and Markov chain Monte Carlo procedures will be suitable here. The model presented in this chapter can be extended to analyse multivariate time series. The family of multivariate AL laws can be obtained as a limiting case of the generalized hyperbolic distributions, introduced by Barndorff-Nielsen (1977) and seems to be suitable for modelling heavy tailed asymmetric multivariate data. However, the implementation of multivariate AL-SV model is not straight forward and work is currently under progress in this direction.

Finally, we have proposed two conditional duration models based on inverse Gaussian distribution and studied their properties. We proposed a new specification of
the disturbance in the ACD and SCD model by assuming that the standardized durations allow non-monotonic hazard function. The parameters of the IG-ACD model are estimated by maximum likelihood method. A Monte Carlo based efficient importance sampling method is proposed for estimating the parameters of IG-SCD model. The simulation experiments show that the estimates and the resulting estimates of the hazard function perform reasonably well. To illustrate the application of the proposed models, we have analysed two data sets on trade durations of the Australian Dollar/Canadian Dollar and US Dollar/Singapore Dollar exchange and displayed that the proposed models provide a good fit. These results indicate that the inverse Gaussian conditional duration models provide an additional choice for analysing transaction durations in financial point process. Possible extensions to the ACD/SCD models include the use of a wider range of distributional assumptions for conditional durations, in particular those that cater for non-monotonic hazard function of conditional durations. It is important to relax the independent and identically distributed assumption for the innovation, to model higher order conditional moments, and to allow possible regime shifts in price durations.

We conclude this thesis with a note that we have several new problems. Some of these problems can be solved under the Bayesian frame work. The problems related to volatility forecasting and model selection are yet to be discussed. The non-parametric and semi-parametric approaches are potential alternatives to the already established parametric approaches to deal with financial time series. These methods will work better when there are no closed form expressions for likelihood functions. Even though we have focused on discrete time space in our studies so far, the events such as changes in price, temperature, etc. take place continuously. So it
is more appropriate to study such problems in continuous time space, which requires the knowledge of stochastic calculus. We would like to tackle these important and interesting, but challenging, problems in future research.