CHAPTER 7

CONCLUSIONS AND FUTURE SCOPE

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7.1 Conclusions

Prediction of TSD is a major research challenge that drawing the attention of researchers from various fields. In this thesis, one-step ahead and multi-step ahead short term forecasting is studied and correspondingly two prediction models are proposed. TSD originating from various applications, in general, comprise both linear and nonlinear variations. Linear ARIMA and GARCH models, nonlinear ANN models cannot individually model such data accurately. Hybrid models which combine the strengths of individual models are better than the individual models, as they are capable of exploiting the advantages of both types of models simultaneously. In the present study, two variants involving ARIMA, GARCH or ANN are devised, one of which is a non-linear hybrid model and the other is a linear hybrid model.

The non-linear TSD prediction model proposed in this thesis is a new hybrid ARIMA-ANN prediction model which has been developed based on the statistical properties of ARIMA sequences. The model uses an MA filter to decompose the given time series data into two data sets. Then ARIMA and ANN models are applied suitably to these decompositions. The final forecasts for this hybrid model are obtained by adding

the forecasts from the two individual models. This hybrid model is capable of both one-step-ahead and multi-step ahead prediction. The model was applied to simulated time series data and to three available data sets of different kinds, namely sunspot data, electricity price data, financial data. For both one-step-ahead and multi-step ahead prediction, the proposed hybrid model has higher prediction accuracy in terms of MAE and MSE than several other models, such as ARIMA model, ANN model and some existing hybrid ARIMA-ANN models. Thus the hybrid model proposed in this thesis becomes a simple and accurate prediction model in many applications.

The second prediction model proposed in this thesis is a linear model, namely the hybrid ARIMA-GARCH model, which is framed for multi-step ahead forecasting. It targets both prediction accuracy and preservation of data trend over the complete forecast horizon. The volatility nature of TSD is characterized using conditional standard deviation plot, autocorrelation plot and QQ plot as a function of delay. The model involves a MA filter based decomposition as a pre-processing step on given TSD. This model is applied on selected NSE India data sets to get multi-step ahead prediction. The obtained results are evaluated using error performance measures MAPE MaxAPE, RMSE, whose values confirm the improved prediction accuracy compared to individual models ARIMA, GARCH and ANN. The proposed model also preserved the data trend over the prediction horizon better than the others.

The other investigations carried out in this research work are:

- For the prediction of internet traffic TSD which is highly volatile in nature, the applicability of various prediction models is explored. The models considered in the study are ARIMA, ANN, Zhang's hybrid ARIMA-ANN, Khashei and Bijari's hybrid ARIMA-ANN, multiplicative ARIMA-ANN, MA-filter based hybrid ARIMA-ANN. Both one-step ahead and multi-step ahead predictions are carried out. The error performance measures, MAE and MSE are used to evaluate the model accuracy. Two traffic TSD series, one with 30 minute sampling and 200 data points, other with 60 minute sampling and 100 data points are used in the investigation. The prediction results in all the cases showed that the MA filter based hybrid ARIMA-ANN model outperformed all the other models discussed in this research work, in terms of both MAE and MSE and hence is suitable for predicting internet traffic data more accurately.

- Variants of ARIMA models are used to forecast average global temperature data for period of 2001 to 2010. This prediction is accomplished using three variants of ARIMA models, basic-ARIMA, Trend-based ARIMA and Wavelet-based ARIMA models. The performance of each of these methods is compared using MAPE. It is concluded that Wavelet-based ARIMA performs the best out of the three. Trend-based ARIMA is better than Basic-ARIMA but is inferior to Wavelet-based ARIMA. All the methods used here are linear in nature.

- For forecasting a stock variable, instead of ARIMA, the possibility

of applying an adaptive filter based prediction model is explored. It is verified that for various stock variables' prediction, both ARIMA and adaptive filter based models render almost similar accuracy, by controlling the length of the adaptive filter. This fact is verified using Tata Steel stock variables of BSE India data.

7.2   Future Scope

The traditional prediction models considered for proposing hybrid models are ARIMA, GARCH and ANN models. Prediction accuracy can be further improved by verifying with other traditional prediction models like SVM, fuzzy, HMM, and other techniques. In this thesis, MA filter based preprocessing technique is considered. Many other preprocessing techniques exist in the literature which can experimentally verified for better prediction accuracy. A suitable pre-processing techniques can also be devised aptly to increase the prediction accuracy to suite the prediction model considered. The PI technique considered in devising the prediction model can be modified so as to include a methodology to decide on the number of partitions instead of trial and error. Also, the prediction performance can be studied by the inclusion of covariates, meaning development of multivariate models, but using minimum number of model parameters.