Empirical Mode Decomposition and ANN Based Hybrid Approach to Forecast High Frequency Foreign Exchange Rates

Hasanthi Pathberiya
University of Sri Jayewardenepura
Sri Lanka

Liwan Liyanage
Western Sydney University
Australia

Chandima Tilakaratne
University of Colombo
Sri Lanka

Chaotic nature of high frequency exchange rates has made it a challenging task to develop forecasting models with higher accuracy. This unanticipated behavior is subjected to surprises in the economic, political and social environments. However, these altering environments are reflected by various kinds of indicators such as Gross Domestic Product (GDP), Trade Balance, Unemployment Rate, etc. to some extent. This fact is evident in improving capability of forecasting models while incorporating such reflective indicators in such models. On the other hand, as supported by the Efficient Market Hypothesis which states that the market prices reflect all the available information, historical rates are supposed to add much information to these models on top of the aforesaid external factors. Hence, historical prices become the most imperative input in the forecasting model. This study proposes EMD-ANN hybrid approach to develop a model to forecast high frequency exchange rates by combining Empirical Mode Decomposition (EMD) and Artificial Neural Networks (ANN). Instead of considering historical series at different lags as a whole, within this study we propose to decompose the original series to a set of Intrinsic Mode Functions (IMFs) defined by considering their level of fluctuations employing EMD algorithm. Ultimate goal of such decomposition is the incorporation of these IMFs into the forecasting model as a set of weighted functions. Contribution of each IMF leading to improve accuracy of forecasts is quantified by defining weights through a feed forward neural network. Results revealed an improvement in the forecasting accuracy in the model incorporates a set of decomposed functions compared to the model with raw historical data. This result implies the significance of evaluating different components in a time series with respect to their level of fluctuations in the process of deriving short term forecasts with high level of accuracy. The model concludes forecasting accuracy as 68% in terms of yielding at most three percentage in points of absolute residual. Moreover, as evident in the results, the proposed approach reduces the misclassification rate from 29% to 21% in comparison to the model fed with raw historical data.