An Improved Probabilistic Neural Network Model for Forecasting the Direction of a Stock Market Index

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N. V. Chandrasekara

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Abstract

Financial market prediction exhibits immense interest among researchers nowadays due to rapid increase in the investments of financial markets in last few decades. The profitability of investing in financial markets is directly proportional to its predictability. Stock market is one of the leading market in this regard due to importance and interest of many stakeholders. Literature reveals that the directional prediction is more effective and leads to higher profits than the value prediction.

With the development of the machine learning techniques, the financial industry thrived with the enhancement of the forecasting ability. Probabilistic Neural Network (PNN) is a promising machine leaning technique which can be used to forecast financial markets with a higher accuracy. However, standard PNN calculates the probabilities based on Gaussian distribution. Therefore, there is a limitation to apply this model to financial data which deviates from the normal distribution. Hence, the main objective of this study is to improve the standard PNN model. This is done by identifying the exact multivariate distribution as the joint distribution of input variables and addressing the multi class imbalanced problem persist in the directional prediction of the stock market (i.e. up, down and no change). This model building process is illustrated and tested with daily close prices of three stock market indices: AORD, GSPC and ASPI and related financial market indices from 21/09/2012 - 20/09/2017.

Results proved that Scaled t distribution with location, scale and shape parameters can be used as more suitable distribution for financial return series. Global optimization methods are essential to estimate better parameters of multivariate distributions. The global optimization technique used in the study is capable of estimating parameters of n dimensional multivariate distributions. The proposed PNN model which consider multivariate Scaled t distribution as the joint distribution of input variables exhibits better performance than the standard PNN model. The ensemble technique: multi class under-sampling based bagging (MCUB) was introduced to handle class imbalanced problem in PNNs is capable enough to resolve multi class imbalanced problem persist in both standard and proposed PNNs.

Final dynamic model proposed in the study with proposed PNN and proposed MCUB technique is competent in forecasting direction of a given stock market index with higher accuracy which helps stakeholders of stock markets for accurate decision making.