ISSN(Online): 2320 - 9801
ISSN (Print) : 2320 - 9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 6, June 2016

Stock Market Prediction with Artificial Neural Network and Machine Learning: A Review of Literature

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ABSTRACT: The data generated by the stock market is priceless. Such data can be used to analyze historical performance of stocks and predict their relative performance in the future. The ability to generate trading signal's with the help of learning machines can provide better opportunities in the stock market. This paper presents a review of literature of Stock market Prediction with Artificial Neural Network and other machine learning methods. Study shows that Artificial Neural Network and other Machine learning methods are able to generate far better result when compared to traditional buy and hold strategy.

KEYWORDS: Artificial Neural Network, Machine Learning, Stock Index, Prediction, literature review.

I. INTRODUCTION

The current era markers the evolution of learning machines. Machine with intelligence and knowledge. Such machines posses a different kind of advantage over other technologies. The machine with learning capability can adept far easily than any other machine. Use of such machine in Finance has been a great topic of research. Tapping the machines capability to find pattern in the stock market has always been fascinating. Artificial neural network and other machine learning methods provided a way to mimic the human brain's capability to identify patterns and ability to learn.
Researchers have argued that a system that may look chaotic can have well defined patterns. Such patterns can lead to a very accurate forecast of such system. With enough CPU computation power, it is not only possible to train such system but also predict future time series values with reasonable accuracy. Researchers have actively improved such systems by incorporating multiple methodologies and technique and are able to identify patterns that were not possible previously.
Further research in the area provides excellent opportunity in the field of pattern recognition and machine learning. As more and more systems are taking over the stock market trading systems (algo trading), it will be reasonable choice to create system that find activity of such system and take advantage of it.

II. ARTIFICIAL NEURAL NETWORK

The first neural network model was established by W.S.Mcculloch and W.Pitts in 1943 (McCulloch and Pitts, 1943). It was called MP Model and they used MP model to put forward the neuron's mathematical description, network construction method and proved that each single neuron can perform logic function, thereby laying a new era of Neural Network research. Artificial neural network has been successfully applied in the field of stock market, pattern recognition, decision making and health care. An artificial neural network is inspired from human brain. Human brain contains approx. 10 billion nerve cells (neurons) and many thousand times connection between them. Such design allows the determination of non linear relationships between input and output. The capability of neural network to identify patterns and the fact it can be trained with sufficient training data makes it really desirable in many situations.

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III. REVIEW OF LITERATURE

The review of literature is without a doubt incomplete with Burton G. Malkiel's theory of Random walk of stock market. According to the author stock market moves in a random fashion and any kind of previous or historical data cannot be used to predict its future values (Burton G. Malkiel, 1970). According to the author the market is efficient and will remove any kind of bias or patterns. But we will observe that many research has provided enough evidence that such prediction not only works but beats the traditional methods by a long shot.

Hirotaka Mizuno, Michitaka Kosaka, Hiroshi Yajima (Mizuno et al., 1998) demonstrated the use of artificial neural network on TOPIX (Tokyo Stock Exchange Prices Index). They used moving average, Deviation of price from moving average, Psychological line, Relative strength index as inputs for the ANN. Output of the ANN was buy, hold and sell signals. Their results demonstrated their system could achieve from 9-10% of average return, which was lower than traditional buy and hold strategy.

However Marijana Zekic (Zekic, 1998) has pointed out that many author ignore the possible structure of ANN which could benefit certain situations. The demonstrates that certain type of ANN structure perform better than others like 10-20-1 structure with back propagation learning.

Fernando Fernández-Rodríguez,Christian González-Martel,Simón Sosvilla-Rivero has demonstrated the correct profitability in different phases of market (bullish, bearish and neutral) (Fernandez-Rodrıguez et al., 2000). Their work demonstrates that technical analyses performs far better than buy and hold strategy in different market conditions.

The work of M. A. Kaboudan (Kaboudan, 2000) on Genetic programming also demonstrates better trading signals can be generated with technical analyses.

The use of many industry indicators with GA & ANN was studied by Kyoung-jae Kim, Ingoo Han (Kim and Han, 2000). Their approach utilized many stock market indicators like Stochastic %K, Stochastic %D, ROC, RSI, OSCP as inputs for GA and ANN to provide better trading signals. The system was tested on Korea stock price index (KOSPI) and results showed that GAFD reduces the dimensionality of the feature space then enhances the generalizability of the classifier from the empirical results.

The use of probabilistic neural network has been demonstrated by An-Sing Chen, Mark T. Leung, Hazem Daouk (Chen et al., 2003) on the Taiwan Stock Exchange. According to them PNN outperformed GMM–Kalman filter, and random walk. According to them This superiority is partially attributed to PNN's ability to identify outliers and erroneous data. Compared to the other two parametric techniques examined in this study.

Many author like Md. Rafiul Hassan and Baikunth Nath (Hassan and Nath, 2005) have suggested to use hybrid model like Hidden markov model (HMM). Their experimental result signify hybrid approaches also perform better than traditional learning methods.

The use of SVM (support vector machines) in market forecast has been highlighted by Wei Huang, Yoshiteru Nakamori, Shou-Yang Wang (Huang et al., 2005) . Their method consisted of using term structure of interest rates (TS), short-term interest rate (ST), long-term interest rate (LT), consumer price index (CPI), industrial production (IP), government consumption (GC), private consumption (PC), gross national product (GNP) and gross domestic product (GDP). Their work demonstrated that SVM is superior to the other individual classification methods in forecasting weekly movement direction of NIKKEI 225 Index.

A similar kind of study by Zabir Haider Khan, Tasnim Sharmin Alin, Md. Akter Hussain also pointed out the use of many technical indicators as inputs produced more reliable results (Khan et al., 2011). Yusuf Perwej, Asif Perwej has demonstrated the success of ANN over volatile markets (Perwej, 2012).

The use of ANN to create an automated trading system was demonstrated by Leonardo C. Martinez, Diego N. da Hora, Jo˜ao R. de M. Palotti,Wagner Meira Jr. and Gisele L. Pappa (Martinez et al., 2009). The experiment result showed huge returns using results of ANN to auto trade.

Bruce Vanstone, Gavin Finnie (Vanstone and Finnie, 2009) have laid empirical methodologies to develop better trading strategies when using ANN or other learning methods. Their methodology defines many critical metric to assess different system and their step by step evaluation.

The paper proposed by Yudong Zhang' , Lenan Wu (Zhang and Wu, 2009) demonstrates an improved bacterial chemotaxis optimization (IBCO), which can be then integrated into the back propagation artificial neural network to develop an efficient forecasting model. Experimental results show its better performance than other methods.

A financial index forecasting model based on modified RBF neural network was proposed by B. Sun and T.k. Li to find critical points of stock index which can solve market identification problem (Sun and Li, 2010). According to them K-means algorithm is used to search and adjust initial center parameters of structure of network.

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The study by Tsung-Sheng Chang (Chang, 2011) looks at artificial neural networks (ANN), decision trees and the hybrid model of ANN and decision trees (hybrid model), the three common algorithm methods used for numerical analysis, to forecast stock prices. The average accuracy of ANN is 15.31%, the highest when compared to real market stock prices, followed by decision trees, at 14.06%; hybrid model is 13.75%. The study also shows that compared to the other two methods, ANN is a more reliable method for predicting stock prices in the volatile post-crisis stock market.
The study by Yakup Kara,Melek Acar Boyacioglu, Ömer Kaan Baykan (Kara et al., 2011) attempted to develop two efficient models and compared their efficiency in predicting the direction of movement in the daily Istanbul Stock Exchange National 100 Index. The models are based on two classification techniques, artificial neural networks (ANN) and support vector machines (SVM). Ten technical indicators were selected as inputs of the proposed models. The results showed that average performance of ANN model (75.74%) was found significantly better than that of SVM model (71.52%).
Kuo-Cheng Tseng, Ojoung Kwon, Luna C. Tjung has studied (Kuo et al., 2001) the traditional time series decomposition (TSD), Holt/Winters (H/W) models, Box-Jenkins (B/J) methodology, and neural network (NN) to 50 randomly selected stocks from September 1, 1998 to December 31, 2010 with a total of 3105 observations for each company's close stock price. It is important to observe that the sample period covers many high and lows of the markets including dot com bubble", the 9/11 event, housing bubble and bust. All three time series approaches fit the data extremely well with R^2 being around 0.995.
Yi Xiao,, Jin Xiao,, Fengbin Lu, Shouyang Wang (Xiao et al., 2013) proposed a three-stage nonlinear ensemble-model. In the proposed model, 3 different types of neural-network based models, i.e. Elman network, generalized regression neural network (GRNN) and wavelet neural network (WNN) are created by 3 non-overlapping training sets and are further optimized by improved particle swarm optimization (IPSO). Finally, a neural-network-based nonlinear meta-model is generated by learning three neural-network based models through support vector machines (SVM) neural network. The superiority of the proposed approach lies in its flexibility to account for potentially complex nonlinear relationships.
In their paper Zhiqiang Guo, Huaiqing Wang, Jie Yang, David J. Miller (Guo et al., 2015) proposed and implemented a hybrid model combining 2-directional, 2-dimensional principal component analysis ($(2D)^2$ PCA) and a Radial Basis Function Neural Network (RBFNN) to forecast stock market behavior. First, 36 stock market technical variables are selected as the input features, and a sliding window is used to obtain the input data of the model. The empirical results show that the proposed model outperforms the PCA-based model, as well as alternative models based on ICA and on the multilayer perceptron.
Discrete Wavelet Transform (DWT) and Artificial Neural Network (ANN) for predicting financial time series has been studied by S. Kumar Chandar, M. Sumathi and S. N. Sivanandam (Kumar Chandar et al., 2016). Their hybrid forecasting technique has achieved better results compared with the approach which is not using the wavelet transform.

IV. CONCLUSION AND FUTURE WORK

The review sums up the efforts of many authors, who have successfully developed better stock prediction system using ANN , Machine learning or Hybrid Approaches. The rise of machine based trading system (algo trading and High frequency trading) has paved a way to predict the very nature of rule based trading systems. Computer based stock market analysis and trading will continue to be a good topic of active research.

REFERENCES

1. Burton G. Malkiel, E.F.F., 1970. Efficient Capital Markets: A Review of Theory and Empirical Work. J. Finance
2. Chang, T.-S., 2011. A comparative study of artificial neural networks, and decision trees for digital game content stocks price prediction. Expert Syst. Appl. 38, 14846–14851.
3. Chen, A.-S., Leung, M.T., Daouk, H., 2003. Application of neural networks to an emerging financial market: forecasting and trading the Taiwan Stock Index. Comput. Oper. Res. 30, 901–923.
4. Fernandez-Rodrıguez, F., Gonzalez-Martel, C., Sosvilla-Rivero, S., 2000. On the profitability of technical trading rules based on artificial neural networks:: Evidence from the Madrid stock market. Econ. Lett. 69, 89–94.
5. Guo, Z., Wang, H., Yang, J., Miller, D.J., 2015. A Stock Market Forecasting Model Combining Two-Directional Two-Dimensional Principal Component Analysis and Radial Basis Function Neural Network.
6. Hassan, M.R., Nath, B., 2005. Stock market forecasting using hidden Markov model: a new approach, in: Intelligent Systems Design and Applications, 2005. ISDA'05. Proceedings. 5th International Conference on. IEEE, pp. 192–196.

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7. Huang, W., Nakamori, Y., Wang, S.-Y., 2005. Forecasting stock market movement direction with support vector machine. Comput. Oper. Res. 32, 2513–2522.
8. Kaboudan, M.A., 2000. Genetic programming prediction of stock prices. Comput. Econ. 16, 207–236.
9. Kara, Y., Acar Boyacioglu, M., Baykan, Ö.K., 2011. Predicting direction of stock price index movement using artificial neural networks and support vector machines: The sample of the Istanbul Stock Exchange. Expert Syst. Appl. 38, 5311–5319.
10. Khan, Z.H., Alin, T.S., Hussain, M.A., 2011. Price prediction of share market using artificial neural network (ANN). Int. J. Comput. Appl. 22, 42–47.
11. Kim, K., Han, I., 2000. Genetic algorithms approach to feature discretization in artificial neural networks for the prediction of stock price index. Expert Syst. Appl. 19, 125–132.
12. Kumar Chandar, S., Sumathi, M., Sivanandam, S.N., 2016. Prediction of Stock Market Price using Hybrid of Wavelet Transform and Artificial Neural Network. Indian J. Sci. Technol. 9.
13. Kuo, R.J., Chen, C.H., Hwang, Y.C., 2001. An intelligent stock trading decision support system through integration of genetic algorithm based fuzzy neural network and artificial neural network. Fuzzy Sets Syst. 118, 21–45.
14. Martinez, L.C., da Hora, D.N., de M Palotti, J.R., Meira Jr, W., Pappa, G.L., 2009. From an artificial neural network to a stock market day-trading system: A case study on the BM&F BOVESPA, in: Neural Networks, 2009. IJCNN 2009. International Joint Conference on. IEEE, pp. 2006–2013.
15. McCulloch, W.S., Pitts, W., 1943. A logical calculus of the ideas immanent in nervous activity. Bull. Math. Biophys. 5, 115–133.
16. Mizuno, H., Kosaka, M., Yajima, H., Komoda, N., 1998. Application of neural network to technical analysis of stock market prediction. Stud. Inform. Control 7, 111–120.
17. Perwej, Y., 2012. Prediction of the Bombay Stock Exchange (BSE) Market Returns Using Artificial Neural Network and Genetic Algorithm. J. Intell. Learn. Syst. Appl. 4, 108–119.
18. Sun, B., Li, T. k, 2010. Forecasting and identification of stock market based on modified RBF neural network, in: 2010 IEEE 17Th International Conference on Industrial Engineering and Engineering Management (IE EM). Presented at the 2010 IEEE 17Th International Conference on Industrial Engineering and Engineering Management (IE EM), pp. 424–427.
19. Vanstone, B., Finnie, G., 2009. An empirical methodology for developing stockmarket trading systems using artificial neural networks. Expert Syst. Appl. 36, 6668–6680.
20. Xiao, Y., Xiao, J., Lu, F., Wang, S., 2013. Ensemble ANNs-PSO-GA Approach for Day-ahead Stock E-exchange Prices Forecasting. Int. J. Comput. Intell. Syst. 6, 96–114.
21. Zekic, M., 1998. Neural network applications in stock market predictions-a methodology analysis, in: Proceedings of the 9th International Conference on Information and Intelligent Systems. Citeseer, pp. 255–263.
22. Zhang, Y., Wu, L., 2009. Stock market prediction of S&P 500 via combination of improved BCO approach and BP neural network. Expert Syst. Appl. 36, 8849–8854.

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