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Artificial Neural Network (ANN) for Stock Market Predictions

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Abstract: ***Artificial neural networks are universal and highly flexible function approximations first used in the fields of cognitive science and engineering. In recent years, neural network applications in finance for such tasks as pattern recognition, classification, and time series forecasting have dramatically increased. However, the large number of parameters that must be selected to develop a neural network forecasting model have meant that the design process still involves much trial and error.Neural Network is a challenging and daunting task to find out which is more effective and accurate method for stock rate prediction so that a buy or sell signal can be generated for given stocks. Predicting stock index with traditional time series analysis has proven to be difficult an Artificial Neural network may be suitable for the task. A Neural Network has the ability to extract useful information from large set of data. This paper presents an application of Artificial Neural Network for stock market predictions and is very useful for predicting world stock markets.***

Keywords: Artificial Neural Network, Stock Index, Prediction

1. Introduction

The total world derivatives market has been estimated at about $791 trillion face or nominal value, 11 times the size of the entire world's economy. Bombay Stock Exchange is the oldest stock exchange in Asia with a rich heritage, now spanning three centuries in its 135 years of existence. What is now popularly known as BSE was established as "The Native Share & Stock Brokers' Association" in 1875. BSE is the first stock exchange in the country which obtained permanent recognition (in 1956) from the Government of India under the Securities Contracts (Regulation) Act 1956.BSE is the World's number one exchange in the term of listed companies and the world's numbers 5th in transaction. Stock market is a public market for the trading of company stock & derivatives at an agreed price; these are securities listed on stock exchanges as well as those only traded privately. Predicting the stock market is not a simple task. Different techniques are being used in the trading community for prediction task. In recent years the new concept of the neural networks has emerged one of them. An Artificial Neural Network (ANN) is able to work parallel with input variables and consequently handle large sets of data swiftly. The principal strength with a neural network is its ability to find patterns and irregularities as well as detecting multi-dimensional non-linear connections in data. The latter quality is extremely useful for modeling dynamical systems e.g., stock market.

2. History of Neural Network

During more than 60 years development history, the research of Neural Network can be roughly divided into the following three stages. The initial stage is form the MP model proposed to the 1960s, the main characteristic of this period was to produce the network model and conform the learning algorithm, then in the developing process people met the essence difficulties which resulted from the electronic circuit overlapping limit, the development of neural network entering a low ebb period, since the beginning of the 1980s.Neural Network theory development has entered a golden period. At present Neural Network has several hundreds of network model, as an active , marginal and cross subject , Neural Network has been widely used in stock predictions, pattern recognition , economic management, control and decision making, health and medical community, agriculture and many other fields .

The foundation of neural networks in a sense begins with biology. The human brain consist of an estimated 10 billion neurons (nerve cells) and 6000 times as many synapses (connections) between them (Haykin 94). All information taken in by a human is processed and assessed in this part of the body. A Neural Network (NN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems.

2.1 Neural Network

Each input from the input layer is fed up to each node in the hidden layer, and from there to each node on the output layer. We should note that there can be any number of nodes per layer and there are usually multiple hidden layers to pass through before ultimately reaching the output layer. Choosing the right number of nodes and layers is important later on when optimizing the neural network to work well a given problem.

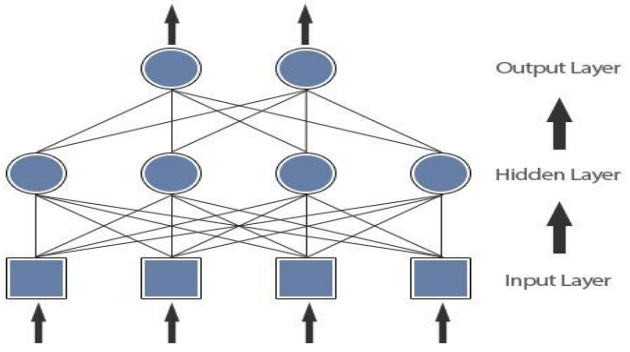

Figure 1: Neural Network

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A multi-layered network consists of numerous neurons, which are arranged into levels. Each level is interconnected with the one above and below it. The first layer receives external inputs and is aptly named the input layer. The top layer provides the classification solution, and is called the output layer. Sandwiched between the input and output layers are any number of hidden layers. It is believed that a three-layered network can accurately classify any non-linear function. Multi-layered networks commonly use more sophisticated threshold functions such as the sigmoid function. This is advantageous because the sigmoid function's range is [-0.5, 0.5] and therefore prevents any individual output from becoming too large and "overpowering" the network.

A neural network consists of four main parts:

1. Processing units{uj}, where each uj has a certain activation level aj(t) at any point in time.
2. Weighted interconnections between the various processing units which determine how the activation of one unit leads to input for another unit.
3. An activation rule which acts on the set of input signals at a unit to produce a new output signal, or activation.
4. Optionally, a learning rule that specifies how to adjust the weights for a given input/output pair.

3. Review of Literature

Yoon and Swales (30) in1991 demonstrated that the neural network approach is capable of learning a function that maps inputs to output and encoding it in magnitudes of the weights in the network connection. And compared Neural Network technique with Multivariate Discriminate Analysis approach Indicated that the Neural Network approach can significantly improve the predictability of stock price performance. F.S.Wong, P.Z.Wang, T.H.Goh, and B.K.Quek(10) in 1992 tried to apply neural gates to forecasting stock market returns, assessing country risk and rating stocks based on fuzzy rules and probabilistic and Boolean data. Lawrence Kryzanowski ,Michael Galler ,David W, Wright (19) in 1993 determines the Artificial Neural Networks accuracy in predicting future return performance as either positive or negative or as negative neutral or positive. The Artificial neural Network correctly classifies 72% of positive or negative returns. Its accuracy in predicting the three-state out comes was below this level that could be attained by chance alone.

R.Glen Donaldson and Mark Kamstra (25) in 1996 investigates the use of Artificial Neural Networks (ANNs) to combine time series forecasts of stock market volatility from the USA also demonstrate the combining with nonlinear ANNs generally produces forecasts which on the basis of out-of sample. It demonstrated how neural networks have been used to test the Efficient market Hypothesis and how they outperform statistical and regression techniques in forecasting share prices. SaeedMoshiri and Norman Cameron (26) in 2000 compared the performance of Backpropogation Artificial Neural network (BPN) model with the traditional economic approaches to forecasting the inflation rate And shows that the hybrid BPN models are able to forecasts as well as the traditional econometric methods.

Angelos Kanas (1) in 2003 extends recent research on non-linear present value models by exploring the relative out-of – sample forecast performance of two parametric models and two nonparametric non-linear models of stock returns. The parametric models considered using the standard regime switching and Markov regime switching, whereas the non-parametric nearest –neighbors and the artificial neural network models. JeoJasic and Douglas Wood (16) in 2004 studied the statistical significant and potential profitability of one step ahead forecasts of stock market index returns provided by univariate neural network model is examined. Using neural networks with genetic optimization offer a tool that can produce mechanical trading systems that are adaptable to changing market timing. Kyoung-Jae Kim and Won Boo Lee (18) in 2004 studied the Genetic Algorithm based future transformation model (GMT) for Artificial Neural Networks to predict the patterns of the stock market.

The GMT discretizes the original continuous data according to optimal or near-optimal thresholds and calculated that the GMT reduces the dimensionality of feature space and then enhances the generalizability of the classifier from the empirical results. Erdinc Altay and M. HakanSatman ESQ (8) in 2005,studied the Istanbul Stock exchange can be forecasted through the learning procedure of Artificial Neural Network and compared the forecasting performance of artificial neural network with linear regression and buy and hold strategies'. G.Armano, M.Marchesi and A. Murru (11) in 2005 studied a novel approach to perform stock market forecasting has been presented and described from the conceptual and perspectives using a hybrid genetic neural architecture. Hepingpan,ChandimaTilakaratne and John Yearwood (14) in 2005 ,investigated several aspects of input feature selection and number of hidden neurons for a practical neural network for predicting Australian stock market index AORD.A basic neural network with limited optimality on these has developed and achieved correctness in directional prediction of 80%.

Hyun-Jung Kim, Kyung-shink, and kyungdo park (15) in 2005 investigate the effectiveness of a hybrid approach with the time delay neural network (TDNNs) and genetic Algorithm (GAs) in detecting temporal patterns for stock market prediction task and showed that the integrated GA-TDNNs approach proposed for this study performs better than the standard TDNNs and Recurrent Neural Network to reflect temporal pattern. Qing Cao, Karyl B Leggio, Marc J.Schniederjans (24) in 2005 used Artificial Neural Networks to predict stock price movement (i.e. price return) for firms traded on the Shanghai Stock Exchange and compared the predictive power of univariate and multivariate neural network models and results shows that

Neural Network outperform the linear models compared and these results are statistically significant across our sample firms and indicated neural networks are useful tool for stock price Prediction in emerging markets like China.

Takashi Yamashita , Kotaro Hirasawa and Jinglu Hu (28) in 2005 utilized Multi-branch neural networks (MBNNs) for prediction of stock prices and simulation were carried out in order to investigate the accuracy of prediction .The results found that MBNNs with fewer parameters could have better accuracy than conventional NNs when predicting Nikkei-225 at time (t + 1) . GoutamDatta, PankajJha, Arnab Kumar Laha&Neeraj Mohan (12) in 2006, discusses the modeling of the Indian stock market data using Artificial Neural Network andstudied the efficiency of ANN in Bombay stock exchange. EleniConstantinou ,Robert Georgiades, AvoKazandjian, and GeorgiosP.Kouretas (6) in 2006,analyses regime switching and Artificial Neural Network in volatility and out-of-sample forecasting of the Cyprus Stock Exchange by using daily data.

Lev Blynski and Alex Faseruk (20) in 2006 studied and forecast option prices with simple backpropogation neural network and to compare the results between conventional Black-Scholes model, the Black-Scholes model with pure implied volatility and neural network models over a seven year period. Chakaradhara panda and V.Narasimahan (5) in 2006 used the Artificial Neural Network for the forecasting of daily Bombay Stock Exchange (BSE) Sensitive Index (Sensex) returns and compare the performance of the neural network with performances of random walk and linear autoregressive models by using six performance measures. Xun Liang (29) in 2006 studied the complicated association of stock information stream with stock price movement and based on the stock information entropy, the intensity for stock information stream was measured and applied to associating with the stock price movement with the aid of neural networks.

Olivier Coupelon (22) in 2007 proposes the modeling process of artificial neural Network in stock movement prediction and studied the problems that can be encountered have been dealt with, which should lead to a good financial forecast. JinyuanShen , Huaiyu Fan ,and Shengjiang Chang(17) in 2007 , tapped delay neural network (TDNN) with an adaptive learning and pruning algorithm was proposed to predict the nonlinear time serial stock indexes ,The Simulation and comparison shows that this optimized neuron network model can not only reduce the calculating complexity greatly but also improved the prediction precision. AsifUllah Khan, T.K.Bandopadhyaya and Sudhir Sharma(2) in 2008, compared a Backpropogation neural network and Genetic algorithm based backpropogation neural network and showed that for stock rate prediction Genetic algorithm based backpropogation neural network gives more accurate prediction.

BirolYildiz, AbullahYalama&MetinCoskun(3) in 2008 developed an efficient three layer Neural Network with revised Back propagation Algorithm to predict the direction of Istanbul Stock Exchange National-100 Indices (ISE National -100) and as a result, the model forecast and direction of ISE National -100 to an accuracy of 74.51%. S.D.Bekiros and D.A.Georgoutsos (27) in 2008, investigates the profitability of a trading strategy based on recurrent neural network that attempts to predict the direction of change of the market in the case of the NASDAQ composite index. ErkamGuresen and GulgunKayakutlu (9) in 2008 evaluated the effectiveness of neural networkmodels, Recurrent Neural Network (RNN), Dynamic Artificial Neural Network (DANN),and the hybrid neural networks which use Generalized Autoregressive Conditional Hetroscedasticity (GRACH) and Exponential Generalized Autoregressive Conditional Hetroscedasticity (EGRACH) to extract new input variables and the comparison of each model was done in two viewpoints MSE and MAD using real exchange daily rate values of Istanbul Stock Exchange (ISE) index XU10.

C.D.TilaKaratne, M.A.Mammadov and S.A.Morris (4) in 2009 studied modified neural network algorithms to predict whether it is best to buy, hold or sell shares of stock market indices. E.L. de Faria, Marcelo P. Albuquerque, J.L. Gonzalez, J.T.P. Cavalcante and Marcio P. Albuquerque (7) in 2009 performs a predictive study of the principal index of the Brazilian stock market through artificial neural networks and the adaptive exponential smoothing method, respectively and compare the forecasting performance of both methods on this market index, and in particular, to evaluate the accuracy of both methods to predict the sign of the market returns. Also the influence on the results of some parameters associated to both methods is studied. Qing Cao ,MarkE.Parry and Karyl B. Leggio (23) in 2009 examined the predictive ability of several well-established forecasting models, including dynamic versions of a single factor CAPM – based model and Fema and French's three-factor model , compared these models with artificial neural network(ANN) models that contains the same predictor variables but relaxes the assumptions of model linearity. And find no statistical difference in the forecasting accuracy of CAPM and three factor model and also found that neural networks may be a useful tool for stock price prediction in emerging markets.

Monica Isfan , RuiMenezes and Diana A.Mendes (21) in 2010 shows that the Neural Network can be used to uncover the nonlinearity that exists in the financial data ,And compared the artificial neural network model with a traditional approach by analyzing the discriministic /stochastic characteristics of the Portuguese Stock market data.

4. Conclusion

The principal topologies of neural networks that are currently most relevant for applications in power electronics have been reviewed including the detailed description of their properties. Both feed-forward and feedback or recurrent architectures have been covered in the description. The application examples that are discussed in this paper include nonlinear function generation, delayless filtering and waveform processing, feedback signal processing of vector drive, space vector PWM of two-level and multilevel inverters, adaptive flux vector estimation, and some of their combination for vector-controlled ac drive.

In this review of literature tried to sum up the application of Artificial Neural Network for predicting stock market .In the World Predicting stock market index is a difficult task. But Artificial Neural Network having ability to predict stock index. This is new emerging field there is considerably large scope to use Artificial Neural Network for predicting more accurate stock index as well as predict whether it is best to buy or hold or sell shares of stock market.

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