A STUDY ON CONCEPTUAL FRAME WORK OF ARTIFICIAL NEURAL NETWORK (ANN) FOR TIME SERIES ANALYSIS

Dr. L. Vijaya Kumar M.Com., M.Phil., MBA,PGHDRM., B.Ed., Ph.D

Head of the Department

Department of Information Systems Management, Ramakrishna Mission Vivekananda College, Evening College (Autonomous), Mylapore, Chennai - 600004.

Abstract

The present study is an attempt to understand the theoretical frame work of Artificial Neural Network for time series analysis. In order understood the theoretical frame work of Artificial neural network for time series with the concept of design, Nature, Benefit, and various area were its used are taken into consideration.   The findings of the study indicated that the article gives the research review on the application of Artificial Neural Network in the field of time series analysis.   .

Keywords: Artificial Neural Network, times Series Analysis, Stock Market prediction, Input and Output Layer.

Introduction

Stock market prediction has since developed into the new technology, the most new technology of the stock market prediction is using artificial neural networks. Artificial Neural Networks involves application of mathematical function and algorithm. The most common form of artificial neural networks in use for stock market prediction is the feed forward network utilizing the backward propagation of errors algorithm to update the network weights.

1.1 Google Trends

Tobias Presis introduced a method of stock market prediction using Internet based sources called Google Trends. This is to identify online precursors for stock market moves, using trading strategies based on volume data provided by Google Trends. It is used to find out the movement of financial relevance and stock Market. Some of the Google trends stock market prediction are Scientific Report, the collective mood of Twitter messages and Google Finance were used to collect the information about the stock market through Internet based.

1.2 Application of Complexity Science

New England Complex Systems Institute (NESCI) introduced a new statistical tools used to stock market prediction and crashes, this application used to identify internal structure of the market and crashes are triggered by panics that may or may not be justified by external laws.

2. Review of Literature

The following are the different studies under taken in different period to predict the stock market, using Artificial Neural Networks.

"Stock Market Value prediction using Neural Networks" by Mahdi Pakdaman Naeini, Hamidreza Taremian, Noma Baradaran Heshemi (2010), predicted a company's share value based on its share value history, using multi layer perception and Elman recurrent Network. It was found that Elman recurrent network and linear regression can predict the direction of the change of stock value better than the Multi layer perception.

Abhishek Kar (2011), in the paper **"Stock prediction using Artificial Neural Networks"** analyzed the prediction of stock market indices, using Artificial Neural Networks for Nifty stock index, using Algorithm on Nifty values on the basis of past 'n' days. The findings indicated that the best care accuracy of 96% on the dataset. It was concluded that the Neural networks serve as an effective tool for stock market prediction.

Using ARIMA analysis, Ahmed Ismail EI Hammady, Mohamed Abo Rizka (2011), in the paper entitled **"Neural Networks based Stock Market Forecasting"** analyzed prediction system in forecasting stock price for Egypt stock market, Commercial International Bank as CIB, using neural networks trained by historical data for 6 years to predict 12 weeks market trend. The findings indicated that ARIMA based recurrent neural network is capable of predicting the market trend with acceptable accuracy.

In the paper "**Price Prediction of Share Market using Artificial Neural Networks",** by Zabir Haider Khan, Tasnim Sharmin Alin and Md.Akter Hussian (2011), analyzed to estimate predict the price of share in the share market, using Back propagation algorithm for training section and Multilayer Feed forward network as a network work model for predicting price. It was found that the predict Back propagation the share price nearest to the actual prices.

"**Application of Neural Networks in Analysis of Stock Market Prediction"** by Neelima Budhani, Jha CK , Sandeep K Budhani (2012), analyzed to identify unknown and unseen patterns in data which are suitable for share market prediction, using Feed forward Neural networks trained by propagation Algorithm. The findings indicated that Back Propagation algorithm was the best algorithm to be used in Feed forward Neural Networks for share price prediction.

Using feed forward multilayer perceptron neural networks with Back Propagation algorithm, Adebiyi Ayodele A, Ayo Charles K, Adebiyi Marion O and Otokiti Sunday O (2012), in the paper "**Stock Price Prediction using Neural Networks with Hybridized Market Indicators**" analyzed the hybridized approach which combines the use of the variables of Technical and Fundamental analysis of stock market indicators for prediction of future stock price. It was found that hybridized approach was satisfactorily adequate as a guide for traders and investors in making qualitative decisions.

"**Prediction of Stock Price Using Artificial Neural Networks: A case of Indonesia**" by Togar Alam Napitupulu and Yohanes Badiman Wijaya (2013), compared the Stock forecasting result of ANTM (PT Aneka Tambang) using Artificial Neural Networks and of Autoregressive Integrated Moving Average. It was found that using artificial neural networks method has smaller error than ARIMA Method.

Bhagwant Chauhan, Umesh Bidavee, Ajit Ganga Thade, Sachin Kale (2014), in the paper "**Stock Market Prediction Using Neural Networks**" analyzed the implementation of Neural Networks with Back Propagation algorithm for stock market. It was found that the use of Back Propagation Neural Networks algorithm to predict the stock market by establishing a three tier structure of the Neural Networks, to get a predictive model improves forecast accuracy.

Hakob Grigoryan (2015), in the paper "**Stock prediction using Artificial Neural Networks Case Study of TAL1T, Nasdaq OMX Baltic Stock**" analyzed the combined prediction model, based on artificial neural networks with Principal Components Analysis (PCA) for financial series forecasting, using Technical analysis, Principal Components analysis and Artificial Neural Networks. The findings indicated that the model can be successfully used as an alternative method to standard technical techniques for financial times series forecasting. It was concluded that the PCA NARX prediction model provides a promising alternative tools to other artificial neural networks based methods in financial times series forecasting.

In the paper "**Stock Market Prediction using Artificial Neural Networks**", by Gaurav Kshirsagar, Rukshed Amaria, Mohit Chandel, Shantan Kakade (2016), analyzed the effects of Artificial Neural Networks to map any non linear function without a prior assumption using prediction algorithm and Back Propagation algorithm, it was found that artificial neural networks are best suited for predicting nearest stock prices.

In the paper "**Stock Market Index prediction using Artificial Neural Networks**" by Amin hedayati Moghaddam, Moein Hedayati Mohaddam and Morteza Esfandyri (2016), determined the ability of artificial neural networks in forecasting the daily NASPAQ stocks during the study period 28th January 2015 to 18th June 2015, using a Robust Model. The findings indicated that there was no distinct difference between the prediction ability of the daily NASPAQ stock

3. Research Design

3.1 Objectives of the Study

1. To understand the theoretical framework of Artificial Neural Network in the filed of Times series analysis.

2. To understand the benefit and Importance of ANN in various areas in the Field of Finance, Marketing, Sales for times series analysis.

3.2 Share price prediction using Artificial Neural Networks

An Artificial Neural Network it consists of three concepts, namely "Artificial", "Neural" and "Networks'. Artificial – made as a copy of something neuron, Neural is a study of the Neurons, and Networks is a group of inter connected group of people who keep in contact to exchange information.

3.3 History of Neural Networks

In 1958 the original perception model was developed by **Frank Roseh Blatt** using three layers, namely "retina" – distribute input, "Association units" converts input with weights, and finally output combines the values, but unfortunately the perception was found to be difficult and impossible to train.

During 1969 critical analysis of perception published by **Marvin Minsky** and **Seymore Paport** analyzed the weakness of perception for a period of time and Interest. Again the Neural Networks was revived in 1986 by **David Rumelhart, Geoffercy Hinton and Ronald Williams,** who used "Learning Internal Representation by Error Propagation". It was used to propose a multilayer network with non linear technique and to provide a reasonably effective training algorithm.

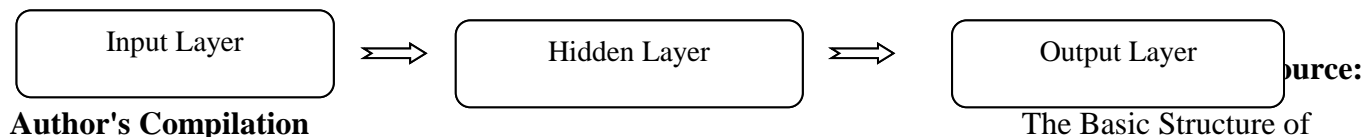### 3.4 Definition- Artificial Neural Network

Dr Robert Hecht Nielson defined Artificial Neural Network as "A Computing System made up of number of Simple, highly inter connected processing of Elements, which process information by their dynamic states response to external Inputs".

3.5 Basic Characteristics of Artificial Neural Networks

- It is typically organized in 'Layers".
- "Layers" are made up of a number of interconnected "nodes" which contains "Activation function".
- Patterns are presented to the network via the "Input Layer".
- Input layer communicates to one or more "Hidden Layers".
- In Hidden layers actual processing is done via a system of "Weighted Connections".
- Finally the hidden is linked layer link to an 'Output Layer".

The following diagram will explain the basic concept about Input, Hidden and Output layer connection of artificial neural networks.

Figure.1 Basic Artificial Neural Network Structure

| Input Layer | ⟹ | Hidden Layer | ⟹ | Output Layer |

ource: **Author's Compilation**   The Basic Structure of Artificial Neural Networks Structure is explained below.

From the above **Figure 1,** it can be understood that there are three layers connected with one another, that is input layer connected with hidden layer and the output layer get information from hidden layer. Here hidden layer plays a vital role in the operation of Artificial Neural Networks, generally the hidden layer will get input from input layer either 0 or 1 and then that input value of (0,1) will convert that with the help of Bias value (1), finally the hidden layer converts the input into output value of 1.

The following picture shows the basic structure of Artificial Neural Networks, how it's connected with multi layer operations.
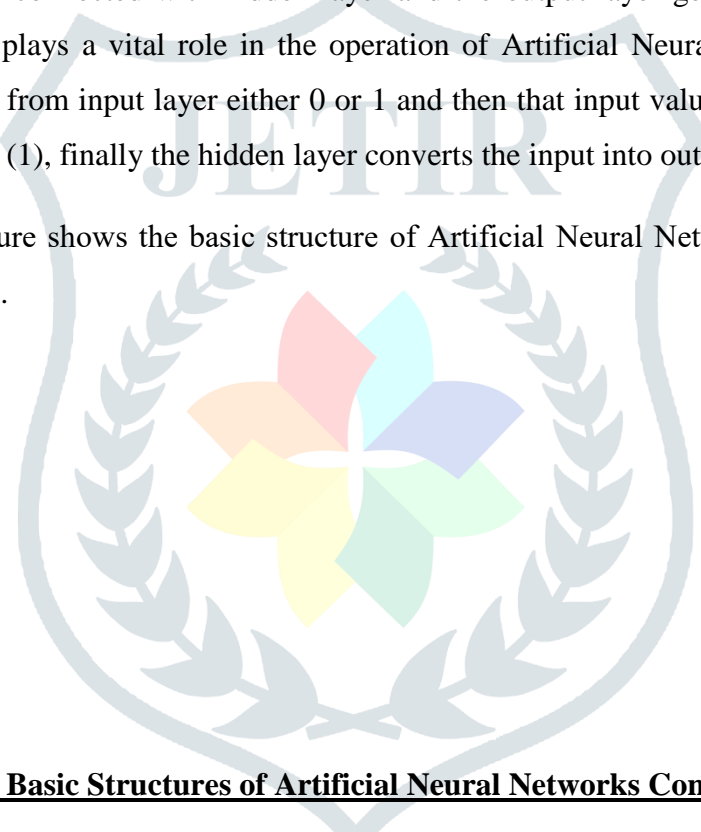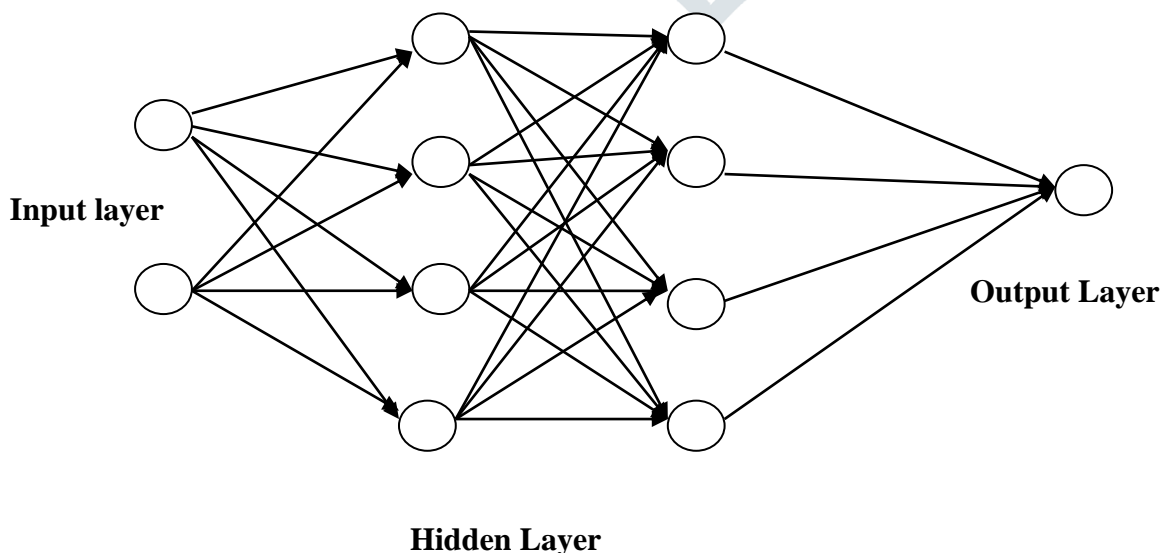
Figure 2 Basic Structures of Artificial Neural Networks Connections

Input layer

Output Layer

Hidden Layer

Source: Author's Compilation

3.6 Types of Neural Networks

The following are the different types of Neural networks used in different fields. They are as follows

Types of Neural Network	Meaning and purpose
Probabilistic Neural Networks	It is a feed forward neural network which is widely used in classification and pattern recognition problems.
General Regression Neural Networks	It can be used for regression, prediction and classification for online dynamic dynamical systems.
Radial basis Function Networks	It is used in mathematical modeling, and is an artificial neural networks used in radial basic function as an activation functions.
Cascade Correlation Neural Networks	It is a self organizing network. It begins with only input and output neurons. During the training process, neurons are selected from a pool of candidates and added into hidden layer.
Functional Neural Networks	
Kohonen Networks	Kohonen networks are one of the basic types of self – organizing neural networks.
Gram – Charlier Networks	
Learning Vector Quantization	
Hebbin Networks	It is a feedforward networks that use Hebbin learning rule. It can be described as a method of determining how to alter the weight between neurons based on their activation.
Adaline Networks	It is based on the Mcculloach – Pitts neuron. It consist of a weight, a bias and a summation function.
Hetero associative networks	
Recurrent Networks	Is a class of artificial neural networks where connections between units from a directed cycle. It can use their internal memory to process arbitrary sequences of inputs.
Hybrid Networks	Hybrid networks are the networks that are based on

	both peer to peer and client server relationship.

3.7 Advantages of Artificial Neural Networks

The following are the major advantages of using neural networks in different filed. They are

- The artificial neural networks can be implemented in any application like Market, Finance and Securities etc.
- Artificial neural networks can be implemented without any issue and problems.
- Artificial neural networks can perform any tasks where linear programs cannot perform.
- An artificial neural network learns and there is no need to be reprogramme.
- When an element of the neural networks fails, it can continue without any problem by their parallel nature.

3.8 Limitations of Artificial Neural Networks

- The artificial neural networks cannot operate without proper training.
- The artificial neural networks architecture is different from the architecture of microprocessors therefore need to be emulated.
- The artificial neural networks need high processing time for large neural networks.

3.9 Different Methodology used in Artificial Neural Networks

S.No	Methodology	Advantages	Limitations
1.	Genetic Algorithm, Support Vector Machines.	1) SVM transform the inputs into decision classes, 2) There is correlation between prices of certain stocks. 3) Considering the closing, opening, Mean, Standard Deviation and number of days for which correlation is found is considered.	Various political, Economic factors, Company policy decide trends of markets are not considered while calculation.
2.	Sentiment Analysis, Trading Model.	1) They collected aggregating information from multiple online sources. 2) They performed sentiment. 3) Analysis on given data and filtered out dataset as a result of sentiment and they found the ratio of sentiment signals. 4) Based on this, they created on	It is necessary to analyze effects of applying different sentiments analysis methodology.

		Trading model to predict stock prices and trend of market.	
3.	Artificial Neural Network - Back propagation algorithm	1) It can be used in field where accurate mathematical, model cannot be produced for example stock market. 2) It can deal with noisy data.	1) Designing is challenging as it requires tedious trial and error process. 2) Selection of data set is complex.
4.	Linear Regression, Data mining	1) Linear Regression is used to perform operation data set where target values. 2) It establishes relation between target values and predicted values. 3) Data mining Techniques have more successful performance in predicting various fields as it uses hidden knowledge of data.	1) Calculations using linear regression are very complex. 2) In Linear regression, Accuracy is low.
5.	Linear regression, Neural networks, Genetic Algorithm, Support Vector Machine, Case based reasoning	1) It is used to find accurate results among them. 2) Helpful for gathering financial data. 3) They are helpful to map the relations among financial product and financial news.	Depend on sentiments and opinion over news content and global news.
6.	Typical price, Chwkin money flow indicator. Relative Strength Index.	1) It calculates the high, low and close value of the market. 2) It tends to give mid value so that customer can buy and sell share according to the values given	Problem is determining the probability that the relationships are not random at all market condition.
7.	Data Collection, Feed forward neural network.	1) Several machine learning techniques are used in parallel to predict most optimal stock market price. 2) The main advantage is that is providing a very systemic approach and its ability to predict	1) Requires large amount of Historical data. 2) It has very high time consuming factor depends on the accuracy of the data provided.

		changes before they show upon the chart.	
8.	News CAT, Text Pre-processing, Automatic text categorization.	1) It automatically analyzes and categories press releases derive stock trading recommendation from them. 2) It can significantly outperform old trading strategies like buying and shorting stock randomly immediately after press release.	1) Selection of categorization is poor. 2) NewsCAT engine needs to be enhanced.
9.	Data Mining	1) It helps to find the hidden pattern in from historic data that have probable predictive capability. 2) It uses real times news to predict its effects on stocks.	1) It requires large amount of historical data. 2) Large amount of data processing is required.
10.	Artificial neural Networks (ANN)	1) It helps to build relation between non – linear input and output. 2) It is very intelligent system and works like human brain.	1) Artificial Neural Networks have not been fully explored. 2) Prediction is satisfactory but still lot of improvement is needed.

Sources: Date collected from article Entitled "Prediction of stock market using Data Mining and Artificial Intelligence", *International journal of Computer Applications ,* 134 (12), 9-11.

4. Various areas for the usage of Artificial Neural networks

The artificial neural networks are used in various areas for various purpose of usage. In areas such as Aerospace, Automotive, banking, Defence, Electronics, Entertainment, Finance, Insurance, Manufacturing, Medical, Oil and Gas, Robotics, Speech, Securities, Tele communication and Transpiration etc, Artificial Neural Networks are applied.

4.1 Aerospace

The artificial neural networks are used in Aerospace for the purpose of autopilot, fight path simulations, aircraft control systems, autopilot enhancement, aircraft components simulation, and fault detectors.

4.2 Automotive

Automotive are the important area in the economic development of the country,   The   various purpose in Automotive field where artificial neural networks are used for Automobile automatic guidance systems, fuel injector control, automatic braking systems, misfire detection, virtual emission sensors, warranty activity analyzers etc.

4.3 Banking

Banking is very important area in finance so artificial neural networks are plays an important role in banking sectors for Checking and other document readers, credit application evaluators, cash forecasting, firm classification, exchange rate forecasting, predicting loan recovery rates and measuring credit risk.

4.4 Defense

Defense department are very important department for the safety of the country. Artificial Neural Networks has to play a very safe and secured role in defence. The artificial neural networks are also used in the field of defense department for the purpose of weapon steering, target tracking, object discrimination, facial recognition, new kinds of sensors, sonar, radar and image signal processing including data compression, feature extraction and noise suppression, signal/image identification

4.5 Electronics

The artificial neural networks are also used in the field of Electronics for the purpose of Code sequence prediction, integrated circuit chip layout, process control, chip failure analysis, machine vision, voice synthesis and nonlinear modeling

4.7 Entertainment

The artificial neural networks play an important role in Entertainment for Animation, special effects and market forecasting

4.8 Financial

Finance department is the life blood of the business, so the finance department has a very important role in economic development; hence artificial neural networks are used for various purposes in the finance department such as Real estate appraisal, loan advisor, mortgage screening, corporate bond rating, credit line use analysis, portfolio trading program, and corporate financial analysis and currency price prediction.

4.9 Insurance

Risk and return department like insurance plays vital role the artificial neural networks are used for Policy application evaluation, product optimization.

1.20 Manufacturing

The artificial neural networks also used in Manufacturing area for the purpose of Manufacturing process control, product design and analysis, process and machine diagnosis, real-time particle identification, visual quality inspection systems, beer testing, welding quality analysis, paper quality prediction, computer chip quality analysis, analysis of grinding operations, chemical product design analysis, machine maintenance analysis, project bidding, planning and management and dynamic modeling of chemical process systems

4.10 Medical

The usage of artificial neural networks in medical department is evident. Artificial Neural Networks are used for Breast cancer cell analysis, EEG and ECG analysis, prosthesis design, optimization of

transplant times, hospital expense reduction, hospital quality improvement, emergency room test advisement etc

4.11 Oil and Gas

The artificial neural networks are also used in oil and gas department for Exploration, smart sensors, reservoir modeling, well treatment decisions and seismic interpretation.

4.12 Robotics

Every organization needs to plan for reducing human resources and increase robotics to do the basic and major work. The artificial neural networks are used in robotics for Trajectory control, forklift robot, manipulator controllers, vision systems and autonomous vehicles.

4.13 Speech

The artificial neural networks are used in Speech recognition, speech compression, vowel classification, text to speech synthesis.

4.14 Securities

Security analysis and portfolio management plays an important role in the procurement of fund for the business where the artificial neural networks are used for the purpose of Market analysis, automatic bond rating, stock trading advisory systems.

4.15 Telecommunications

The artificial neural networks are also used in telecommunication field for the purpose of   Image and data compression, automated information services, real-time translation of spoken language, customer payment processing systems.

4.16 Transportation

The artificial neural networks are also used in transportation for Truck brake diagnosis systems, vehicle scheduling, routing systems.

Conclusion

This paper has described the conceptual for an Artificial Neural Network. From the above, it is under stood that the artificial neural network are used for the field of fiancé, space, airport, transportation, telecommunication, securities etc. It has paying the attention of researchers, industry practitioners and academics. This article aims to give the research review on the application of Artificial Neural Network in the field of time series analysis.

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