**THE UNIVERSITY OF TURKISH AERONAUTICAL ASSOCIATION
INSTITUTE OF SCIENCE AND TECHNOLOGY**

**IRAQI STOCK MARKET FORECASTING USING
ARTIFICIAL NEURAL NETWORK**

MASTER THESIS

Araf ALYOZBAKEE

Science and Technology Department

Master Thesis Program

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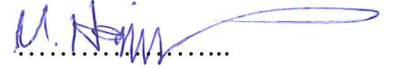
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Thesis Supervisor: Assist. Prof. Dr. Abdellatif BABA

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Araf ALYOZBAKEE

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LIST OF ABBREVIATIONS

SMA : Simple Moving Average
MACD : Moving Average Convergence Divergence
RSI : Relative Strength Index
GUI : Graphical User Interface
T : Target data
IT : Informatıon Technology
ICT : Information and Communications Technology
EMH : Efficient Market Hypothesis
SDMA : Six Days Moving Average
PC : Close prices
NNs : Neural Networks
ANNs : Artificial Neural Networks
MLP : Multi-Layer perceptron
SMFM : Stock Market Forecasting Model
RMS : Root Means Square
EMA : Exponential Moving Average

ABSTRACT

IRAQI STOCK MARKET FORECASTING USING ARTIFICIAL NEURAL NETWORK

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Master, Department of Informatıon Technology

Supervisor: Assist Prof. Dr. Abdellatif BABA

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Recently, researchers have developed the most matters in stock market forecasting because of its powerful and unpredictable temperament. Predicting is very hard for anything particularly if a relationship between inputs and results are non-linear in characteristics and artificial neural networks are one of them. Forecasting stock data with a customary time series evaluation has shown to be intricate. Because no primary postulation about a suitable mathematical model must be made prior to prediction furthermore, a neural network gets the knack to draw out useful information from significant collections of data, which frequently is necessary for a gratifying description of the financial time series. The technical analysis can be an important aspect at the global financial via its impact on the decisions of the trader for identifying stock prices and movements for future years; Therefore, this research focuses on recognizing the useful extent of the investor in the Iraq market for securities of this analysis, by focusing on how to identify and understand the trader of technical analysis, and the degree of its adoption to make investment decisions to exit or enter the market. Finding depends on a group of technical analysis indexes used in the procedure to forecast the trend of stock prices. This study proposes an application of artificial neural networks (ANNs) solution to combine three indexes of closing prices, SDMA, MACD, RSI, and the existing closing prices into the following day's predicted closing price to find the rules that describe the indices' change by the dependence of the change of closing price utilizing the training data

set. This research finds many conclusions, the main of these that revolve around the existence of a statistical value in the probability of reliance on these indicators along the way of prediction the trend of stock prices for the bank sector detailed in the Iraq market for securities to modify to the circumstances of the Iraq environment. In this study will complete recommendations that urged traders to improve perception and knowledge of technical analysis, The necessity for diversification in the utilization of technical analysis methods prior to making a financial decision, and urged academia enhance focus on the technical analysis using motivating study and researchers.

Keywords: technical analysis indexes, artificial neural networks, Stock prediction, Backpropagation, a financial time series.

ÖZET

YAPAY SINIR AĞINI KULLANARAK IRAK BORSASI TAHMİNİ

ALYOZBAKEE, Araf

Bilgi Teknolojisi Yüksek Lisans Bölümü

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Son zamanlarda, araştırmacılar güçlü ve öngörülemeyen niteliği nedeniyle borsa tahmininde çok sayıda çalışma gerçekleştirmişlerdir. Özellikle de karakteristik olarak girdi ve çıktılar arasındaki bir ilişki lineer olmadığında, herhangi bir durum için tahminde bulunma çok zor olup yapay sinir ağları da bunlardan biridir. Geleneksel bir zaman serisi değerlendirmesi ile borsa verilerini tahmin etmenin karmaşık olduğu görülmüştür. Uygun bir matematiksel model hakkında öncül bir varsayım daha ileri bir tahmin öncesinde yapılamadığından, bir sinir ağı sıklıkla finansal zaman serilerinin tatmin edici bir açıklaması için gerekli olan toplanan önemli verilerden yararlı bilgileri çekmek için bir püf noktası elde etmektedir. Teknik analiz, gelecek yıllar için borsa fiyatlarını ve hareketlerini tespit etmek üzere ticaret yapanların verdikleri kararlar üzerindeki etkisi üzerinden küresel finansta önemli bir bakış açısı olabilir. Bu nedenle, bu araştırma teknik analizi yapan ticaret erbaplarının nasıl tespit edileceğini ve anlaşılacağı üzerine ve de piyasadan çıkmak ve piyasaya girmek için yatırım kararları almadaki benimsenme derecesi üzerine odaklanarak, bu analizin menkul kıymetler için Iraq piyasasında yatırımcının faydalı ölçüsü üzerine odaklanmaktadır. Bulgular, hisse senedi fiyatlarına ait trendi tahmin etme prosedüründe kullanılan bir grup teknik analiz endekslerine bağlıdır. Bu çalışma, SDMA, MACD, RSI olarak bilinen üç adet kapanış fiyatı endeksi ile mevcut kapanış fiyatlarının ertesi günün tahmini fiyatı ile birleştirmek amacıyla yapay sinir ağları (YSA) çözümünün bir uygulamasını önermektedir. Yapay sinir

ağları (YSA) modeli, eğitim veri setini kullanılarak kapanış fiyatının değişim bağımlılığı ile endekslerin değişimini açıklayan kuralları bulmak için girdi değişkenleri olarak bu endeksleri kullanmaktadır. Bu araştırma, birçok sonuç elde etmektedir, bunlardan en önemlisi; Iraq piyasasındaki koşulları değiştirmek amacıyla Irak piyasasındaki menkul kıymetler için detaylandırılan banka sektörü için hisse senedi fiyatlarının trendini tahmin etme yoluyla bu göstergeler üzerindeki güvenirlik olasılığındaki istatistiksel bir değerin varlığı etrafında dönen sonuçtur. bu çalışma, bir mali karar vermeden önce, teknik analiz algı ve bilgilerini, teknik analiz yöntemlerinin kullanımındaki çeşitlendirme gerekliliğini geliştirmek için ticaret yapanlara baskı yapan, motive edici bir çalışmayı ve araştırmacıları kullanarak teknik bir analiz üzerine odaklanma için akademik çevreye baskı yapan tavsiyeleri tamamlayacaktır.

Anahtar Kelimeler: teknik analiz endeksleri, yapay sinir ağları, menkul kıymetler tahmini, geri yayılma, finansal bir zaman serisi.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

The stock market is where investors can officially gamble on the prices of stocks to get some type of profit or sometimes can fail to the plummeting influx of the volatile market [1]. It offers investors the opportunity to earn more income if they learn how to run smart in this game of stock market prediction. It is definitely a favorite field of analysis in financial data-mining. The aim of prediction study has been largely beyond the ability of traditional study which includes mainly centered on developing intelligent systems that are likely to emulate human intelligence. Currency markets are highly volatile, which is unarguably very hard to predict effectively predicated on certain variables. The stock market is highly volatile and is also very hard to forecast effectively predicated on certain parameters unarguably.

The Iraqi stock market is the main engine of economic growth as the economic development is closely linked to the existence of a thriving securities market and sophisticated. On the other hand, led boom and the increase of such securities and diversity as well as attractive to the public to increase to deal with the market for such securities issuance and traded, supported by the encouragement and support of the custodians in terms of providing laws march and exercise control in order to ensure that the rights of dealers and required to do their duties It specializes these transactions medium and long term and offer came in which of several categories of owners fiscal surplus of savers who want to invest their money for a long time the demand comes from the owners of the fiscal deficit wishing to invest these funds in long-term projects. That the securities by trading in this market loans through bonds or equity shares through or other movable securities. These markets have seen in

developed countries a significant development in technologies and regulations while still taking its first steps in the Arab world along the lines of those that made an important step but sought to develop its financial markets try to catch up with advanced countries.

The subject of time-series and entered the broad areas in our life and in particular economic areas, specifically financial ones under the financial time series title since the last century, a rapid development in the field of the stock exchange, and here it seemed interested in the study of a financial time series and which is characterized by a kind of instability or uncertainty that there are no time periods of volatility followed by periods of relative calm, which makes them experiencing severe fluctuations and turns fail and succeed in analysis and interpretation. And this, in turn, requires the use of analytical models can formulate these fluctuations, mathematical models that allow for future planning, where it is known that most of the financial markets. Markets and foreign exchange, local and even some economic variables (inflation and stock prices) characterized by volatility and feature of this property it means to get large fluctuations beyond uncommon, for example, in the stock price or the number of shares traded and of course that these fluctuations are Undesirable by investors or even decision-makers and politicians, because this creates a kind of uncertainty in the financial and economic transactions that may happen as a result of windfall profits or losses. Financial markets of the most important factors of the economy of any country in the world, but in order to address financial crises that occur in the market has to be the use of statistical models take into account fluctuations that occur during the trading periods, and trying to explain these fluctuations and these models a Simple Moving Average Index (SMA), Moving Average Convergence Divergence (MACD) and The Relative Strength Index (RSI) that we are going to be studied in detail and analysis through the data application of the stock market which takes into consideration the daily fluctuations in the index over time, In order to build an appropriate model for the index of the market process has been smooth data collection time were analyzed.The test this time series was a better model for the representation of this data by relying on several Criteria of informational for comparison between a model.

Stock prediction uses widely one of the very most techniques that are called Artificial Neural Networks (ANN). We have attempted to consider some vital input

variables, which were neglected by a lot of the systems. Utilizing the backpropagation algorithm to train the network by error correction and modifying the weights predicated on these corrections. ANN has the capability for arbitrary non-linear function approximation and information handling other methods do not have. Artificial Neural Networks (ANN) are well put on problems were reproducing the relationships among data is absolutely difficult so long as. On the other hand, there are a huge enough training data sets.

Another study [31] has used fuzzy logic techniques to solve the same problem, in spite of their good results; they still have a wide margin of uncertainty in their predictor. In our study we propose to use an Artificial Neural Networks (ANN) based solution to combine three indexes of closing prices, SDMA, MACD, RSI, and the existing closing prices into the following predicted day close price. The artificial neural network (ANN) model utilizes these indexes as input parameters to find the guidance, which describes the change of indices by the dependence of the change of close price utilizing the training data set.

1.2 Research Problem

The process of identifying the organization to be headed by its stocks in the first stage of the investment process, and it stays in front of the investor the right time for that here has to be asked the following question:

What is the mechanism for the following sub-questions [2]

1) How can an investor know the basic issues in the financial market and what these issues?

2) The nature of philosophy and indicators of technical analysis and the strengths and weaknesses in it.

3) How is the ability to know technical analysis indicators in predicting stock prices?

1.3 Research Importance

The technical analysis can be an important aspect at the global financial via its impact on the decisions of the trader for identifying stock prices and movements for future years; Therefore, this research focuses on recognizing the useful extent of the

investor in the Iraq market for securities of this analysis, by focusing on how to identify and understand the trader of technical analysis, and the degree of its adoption to make investment decisions to exit or enter the market. Finding depends on a group of technical analysis indexes used in the procedure to forecast the trend of stock prices, symbolized with SDMA, MACD, and RSI. Technical analysis is an important tool to support the investment decision is not only in stocks but with respect to moved values generally because scientifically lends character to the investment decisions made by investors in addition to that one approach is less complicated compared to the fundamental analysis is based Importance of the study the following points:

1) To recognize the importance of technical analysis for investors as they seek to achieve the highest return using many of the methods that can guide an investment decision.

2) Increase investor confidence in the stock exchange and technical analysis.

3) Illustrate its importance for the management of the financial market as the Stock Exchange seeks to develop and stimulate the market by the same investors to support technically and administratively and work to rationalize their decisions.

1.4 Research Objectives

The big challenge of utilizing a database is to create useful rules from a database for users to take decisions, and these rules may be hidden in the raw data of the database deeply. The issue with predicting stock prices is the fact the quantity of data is huge. There is certainly wish of classification methods on the historical data open to make an effort to help the investors to develop their decision on whether to sell or buy that stock to be able to attain profit. Fundamental analysis includes analysis of profitability and also performance to find out its share price. By focusing the entire economic conditions, business's competition, and other factors, it is able to decide expected returns and the intrinsic value of shares. Various algorithms are available to use for forecasting the info but accuracy is not up to. The results of accurate will take the business to the safe side. Economic environment relates growth prospects to the present. The neural network can achieve these issues and achieve goals with some steps.

1) To acquire the historical stock data.

2) To predict trends of stock exchange movement using the entrance of technical analysis and determine what if these trends in the case of the rising or falling.

3) To provide a favorable climate for investment in technical analysis techniques by disclosing strengths and weaknesses.

4) To provide an experimental guide for investors seeking information on future market trends using technical analysis.

5) To construct a prediction model for Iraq market using multilayer Artificial Neural Networks (ANN) to develop a prediction model.

6) To study the model with real data and research on performance parameters to achieve its accuracy.

7) To recognize the problems in the current method.

8) To analyze the total results and plot graphs

1.5 Research Scope

Days gone by three years' data of Iraq market are used for building, training and testing the prediction model for back propagation Multi-Layer perceptron (BPMLP) algorithms.

1.6 The Proposed Methodology

a) The data collection- past data of the Iraq stock market are collected from various authorized sources. The data for the duration of four years has been collected.

b) Develop an algorithm to predict a stock price by using a back propagation neural network. With Neural Network Toolbox MATLAB that is made and trained for various data and parameters.

The proposed approach used is actually

1) Analyze of an existing Forecasting Techniques.

2) Identify and study the great things about forecasting technique.

3) Study on real-time prediction situations.

4) Pick the reliable strategy to enhance the accuracy.

5) Analyze the results to predict stock price.

6) The way to obtain research will be the internet, Journals, and conferences.

1.7 Motivation

Despite a comprehensive study in the field of the stock market, no significant guidelines to determine or predict the market which has been established. Many methodologies with various analyses have used to try and predict the price. However, there is certainly profoundly limited research conducted in the amount of data had a need to predict stock markets. Therefore, this study intends to research how this factor impacts the performance of Artificial Neural Networks (ANN). Stock markets have influenced by using many uncertainties and interrelated financial and political keys at local and global levels. The main element to successful stock market prediction is attaining the best results with a little-required input data. To look for the group of relevant factors to make appropriate predictions is an elaborate task, therefore, regular stock market evaluation is very essential. More specifically, the stock market's trends are analyzed and forecasted to be able to get knowledge that could guide traders on when to invest. Also, it can help the investor to generate income via his investment in the stock market. This study reviews large numbers of web-sources, research papers, company reports and other available sources.

1.8 Thesis Organization

The research is split into four chapters. Chapter one offers in details the study background on stock market price, research objectives, and research scope and research motivation. Chapter two provides a comprehensive literature review of this thesis. It starts by presenting the value of Artificial Neural Networks (ANN) concepts, challenges, characteristics, Chapter three show details of the methodology utilized in this thesis. It specializes in describing the different parts of a model; and it also presents the model details, parameters, and performance of prediction for the proposed method. Chapter four shows the result using different parameters. Additional, it shows and discusses the results.

Finally, Chapter four concludes the consequence of the thesis, the benefits of the proposed study and recommendations for future work.

1.9 Summary of the Proposed Work

The key motivation for aiming to forecast the stock market prices is a financial benefit. The ability to discover a numerical model, which is able to reliably forecast the route of the future stock prices, would make who owns the model. Thus, academics, traders, and trading experts are always looking for a stock market model, which could gain them with higher earnings.

CHAPTER TWO

LITERATURE REVIEW

Nowadays, the important subject is predictions of a financial time series for most financial experts and research workers appropriate a prediction of various financial applications represent an integral role in financial commitment-making. Prediction of the stock market is an element of the hardest processes of time series analysis because the financial market segments are affected using many external economic and social-psychological factors [1]. An efficient market hypothesis states that stock price trends do not follow any patterns or movements, which basically impossible to forecast the future price activities established on the historical data [2]. However, time series for financial are usually non-stationary noisy and complicated, it is not impossible to build mechanisms for forecasting of financial markets [3].

The history has an understanding about the problems of predicting stock market data with technical methods. Initially, areas of effects on stock market behavior are protected and typical ideas about data fluctuations are raised. Technical analysis is broadly explained below, accompanied by a depth investigation on distinctive properties and inside architecture of Artificial Neural Networks (ANN).

Recently, researchers have developed the most of the matter in stock market forecasting because of its powerful and unpredictable temperament. Predicting is very hard for anything particularly if a relationship between inputs and results are non-linear in characteristics and stock price prediction is one of them. Forecasting stock data with a customary time series evaluation has shown to be intricate. Artificial neural networks (ANNs) may become more important for duty. Because no primary postulation about a suitable mathematical model must be made prior to prediction Furthermore, a neural network gets the knack to draw out useful information from significant collections of data, which frequently is necessary for a gratifying description of the financial time series.

2.1 The Stock Market

2.1.1 Stock Market Definition

Stock market is share in the company ownership. Stock represents a claim on business's assets and earnings. Keeping a company's stock means that you will be one of the numerous shareholders of a company; therefore, you have a promise it really small to everything the business owns. The value of a company is its market capitalization that is the stock price multiplied by the amount of stocks outstanding. A stock market is a mixture of customers and vendors of stocks and that become safeties listed over stock market as well as those that could be exchanged privately. Stock market indices are referred to as a way of calculating a stock market altogether. The key kind of market indices is the broad-market index which includes the big liquid stocks of the country. In the majority of the countries, there are present a one major indices that dominate benchmarking, indices derivatives, indices money and research applications. On top of that other particular indices find interesting applications frequently.

2.1.2 Stock price Concept

Financial theorists describe stock price as today's value of most future income expectations for the business divided by its range of shares outstanding. Essentially the gaining capacity of the company is exactly what identifies price. Even companies that do not earn money today can have a higher share price because the price   is dependent on the future earnings of the business [4].

2.1.3 Reasons for a Stock Market

The goal of a stock market is to assist in the exchange of securities between customers and vendors, thus minimizing the potential risks of trading. Stock prices change every day by market forces. Therefore that share prices change because of supply and demand. Understanding supply and demand is not difficult what is not easy is to quantify the impact the positive and also negative news on the stock price.

2.1.4 Stock Market Prediction

The activity of stock prices is induced by modifications related to supply and demand, generally known as market forces. These represent results a mixture of factors such as income and impact of social media, related to a strongly business's internal and external properties. From another point of view, data is affected by up to date and noise investors. A stock market is a mixture of customers and vendors of stocks and that become safeties listed over stock market as well as those that could be exchanged privately. The essential function of the stock market is businesses of shares between traders. Stocks are constructed into industry organizations according to their main business [5]. A transaction is the willing of a trader to market some stocks and the demand of another to buy those [5]. Each stock is not just considered by its price but by others parameters also. There can be found a relationship between each one of these parameters in support of a deep analysis we will get the behavior of the stock as time passes. The stock is recognized as abnormal and unpredictable in manner. Patterns permit the forecasting of movement may be originated. Stock market analysis handles research of these patterns. Investing and buying requests of stocks based on different decision-making algorithms are applied on financial data for past and present to forecast the behavior of stock market's future such as technical analysis, fundamental analysis, and machine learning method have all been used. Therefore, stock market forecasting can be recognized as an artificial problem in neuro-scientific data mining.

Therefore, to create earnings in stock markets, a variety of important factors are to be considered. For the intended purpose of accurate predictions, investors apply approaches of analysis produced either from a fundamental or technical [4]. The traditional strategy is the fundamental analysis including factors with regards to the business such as market position, growth rates, and earnings generation [6]. The technique leveraged in this study is the technical analysis predicated on historical fluctuations.

2.2 Prediction Method Evaluation

Trading shares, as well as commodities, were mainly depended on intuitions. As the trading went further and grew, people attempted to derive methods and tools

which can effectively predict the share prices to increase their profits and minimize their risk. Huge methods such as technical analysis, fundamental analysis, and machine learning method have all been used to try forecasting of share prices but none of them have been proven as a regularly suitable prediction tool.

2.2.1 Fundamental Analysis

The physical study of a company in conditions of its product sales, quality infrastructure, manpower, etc. known fundamental analysis to comprehend it position on the market and therefore its success as an investment [7]. The fundamental analysts consider that the market is described 90 % by logical and 10 % by physiological factors. But, this analysis is not ideal for our research because the data it utilizes to look for the intrinsic value of an asset will not change on a daily basis and therefore is not well suited for a short-term basis. But, this analysis is ideal for predicting the share market only in long-term basis [8].

2.2.2 Technical Analysis

Methods began with technical analysis utilize historical data predicated on the existence of repetition of history, trends in cost activities, and assumptions of absolute market action [6]. This technical will not consider factors about the business and depends on the assumption that general information does not have any effect on the price [9]. Technical analysis opposes the Efficient Market Hypothesis (EMH) that stock prices are influenced by all available information [11]. Hence, the EMH shows that prediction is not possible. Simplification of the idea supporting technical analysis expresses that enhanced supply would result in a price fall likened in compared to results of an elevated demand [10,30]. Therefore, timing has identified an integral for successful prediction. According to a comprehensive study, technical analysis has indicated excellent results in conditions of prediction [11].

2.3 The Data Sets and Pre-Processing

This study offers a time series prediction way and shows our model on three years close prices (*P*) of the Iraq stock market from 2013 to 2015. The dataset is available from Iraq stock website [12]. The initial dataset extracted from this website

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experienced absent days due to the stock markets' close during the weekends and holidays. The missing time series data contains negative behavior in the processing of future prices due to the canceled time steps in the data set relates to financial consumption throughout that period. Mainly three solutions to avoid the missing details for the off days the easiest solution is taking either the next day or the past day prices into the missing day's final price. The third solution fills the missing price days c_{th}, P_c, by linear interpolation using the past and following day prices, *Pc-1* and *Pc +1*.

2.3.1 Closing Prices of Iraq Stock Market

The random activity of the closing prices for Iraqi stock market which closed initially with prices of 2013 is about 6000 GBP. It generally does not affect well totally after 3 years from the impact of the financial meltdown. 5365 GBP is the average of the closing prices for three years.

2.4 The Index of Stock Market

2.4.1 Moving Average Indicator (MA)

This indicator is one of the more common indicators of technical analysis that determined the course of prices. A couple of common kinds of moving averages is available; a simple moving average (SMA) and an exponential moving average (EMA). SMA is produced by calculating the average price of a security over a particular period. Many moving averages derive from closing prices. A 35-day simple moving average is the sum of thirty-five day of closing prices divided by thirty-five. As its name means, a moving average can be an average that movements. This generates the average to go along enough time range. This indicator is one of the more common indicators of technical analysis that determined the course of prices. A mathematical equation easy and accurate and can calculate SMA according to the equation [13].

$$\text{MAc} = \frac{\sum_{j=0}^{k} Pc - j}{k} \tag{2.1}$$

The close price of a confirmed day, which is the period where the moving average has been computed?. An exponential moving average (EMA) is computed by firmly taking a weighted average of previous prices. As prices enter the past further, these are weighted less and less. This implies more recent values of security result the EMA effect more than past values. EMA is computed by:

$$EMA = C (Pc - EMA (t-1)) + EMA (t-1) \tag{2.2}$$

Where

$$C = 2 / 1 + k \tag{2.3}$$

K is the time of the EMA which is the closing price of the existing day. In order to compute the first EMA value, a SMA can be utilized.

In this study, 36-day Moving Average ($SDMA_c$) is utilized to refer the short-term closing prices with minimized influence of volatility depended on noise [14].

Generally, $SDMA_c$ together with P_c can supply forecasting of next close price P_{c+1} by a linear expression

$$P_{S,c+1} = \alpha_{S,1} \ P_c + \alpha_{S,2} \ SDMA_c \tag{2.4}$$

The mistake in forecasting c^{th} through SDMA is $E_{s,c} = P_c - P_{s,c}$. Over k observations, the root means a square (RMS) error of the determination by $SDMA_c$ is computed by

$$E\ RMS \ = \ \sqrt{\frac{1}{k}\sum_{i=0}^{K}(P_{c-j} - P_{Sc-j})^2} \tag{2.5}$$

Based on historical commercialism amounts, support and confrontation points are distinguished where in fact, the stock market price reversed it is up or down movement, within days gone by a price, by this real way the decision are taken. The most common applications of MA are to recognize the movement and also to estimate levels of support and resistance.

2.4.2 Moving Average Convergence Divergence (MACD)

The MACD is a group of three indicators, which are computed utilizing EMA. The first one, MACD represents the comparison between a twelve day and a twenty-six-day exponential moving average. The second one indicates to the ninth day EMA

of the MACD. Finally, the histogram is available, which is the comparison between the MACD and the indication. Additionally, it is known as Price Oscillator when the MACD has different values for the moving averages. It is utilized to recognize changes in power, momentum, and direction of a security ［15］.

c =1...n using an exponential moving average

$$EMA_{12,c} = 0.985 EMA_{12,c\text{-}1} + 0.015\ P_c \qquad\qquad \textbf{(2.6)}$$

And 26-day *EMA*

$$EMA_{26,c} = 0.926\ EMA_{26,c\text{-}1} + 0.074\ P_c \qquad\qquad \textbf{(2.7)}$$

The difference of EMA_{12} and EMA_{26},

$$MACD = EMA_{12} - EMA_{26} \qquad\qquad \textbf{(2.8)}$$

Provides short-term, movement of the price a nine-day EMA signifies the selling or buying a day of the stock if your choice shall be established only on MACD. The idea of MACD is that whenever two MAs combination, a significant change of a movement in the stock's price is more probably that occurs. Like all indications, MA crossover has large doubt to contemplate it as a complete truth in stock investment [16].

$$Signal = EMA\ (MACD,\ 9) \qquad\qquad \textbf{(2.9)}$$

$$Histogram = MACD - Signal \qquad\qquad \textbf{(2.10)}$$

Generally, $SDMA_c$ together with $P_{c\ can}$ supply forecasting next closing price P_{c+1} by a linear expression [17]

$$P_{M,c+1} = \alpha_{M,1}\ P_c + \alpha_{M,2}\ MACD_c \qquad\qquad \textbf{(2.11)}$$

2.4.3 Relative Strength Index (RSI)

The RSI is a momentum indicator that is between values of zero and one hundred. RSI is utilized to make measuring the velocity and direction of price trends. It is calculated using the equations below [18]. One of the normal technical indications, RSI was initially released by Welles Wilder [19]. A set of step-by-step commands to compute and interpret the RSI is offered in Wilder's book that called New Concepts in Technical Trading Systems. RSI is computed in a MATLAB simulator by just the RS index ( ) function.

$$RSI = \quad 100 - (100 \div (1 + RS)) \tag{2.12}$$

It really is depended on the easy moving averages of the up steps (EMA(U, n)) and down steps (EMA(D,n)) altogether n=14 day period

$$RS = EMA\ (U,n) \div EMA(D,n) \tag{2.13}$$

Consequently, RS is merely the proportion of average up finished days to the average of down close days

For trading periods that experience an up, change utilize

$$U = Pc - Pc\ (t\text{-}1) \tag{2.14}$$

When $\qquad$ **D = 0**

Conversely, for a period that swings down, utilize

$$D = Pc\ (t\text{-}1) - Pc \tag{2.15}$$

When $\qquad$ **U = 0**

2.5 Neural Network

Enormously parallel distributed a processor is defined which is composed of a simple processing unit that includes a capability for keeping experiential knowledge and which makes it accessible for usage. The neural network can be utilized in signal processing, speech recognition, financial prediction, keeping track of process control and for analysis. There were huge prediction studies using artificial neural networks (ANNs) in the stock market forecasting [14]. A lot of triumphant applications show which ANN can be considered a very handy tool for time-series modeling and prediction. Many applications in the field of neural networks (NNs) who are handling industry issues has generated their pros over statistical while other methods do not accept AI, although there is absolutely no optimal strategy for a certain issue. To be able to recognize the key benefits and disadvantages of previous methods in NN applications and also recognize organizations between strategy and problem statement, data models, and the results achieved, a proportional evaluation of picked applications is conducted. It could be concluded from inspection that neural networks NNs are most carried out in prediction stock prices, takings, and stock modeling

2.5.1 Artificial Neural Network (ANN)

ANNs are an information handling system, which was first of all inspired by a generalization of numerical of a human. The brain of the human can be an extremely complicated, nonlinear, and parallel computer such as information-processing system. Neural Systems are simplified types of biological neuron system. It really is functional, which comprises of simple processing models similar to a parallel distributed processor; those have an all-natural proclivity for keeping the experimental knowledge and which makes it accessible for use.

An artificial neuron can be the basic processing component of ANN. Similar to natural neuron in the brain of human, inputs, processes are received by neuron and create the results. The three important components of the neuron established model are a couple of synapses, an adder, and activation function. Some impulses are received by every neuron from other neurons. Each neuron applies an activation function that is likely to be worked when obtained the threshold is significantly lower than total input as shown Figure 1.

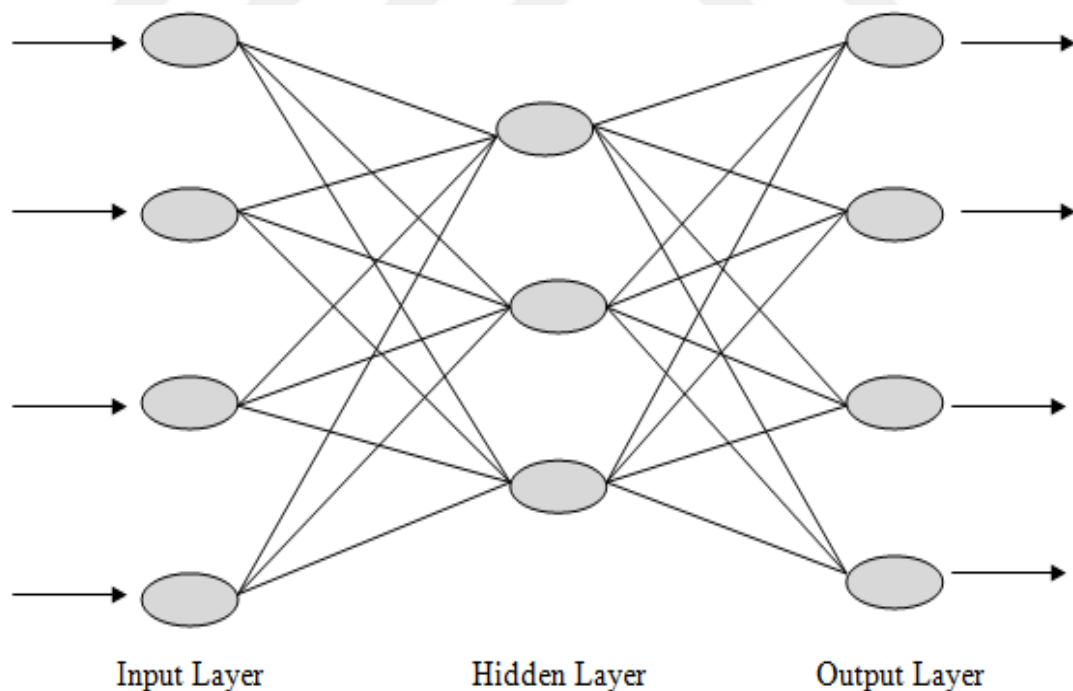Input Layer   Hidden Layer   Output Layer

Figure 1.1: Representation of ANN.

ANN, just called a neural network often is a group of interconnected links that contain weights associated with them. The idea of ANN was produced from

biological neural networks. Neural networks start a fresh foray into the area of learning efficient and useful predictions to be able to optimize gains. Numerous areas can be used by Artificial Neural Networks, as it can be an irrefutably effective tool that supports the technological community in forecasting about possible outcomes.

Any ANN can be regarded as a group of interconnected units broadly classified into three layers that are the input layer, the hidden layer, and the output layer. The input layer is fed by output, and weight is passed onto the hidden layer. The neurons in the hidden layer are essentially hidden from view. Using additional degrees of hidden neurons gives more flexibility and more appropriate handling. However, the overall flexibility gets at the expense of extra difficulty in the training algorithm. They have hidden neurons more than necessary is wasteful, as less a range of neurons would provide our goal just fine. Alternatively, having hidden neurons less than needed would go to reduce robustness of the operational system, and defeat its very goal.

2.5.2 Multi-Layer perceptron (MLP) Neural Network

MLP is a supply forward neural network with a few of layers between input and results. MLP draws collections of input data to a group of appropriate results. Feed forward define that data moves in one way from input to the output layer. MLP involves multiple levels (layers) of nodes in a directed graph, with each layer linked to the next one fully. Aside from the input nodes, each node is a neuron with a nonlinear activation function. This sort of network is trained with the back propagation learning model. MLP is being used for pattern classification widely, recognition, approximation, and prediction. MLP can find a solution for problems that are not linearly separable. MLP isolates classes by Hyperplanes. MLP utilizes distributed learning. MLP contains a number of hidden layers or just one layer. MLP Neural network is shown in Figure 2.
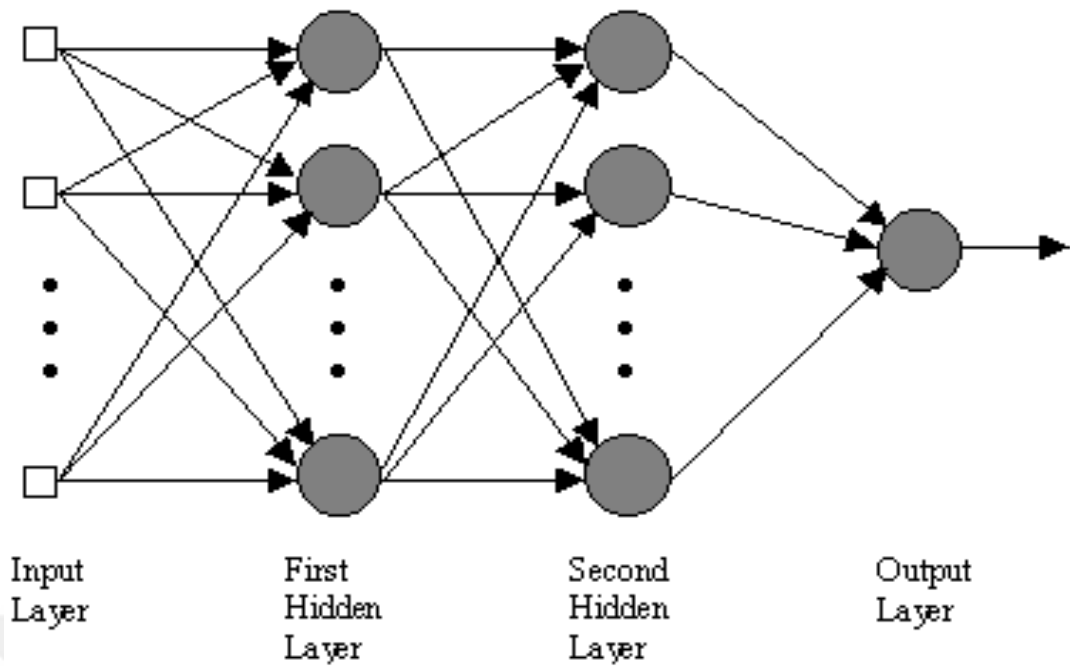
Figure 2.2: MLP neural network.

2.5.3 Backpropagation with Feed-foreword ANN

Back propagation [20, 21, 22] is the actual procedure of back-propagating the mistakes from the result [14] essentially layers for the input layer during the training period. Back propagation is essential because the hidden units do not have a focus on values that is able to be utilized, therefore these units must learn dependent on errors from the past layers.

The output layer includes a goal that has value is utilized to test computed value. When the errors are back-propagated by using the nodes, the weights constantly updated Training, which will happen until the errors in the weights are sufficiently small to be approved. Alternatively, the calculation complexity of Backpropagation Algorithm is merely O(n) top features of the algorithm are the key requirements for forecasting prices accurately. The primary steps utilizing the Back-propagation algorithm, the following:

Step one:

Supply the normalized input data test, calculate the corresponding output;

Step two:

Calculate the error between the result and the targets;

Step three:

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The weights and membership functions are fine-tuned;

Step four:

IF Error is greater than Tolerance THEN go to Step one ELSE

Finish (stop).

2.6 Why is Neural Network Most Beneficial For Prediction?

The extraction of the prototype in time-series forecasting is referenced as the procedure of figuring out previous relationships and movements in historical data for forecasting future prices. The pattern modeling method works commonly used statistical methods on different error measurements and forecasting the trend of change in time-series [25]. Green and Pearson (1994) and more argue that an improved technique for calculating the performance of neural networks (NNs) is to investigate the route of change [27]. Therefore, the study accuracy and reliability of the neural network prediction models built for the study provided in this study is the ratio of the correct market route predicts created by the neural networks (NNs). The direction of alteration is determined by reducing today's price from the prediction price and identifying the indication positive or negative of the effect. The percentage of the correct route of change predictions is the same as the percentage of profitable investments empowered by using the artificial neural network (ANNs) system. With regards to the trading methods implemented intensity-based prediction models, prediction methods predicated on latent smoothing, Bayesian vector auto regression minimizing prediction error might not exactly be a satisfactory regression, multivariate transfer function, and also to achieve their goals [26]. In other conditions, trading (multilayered supply forward neural networks (NNs) that motivated by a certain prediction with a tiny force will be analyzed versus their classification problem might not exactly be as profitable as trading counterparts. The design of the lead by a precise forecasting, the route experiment activity or an indication of return is reviewed, forecasting the route of the stock's change exactly how to use directional predictions market indices and its own return is significant in the posterior probabilities given by the classification development of effective market models. Forecasting is replaced the traditional real prices of the stock return, the route of future change for the financial market is what actually required.

Forecasting the route of change is simpler for the neural network in comparison with a real value due to the no stationary and noisy action of the financial time series. The forecasted route can be used to produce a trading summary. This is achieved by changing the time series forecasting error into a classification task. Recently, [26] realize that the prediction models predicated on the route of stock return outperform the models predicated on the amount of stock return in conditions of forecasting the route of stock market return and increasing earnings from trading. Machine learning methodology is appealing for artificial intelligence network (ANNs) since it is dependent on the concept of learning from practice and training. Artificial intelligence network (ANNs), are well suited for a machine learning where weights are fine-tuned to enhance the performance of the network. An artificial intelligence network (ANN) is a connection of nodes linked with directed arcs everyone with a numerical weight

2.7 Stock Market forecasting through Neural Network (NN)

There are lots of real-life tribulations where future occasions must forecast based on past history. An example of that process is that of predicting the action of stock market indexes. [28] Discover that forecasting depends on a couple kinds of knowledge underlying laws, a very engaging and accurate method of prediction and the finding of powerful empirical regularities in observations of a confirmed system. Though perfect forecasting is seldom possible, artificial neural networks (ANNs) may be used to achieve relatively good forecasting in several instances. In forecasting issues, it is significant to refer both short-term (one leg) and long-term (multi-lag) forecasting. In short-term prediction, we predict another value centered only on real past values. In long-term prediction, on the other side, a few forecasted values are being used to forecast futures values also. From an extremely broad outlook, artificial neural networks (ANNs) can be utilized for financial forecasting in another of three ways:

1) It could be fed through inputs that allow it to find guidelines relating the present state of the model being forecasted to future states.
2) It could have a screen of inputs unfolding a constant set of recent time's states, and associate those with future states.

3) It could be supposed with an internal state to permit it to learn the partnership associated with an indefinitely large group of previous inputs to future states that can be accomplished by repeated connections.

Forecasting on stock outlay using a neural network (NN) involves a two phases training of neural network (NN) and forecasting. In the training phase, a network produces a cluster of connecting weights, obtaining a result through the positive spread, and compares this with possible value then. In case the error has not finished estimated minimum, it becomes negative spreading task, correct linking weights of a network to lessen errors. The calculated result of positive pass on and linking weight calibration of negative pass were done subsequently. This process continues till the problem between the realistic result and expected value satisfies the requirements, so the reasonable connecting weights and threshold may be accomplished. Network forecasting practice is to input an experiment sample to forecasting, by using a stable trained network involving training variables, linking weights and threshold. It really is nowadays a typical notion that vast levels of capital are business through the stock markets all over the world. Countrywide economies are robustly connected and seriously by the performance of these stock markets. Furthermore, recently the markets have grown to be far more available an investment tool, not limited to strategic investors nevertheless for common people also.

Consequently, these are not just associated with macroeconomic variables; however, they persuade everyday activities in a more direct course. Therefore they consist of a mechanism that includes a key and direct social.

2.8 The Strengths and Weaknesses of the Technical Analysis

2.8.1 Strengths in Technical Analysis

As a result of our accumulated experience in this field, the investor in any financial market can distinguish the following strength points of any proposed predictive technique.

1) Focus on a price: represented investment of buying and selling policy decisions based on the expected share price If the share price is expected to rise, the investment decision, the purchase will be and the reverse is true as

it looks to the stock market as a key indicator economy precedes the actual state of the economy six to nine indicators a month.

2) Determining supply and demand through price analysis: that the use of data (the opening price highest price lowest price and the closing price) when analyzing the trend of prices for shares what does not mean anything if used separately, but together reflect the forces of supply and demand.

3) Support / Resistance: The graphs illustrate the balance of forces of supply and demand for shares when prices are affecting this term down or penetrate up suggests beat someone on the other Penetrating the upper limit of resistance means increased demand and break the lower limit the support means to increase the offer.

4) Date Price Photographer: graphs of prices make it easier to read a past history at certain periods of time and are much easier to read the tables and in the majority of graphics charts for stocks find a number of factors at the bottom of the drawing.

5) Assistant in determining the time of entry and exit from the market: Technical analysis is used to determine the best times to enter or exit the market.

2.8.2 Weaknesses in Technical Analysis

According to same experience mentioned above, we can identify some of the weaknesses in technical analysis. Therefore, we are going to explain how to treat these drawbacks in the upcoming chapters. These negative points are:

1) Influenced by the opinion of an analyst: Technical Analysis influenced an impression of an analyst for the stock and should, therefore, note this point when your analysis per stocks If the analyst is optimistic, up an arrow may not see signs landing and vice versa when the pessimist may not see signs of ascent.

2) A different reading of the chart itself: Although there are general rules of technical analysis but in often if the same chart was given to two technical analysts have all read each chart a different way and a different scenario, both of which will support reading points support, logical resistance, penetration, and refraction.

3) Delayed technical analysis signals: from the outlet on technical analysis that the transmissions too late, there is no determined direction of the stock movement only after the considerable part of the movement has already happened, Therefore after this big move ratio of return to risk has fallen significantly and the loss as part of the chance.

2.9 MATLAB Simulator Version 2013

MATLAB was as the tool to create the investment simulator due to its simplicity. Most features are necessary for this simulator were already available inside existing toolboxes or easily available off the web. It was made to be flexible, permitting an individual to improve what stock to simulate, the period of time when the stock being tested, how to classify the times, how to classify which kind of classifier to utilize the frequency of investments, the speed of retesting and an array of multiple data reduction techniques. By using this simulator, an investment model was made to explore how to increase classification ratio and investment method earnings

2.10 Summary of the Prediction

Forecasting or Prediction means discovering the future knowledge based on past knowledge. Forecasting is necessary for a variety of fields such as fraud, detection, stock market forecasting, weather prediction etc. Forecasting is utilized by combining with the other data mining techniques as classification; pattern matching, etc. using evaluating previous events, a prediction can be made by us for future. For an example mixture of decision tree analysis of every historical data with classification and previous pattern, matches are being used to recognize the next following day's opening price of the stock market, using closing prices and a past day's opening.

CHAPTER THREE

EVALUATING THE METHODOLOGY

3.1 Proposes of Study

The primary target of this study was to produce an automated investment strategy which can outperform the trade procedure and less risk. This plan must have been influenced for any market security, taken an acceptable a quantity of historical training data the next one was to find out about a computational finance method. Because of globalization and the Internet, the world becomes more linked, the capability to measure and track these increases of connections. In the current society that is more data has been noted than ever before, the given information being gleaned from these details is in its infancy. The training methods are to use to parse, and big data sets are classified, which was the best goals because of the value it can invest in the world future.

This chapter reveals the proposed prediction strategy to construct the stock market forecasting Model (SMFM), basing on predicting the stock prices utilizing popular predicting strategy in input arguments. Closing prices of Iraq Stock Market from 2013 to 2015 were utilized as the time series data to validate our model. A block diagram of most processes of SFPM involving its test processes is shown in Figure 3.1.
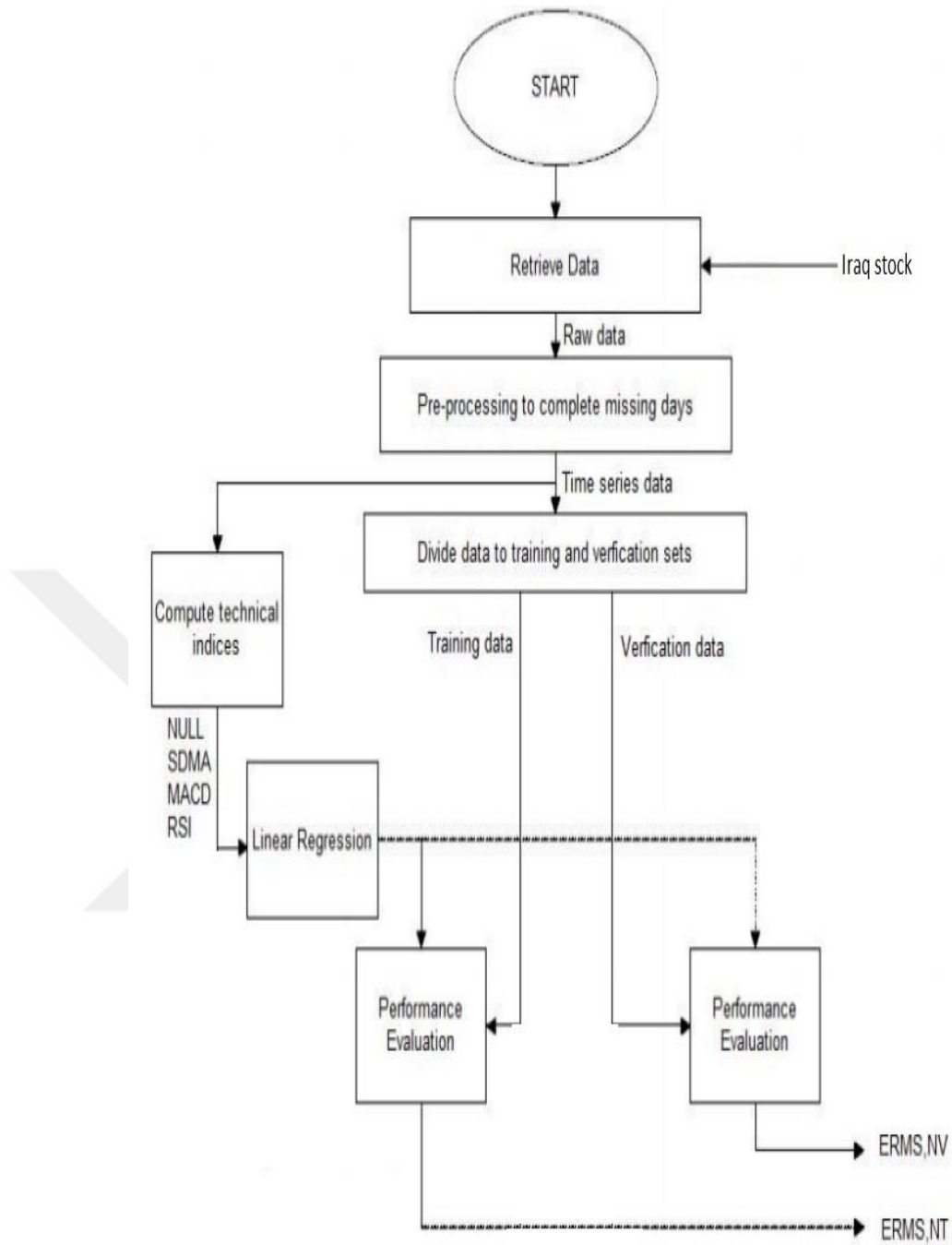
Figure 3.1: The proposed model involving its testing.

3.2 Data Pre-Processing

Data pre-processing is conducted on the time series data to be able to link the difference between the missing dates utilizing the interpolation strategy. The evaluation of the forecasting error without and with missing data is continued 24 hours and 48 hours in advance forecasting utilizing a linear regression of the previous 48 hours to confirm the result of this task. Then doing the missing values,

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the time series is separated in two aspects, from almost 1095 days in time series data, the first 344 is utilized for training goal in determining the variables of the forecasting strategy, and the previous 344 is utilized for verification goal to look for the performance of the forecasting strategy.

3.3 Computation of Stock Market Indexes

Three Indices, SDMA, MADC, and RSI, are computed on the pre-processed time series data utilizing the strategies explained in Chapter two. From indexes, MADC and RSI appear the movement of prices, and SDMA provides an accurate seventeen short term postponed price status. The indexes separately were found in forecasting 24 hours and 48 hours prices by linear regression to look for the degree of information content in each index by using the following procedure.

3.4 Regression Without Indexes

Null Regression is essential to test the forecasting performance associated with an induce in forecasting 24 hours ahead future price ($PK,c+$a) without and with that indexes. 24 hours ahead price regression is taken to estimate the coefficients of the linear expression

$$PK,c+\text{a}= \alpha K,1 \quad P_C + \alpha K,2 \quad P_C\text{-}1 \tag{3.1}$$

N α= (N,1 α, N,2) are the coefficients and can obtain them by forming training matrices of inputs and results.

$$MZ= \begin{bmatrix} p_c & p_{c+1} \\ .... \\ p_{k+c} & p_{k+c+1} \end{bmatrix} ; \quad NZ \begin{bmatrix} p_{c+a} \\ .... \\ p_{c+a+k} \end{bmatrix} \tag{3.2}$$

Where 1-day n ahead the $a = 1$ is provided, and 2-day-ahead coefficients, then a=2 is provided. Using XT and YT the expression in the matrix form is written

$$N=M \ \alpha к \tag{3.3}$$

and can calculate N by

$$\alpha K = (M^Z M)^{-1} \quad M^Z N \tag{3.4}$$

Hence N is calculated, then for training and verification can calculate the RMS error by

$$N_{KZ}=M_Z\,\alpha_{K,} \quad \text{and} \quad N_{KX}=M_X\,\alpha_{K,} \tag{3.5}$$

Errors are estimated for training and verification by

$$E_{RMS,KZ} \;=\; \sqrt{\frac{1}{K}(N_{KZ}-N_Z)^Z(N_{KZ}\quad-N_Z)} \tag{3.6}$$

$$E_{RMS,KX} \;=\; \sqrt{\frac{1}{K}(N_{KX}-N_X)^Z(N_{KX}\quad-N_X)} \tag{3.7}$$

3.5 SDMA Index Regression

SDMA can be a signal of the short-term price with an approximate time lag of 72 hours. A forecasting of 24 hours ahead the price by linear regression needs previous 48 hours prices as well as SDMA

$$SDMA_C = (p_{c+}\ p_{c-1}+\ldots\ldots\ldots+\ p_{c-1})/6 \tag{3.8}$$

$$PS_{,c}+a=\ \alpha S,1\ \ P_C+\alpha S,2\ \ SDMA_C \tag{3.9}$$

The coefficient vector $\alpha S=(\alpha S,1+\alpha S,2)$ is extracted from regression utilizing the training data set, and errors of the training and verification ERMS, SZ, and ERMS, SX are calculated by similar computations given for the Null Regression.

3.6 MACD Index Regression

MACD is simply calculated by function macd () in MATLAB, which computes it as described in Chapter two. There is the MACDc value of the day; a linear expression forecast the future price.

$$PY,c+a=\ \alpha Y,1\ \ P_C+\ \alpha Y,2\ \ MACD_C \tag{3.10}$$

Comparable to Null and SDMA situations, the variables $\alpha M=(\alpha M,1\ \alpha M,2)$ are given by regression utilizing the errors ERMS, and the training data, MZ and ERMS, MV are calculated by similar computations obtained for the Null Regression.

3.7 RSI Index Regression

RSI indices require keeping track of the loss and gain days, also processing the total the gain and the total loss days over the last two weeks period. Using the MATLAB function RS index ( ) computes the index RSI as explained in Chapter two.

The RSI index is a rating of the movement, as opposed to the price value. The linear expression with RSI is:

$$P_{S,c+a} = \alpha_{S,1} \; P_c + \alpha_{S,2} \; RSI_c \qquad \textbf{(3.11)}$$

The prediction of a-day-ahead price is given after that the coefficients are calculated using regression by training data set.

$$\alpha = (\alpha_{S,1} \; \alpha_{S,2)}$$

In a similar way can calculate the errors ERMSSX, and ERMSSX as described for Null Regression.

3.8 Linear Prediction of all Three Indices

By using the expression

$$P_{b,c+a} = \alpha_{b,1} \; P_{kc} + \alpha_{b,2} \; SDMA_c + \alpha_{b,3} \; MACD_{kc} + \alpha_{b,4} \; RSI_{kc} \qquad \textbf{(3.12)}$$

A-day-ahead the future price is calculated from all three indexes (SDMA, MACD, and RSI). The parameter vector

$$\alpha b = (\alpha b,1 \quad \alpha b,2 \quad \alpha b,3 \quad \alpha b,4) \qquad \textbf{(3.13)}$$

By training data set using linear regression procedure that is obtained, while we can calculate the future price by

$$P_{b,c+a} = (P_c \; SDMA_c \; MACD_c \; RSI_c) \; \alpha_b \qquad \textbf{(3.14)}$$

In a similar way can calculate the errors ERMS,RV and ERMS,RT as described for Null Regression

3.9 Methodology

In our model, we build up the Stock forecasting using the following variables:

3.9.1 Data Set

To forecast values in any field, it needed a big collection of data. Using, which data system is able to forecast future value, and it's necessary to learn and validate the neural network. So in this functional system, we needed stock market data that take from website [12]. Network for that people remove unrequited data from non-linear data and then normalized it in scope {-1, 1} using minimum to maximum normalization strategy. Then normalized data form that is able to be provided by the network. Then getting output, this is also in normalized. In a similar manner, it obtains an actual output, which is demoralized. To train a network, the complete data is classified into the three subsets, which is set of training data, validating data, and testing data.

An ANN model which is well tuned with the correct variables can be used to develop such a predictive tool.

3.9.2 Neural Network and Training Design

The neural network is established by three layers which are input layer, hidden layer, and an output layer. in addition, the neural network is based other variables such the following:

1) Layers in network
2) Input layer has many neurons
3) Hidden layer has many neurons
4) Momentum rate
5) Network Rate

In the beginning, learning network was made with some primary values. The back-propagation algorithm has to be used to train a network, using to enhance the performance of the neural network. To train a network it needed a data set. By using that data set a network gets trained and a present correct result (output) after processing input data [23].
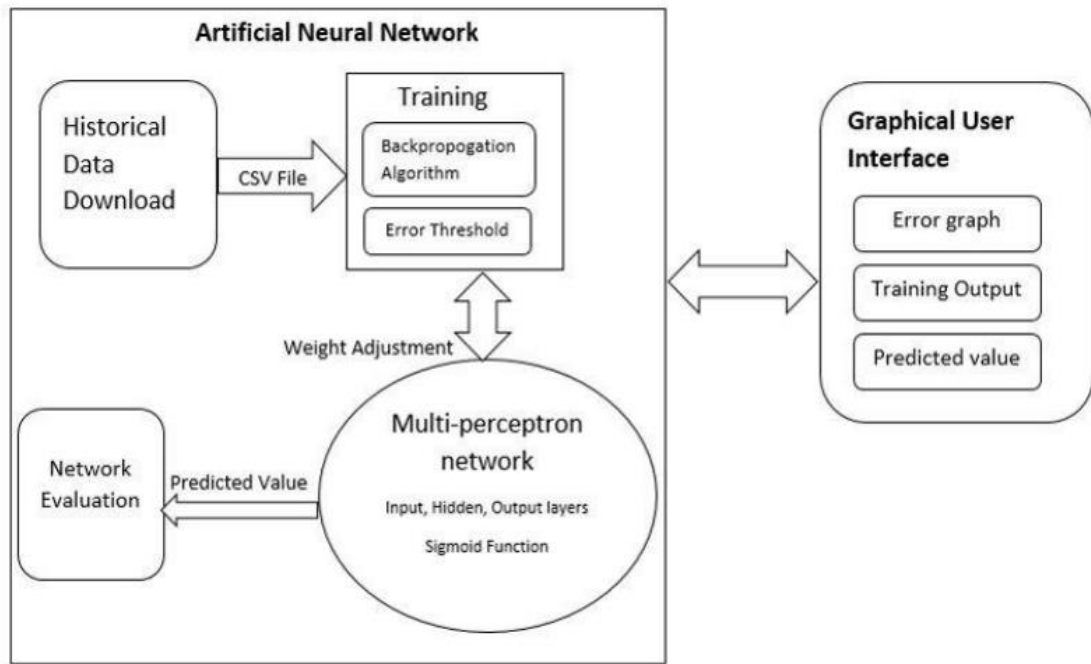
Figure 3.2: Architecture diagram.

3.10 Model Analysis

We worked a feed-forward neural network that includes an input layer has three neurons, a hidden layer that includes five neurons and an output layer has one neuron. The training of a network has utilized back-propagation algorithm to achieve that. Levenberg-Marquart algorithm (*trainlm*) are used as the training function, adaptive learning rate back-propagation (*traingda*) with Gradient descent and momentum and an adaptive learning rate back propagation (*traingdx*) algorithm with Gradient descent designed in MATLAB Neural Network Toolbox. Neurons with the Log-sigmoid transfer function (*logsig*) are used in the tested structures, the hidden layer has Radial Basis Transfer Function (*radbas*) and linear transfer function (*purelin*) has one neuron within the output layer.
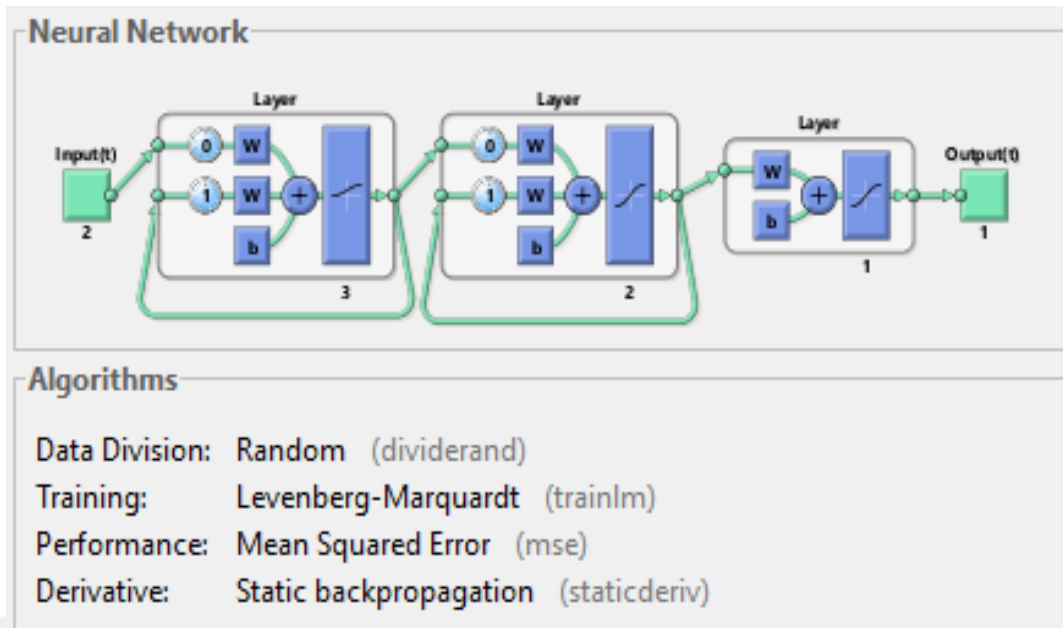
Figure 3.3: The proposed model network in MATLAB.

3.10.1 ANN Training

The training stage can be split into two parts, the propagation stage, and the weight update stage. Inside the propagation stage first, the normalized data is input to feed the input nodes for the network using the formula.

NI = (I –min/ max-min) (new maximum – new minimum) + new minimum   **(3.15)**

Where

NI = Normalized Input.

I = Actual Input.

New maximum is the scope of the new data, Min, Max is the scope of the old data. New minimum. In this it is {-1, 1} because the back-propagation can process data between {-1, 1}[24].

From the figure 3.4, we can easily see that the normalized input data are passed into the input layer, and then the weights are multiplied with each input data and supply into the neurons of the hidden layer. In the proposed model we worked one hidden layer, and also the layer neurons get the same functions as the neurons of input layers. Then one of the neurons moves to another neuron of the output layer.
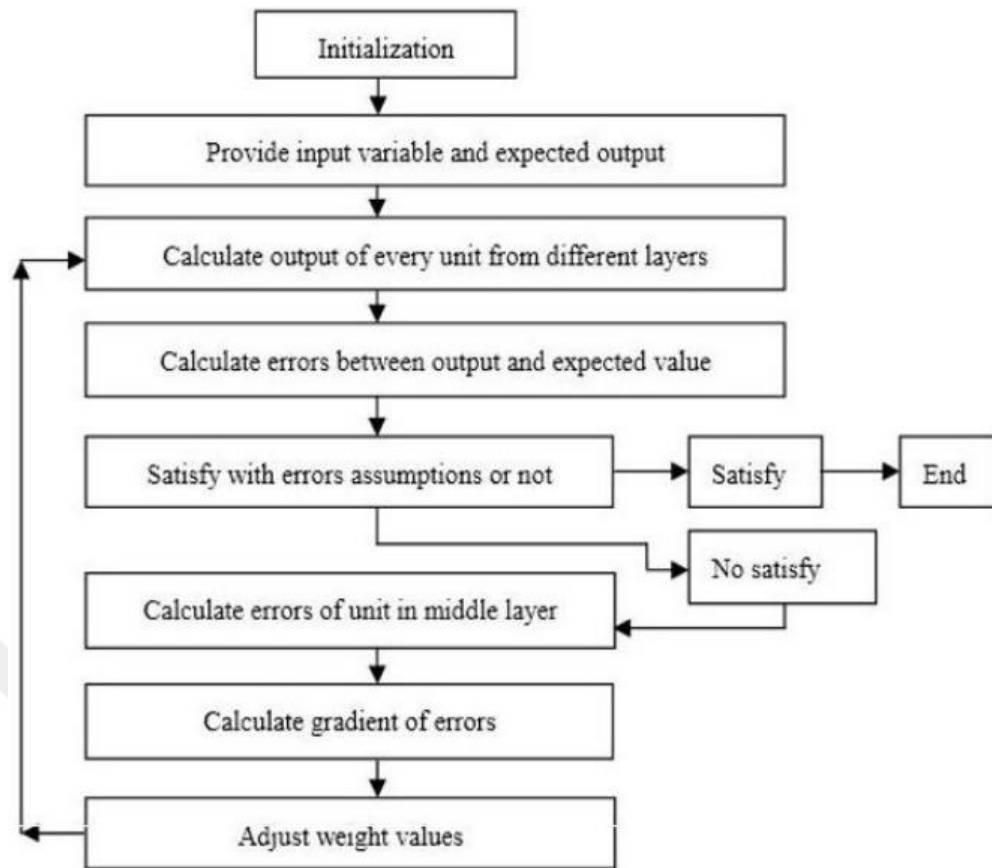
Figure 3.4: Back propagation workflow diagram.

3.10.2 The Prediction Phase

ANN is predicted when it finished training. Following training with an acceptable error the weights are established into the network then we offer the trained model the input data arranged of our day that price is wanted to predict. The trained network then forecast the price by the input data set a hidden layer neuron is given and product the previous output that is in comparison with the real output and calculates an error signal.

$$\text{Error} = \text{actual result} - \text{ANN result} / \text{actual result} \qquad \textbf{(3.16)}$$

The error is generated from the propagation stage can be employed to update the weight.
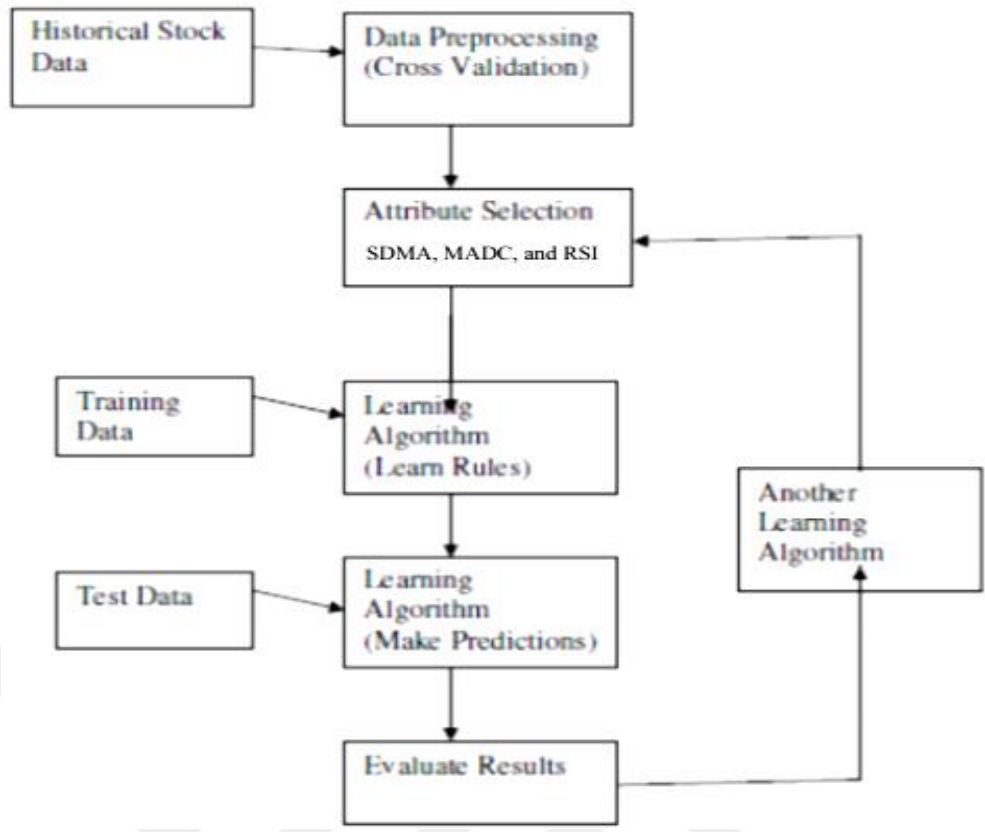
Figure 3.5: Environments for stock rate prediction.

3.11 Stock Classification

Classification of stock is performed based on a kind of company. It is essentially computed as the business's value, or in other conditions utilized as the amount of values which is predict from the business. Therefore, the stocks are basically classified as that can be recognized by us. Shares are classified based on their characteristics. Some stocks and options are classified corresponding to their growth over time and the others according to their current prices. In the same way, we can classify shares according to their capitalization. The feature that stock contains in regular is the ambiguity that is associated with their short-term and long-term future state. This feature is objectionable for the trader additionally it is faced whenever the stock market is chosen as the trade means. The best possible, which one may do is to attempt to decrease this doubt.

Logical Classification:

The price tag on a particular security on the stock market is merely dinars dependence on the purchase price to buy one stock. This study handles time series

data, which is indicated in these dinars values. The binary classification was picked in an effort to symbolize this data in a more simplified representation. This simplification enhances the classification task. The binary classification was determined by utilizing a couple formulas. One, a simple difference was considered; future data point subtracts present data point. For instance, in case the time series data, which is daily stock value, hence classification would express whether close tomorrow value that is higher or less than close price. Higher was symbolized by using a ('1)', lower was symbolized by using a ('0'). Subsequently, a collection percent is necessary before classifying a point as '1'. For example, in case one percentage is necessary with daily data, just days where in fact, the close is up at least one percentage from the prior closing day will be categorized as '1', in any other case it is given'0'.

3.12 Investment Frequency

In this study, the investment frequency was everyday investments at the price of closing for security. By daily, the classifier results in a forecasted trend for the closing tomorrow price. If this closing price is up-drawn, thus buy is manufactured at the closing price of the present day. In case the closing price is down-drawn, thus no purchase of securities is manufactured. In addition, any positions that are available currently are closed. Technical indexes utilized as inputs to the classifier were computed by using the discrete way of measuring of 24 hours.

3.13 Data Normalization

Classifiers utilize distance measurements to evaluate samples. In order to achieve this effectively, each classifier source will need the same level. The indexes are being built in this study contain values, which range from below 1 to millions. To range inputs, the vector of most examples for every single input is normalized to the amount of 1 [29]. That is completed by utilizing MATLAB version 2103.

3.14 Walk- Forward Evaluating

Evaluating and training the classifiers, this evaluation system was utilized. This evaluating utilizes the original training data to execute an evaluation over a subset of

evaluation data, which has been examined; it has in the next iteration of training data. Model is retrained with the excess training data and analyzed over another subset of evaluating data in the time series. The retries until all evaluation data has been examined. This evaluation's retraining of data can enhance a correctness of test outcomes because of the most recent data being contained in the training collection. Retraining among each data theoretically obtains the most practical simulation of the daily trading model, because of the time intensive characteristics to do a large number of training cycles. Although a different model was designed that permits for any quantity of evaluation window sizes, an interval of fifty days between retraining was utilized for some evaluations.

3.15 Mean Square Error (MSE)

Performance analysis is an important aspect. Mean Square Error (MSE) is measured by using squaring the difference of predicted result and the real result. Mean Square Error MSE0 has the main problem that is the MSE value boosts with the rise in the stock price. It uses to train the neural network. The output layer becomes back-propagation to the system dependent on the errors of the training process. The result part includes the expected values which can be to compare with real ideas to learn the correctness of our model.

3.16 Summary

This study proposes an application of artificial neural networks (ANNs) solution to combine three indexes of closing prices, SDMA, MACD, RSI, and the existing closing prices into the following day's predicted closing price. The artificial neural network (ANN) model utilizes their indexes as input parameters to find the rules that describe the change of indices by the dependence of the change of closing price utilizing the training data set. İn chapter four, we will find lots of conclusions, the main of these that revolve around the existence of statistical value in the probability of reliance on these indicators along the way of prediction the trend of stock prices for the bank sector detailed in the Iraq market for securities to be modified to the circumstances of the Iraq environment. And also this study will complete recommendations that urged traders to improve perception and knowledge

of technical analysis, and the necessity for diversification in the utilization of technical analysis methods prior to making a financial decision, and urged academia enhance focus on the technical analysis using motivating study and researchers.

CHAPTER FOUR

THE RESULTS OF FORECASTING USING THE PROPOSED MODEL

This chapter describes the approach that forecasts the stock prices using a data set taken from Iraq Stock Market for the three years between 2013-21015, This data set is collected from finance section of (isx-iq.net) website and listed in the appendix.
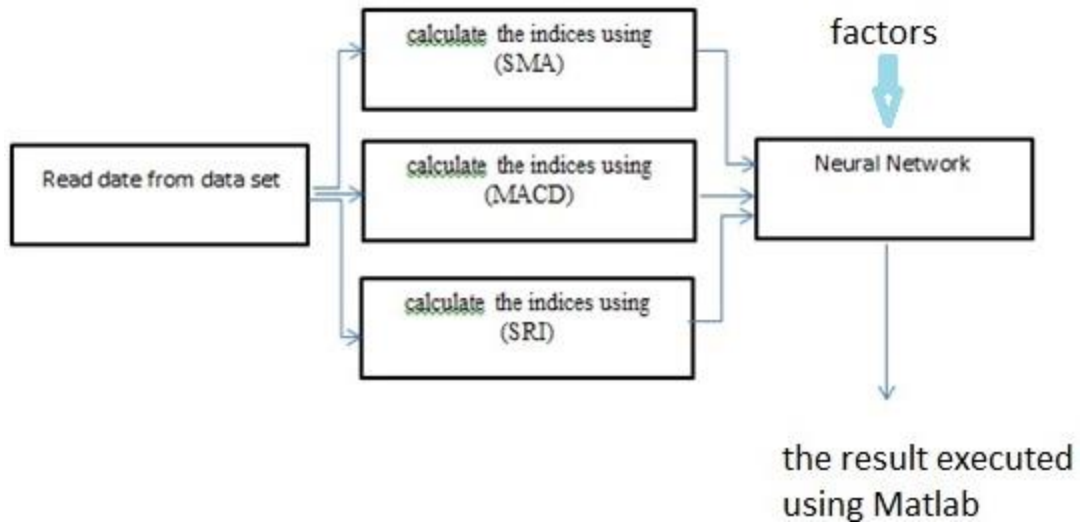
Figure 4.1: Diagram of the system.

Three parameters are used to calculate the indices of the Iraqi stock market (SMA), (MACD) and (SRI). The first parameter is calculated depending on the collected data for 35 days ago. The last two parameters are introduced to an Artificial Neural Network to produce one predicted value for the upcoming day.

The code of our proposed system is written using MATLAB. Figure (4-1) shows an overall diagram of our system.

4.1 The System Interface
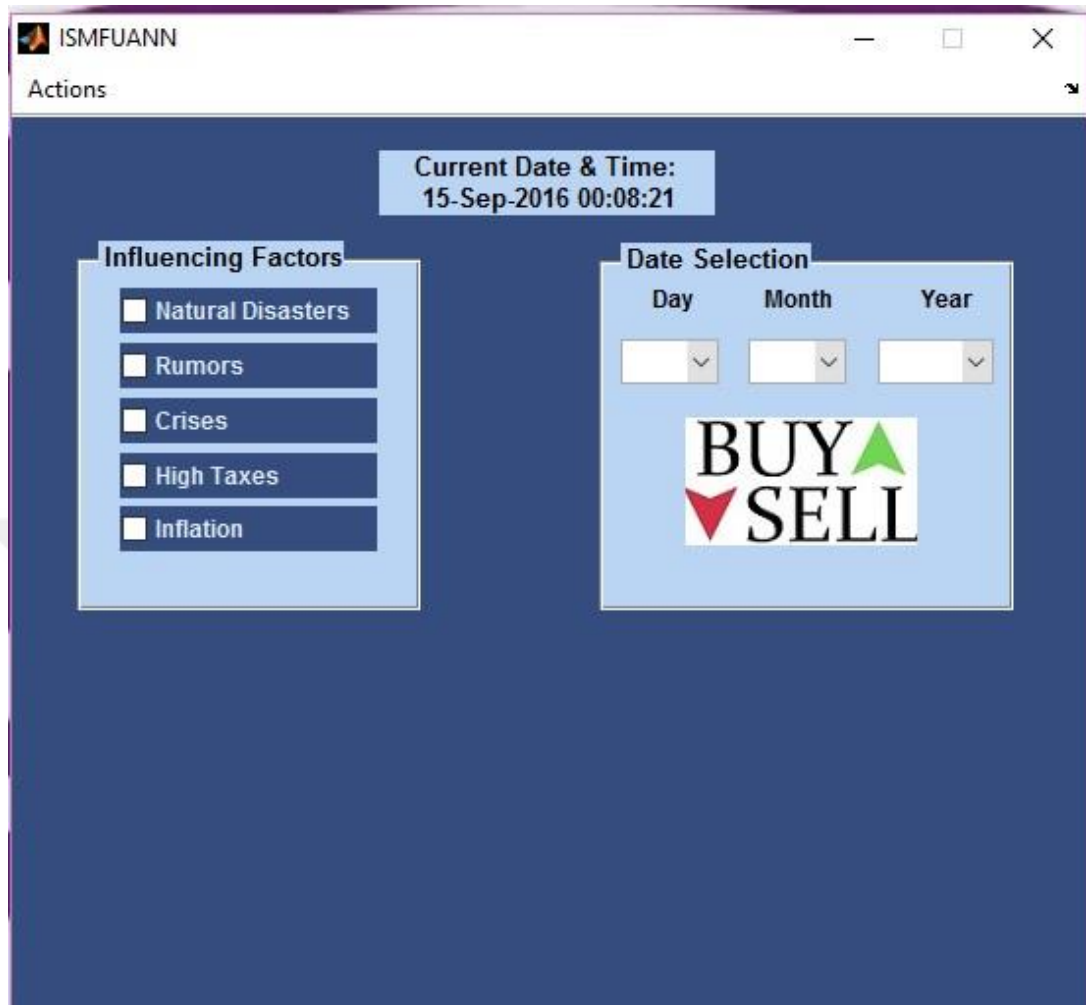
Figure 4.1: Graphical user interface of the system.

The interface of the system was coded using GUI tools. The first interface provides sections: data set selection, which is used to select the appropriate date which has to be used to estimate the market price in the upcoming date (date/month/year) selection factors to select between five factors we suggested that may be effect on the result. And finally, in the action bottom can select the plot section that shows closing price and three types of curves (moving average, moving average convergence / divergence and RS index).

The Results of Forecasting Using the Proposed System

4.2 Select a Date for Estimation

In this experiment, we simply select arbitrarily any date from the list to estimate the price for the upcoming date, as an example, take (3/11/2015) as shown in Figure (4-2). And the result shown in this example "the predicted price is going up"
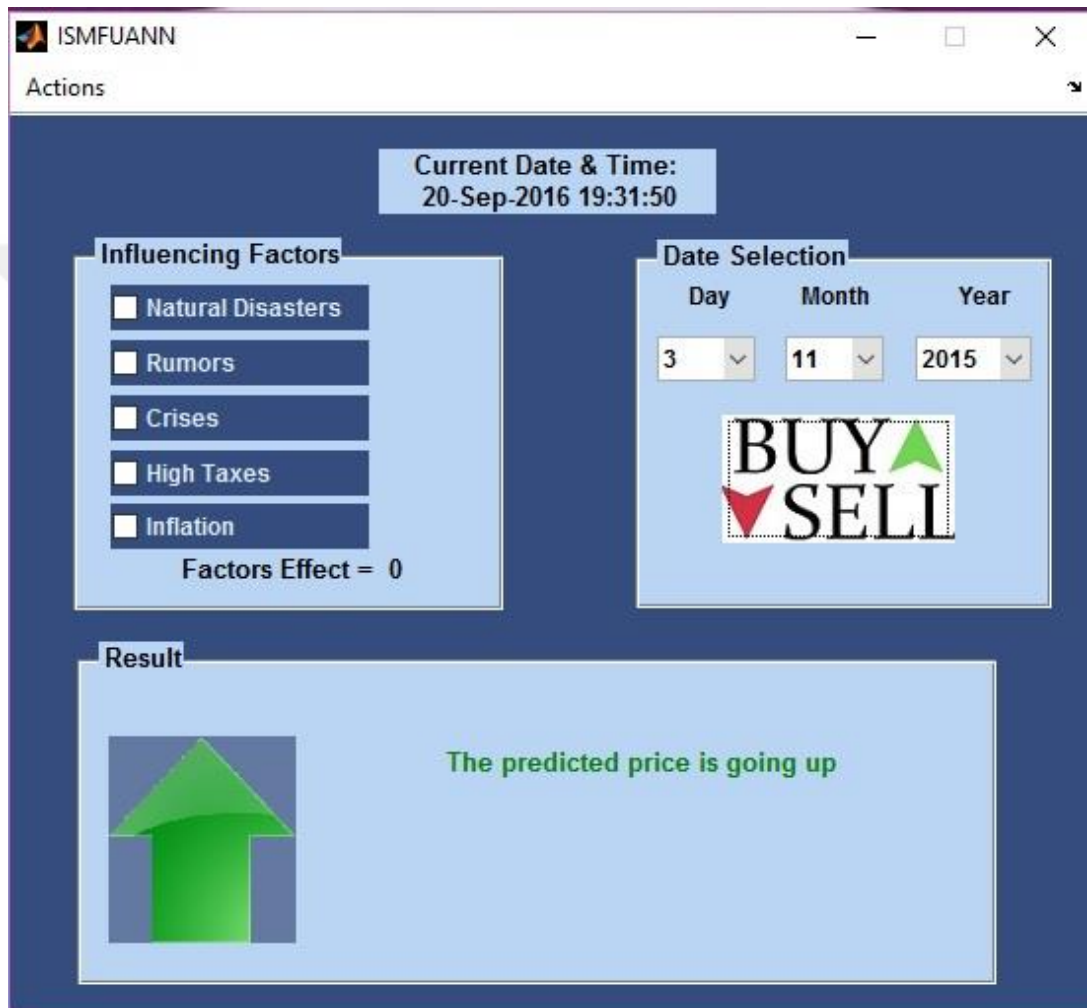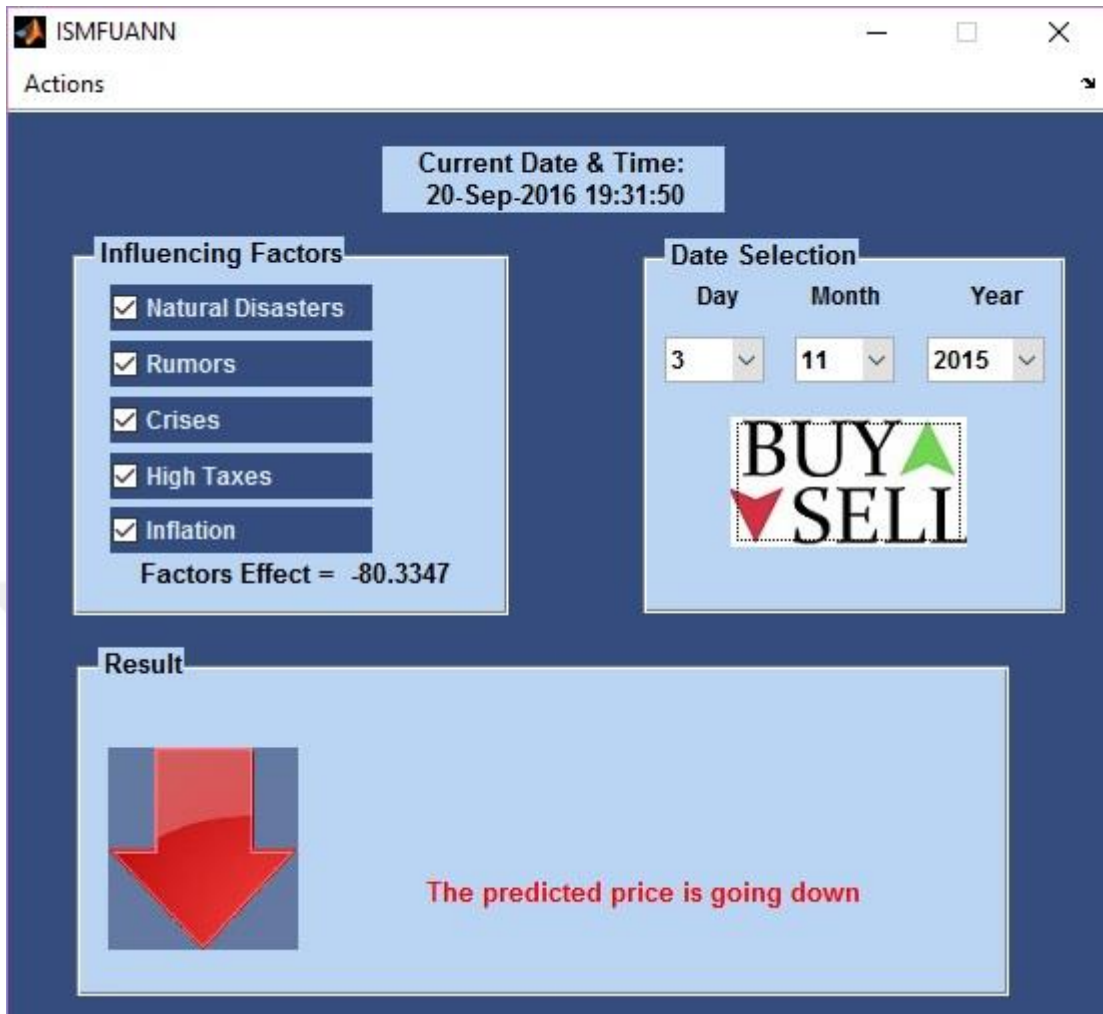

Figure 4.2: Select the date for estimation.

Figure 4.3: This figure clarifies the implementation of our interface after adding the factors, and how it affected on the previous value.

4.3 Show The Curve

The next step is to draw one of four plots using MATLAB version 2013

1. Plot moving average:
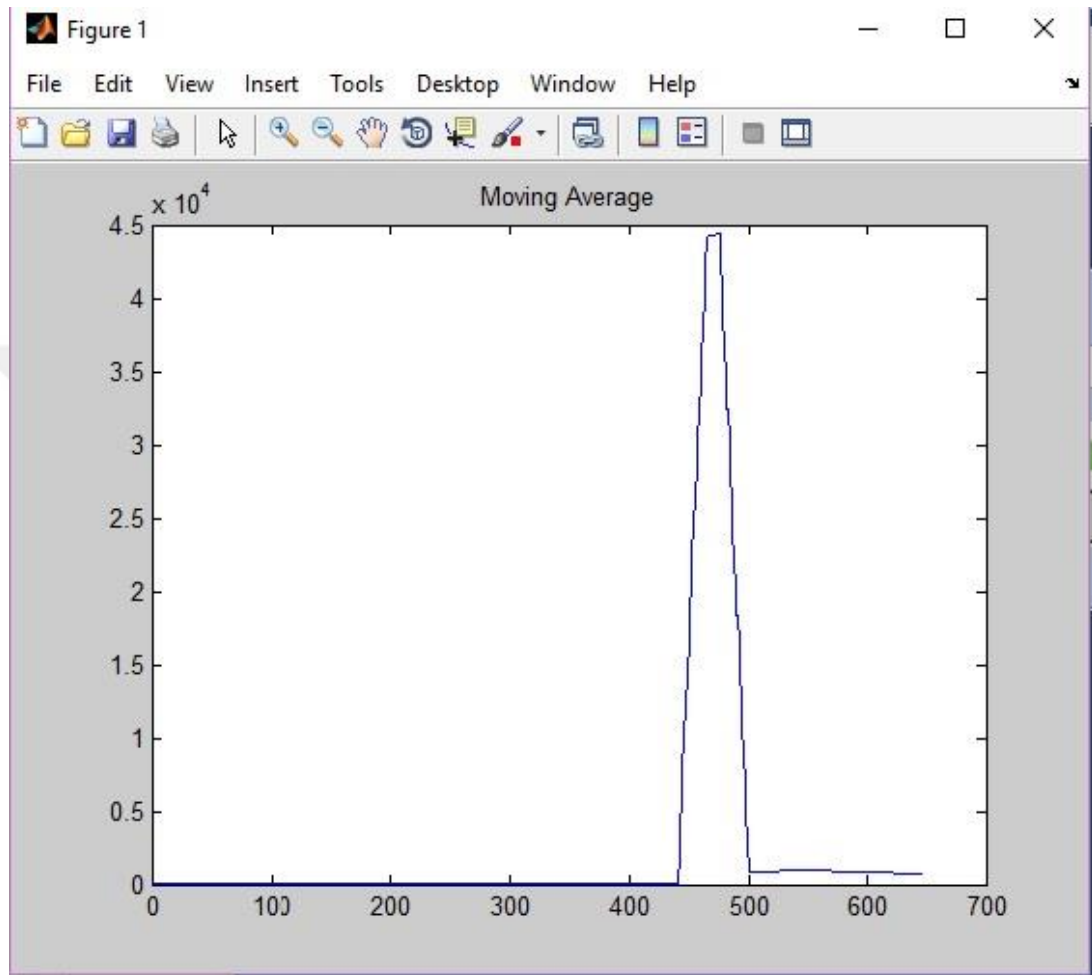
Figure 4.4: Drawing the curve that reads the moving average after applied it on Iraqi dataset, the (x) axis refer to days and (y) axis refer to the change of the result.
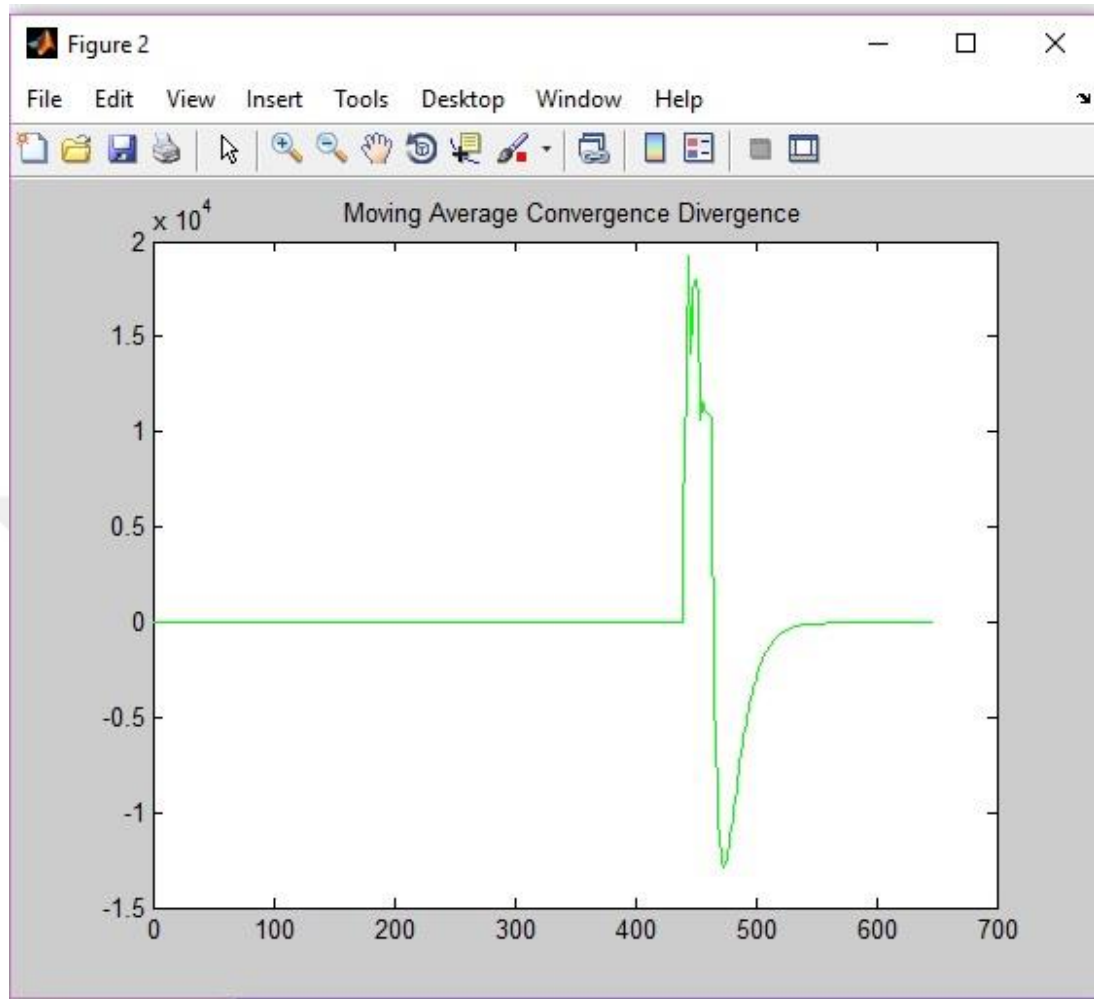
2. Plot moving convergence / divergence:

Figure 4.5: Drawing the curve of convergence/divergence after applied it on Iraqi dataset, the (x) axis refer to days and (y) axis refer to the change of the result.

3. Plot **RS** index:

This figure plots the RS Index after applying it on Iraqi stock market dataset, the result shows how the closing price is increasing and decreasing its value, the horizontal axis refers to days while the vertical axis refers to the price movement.
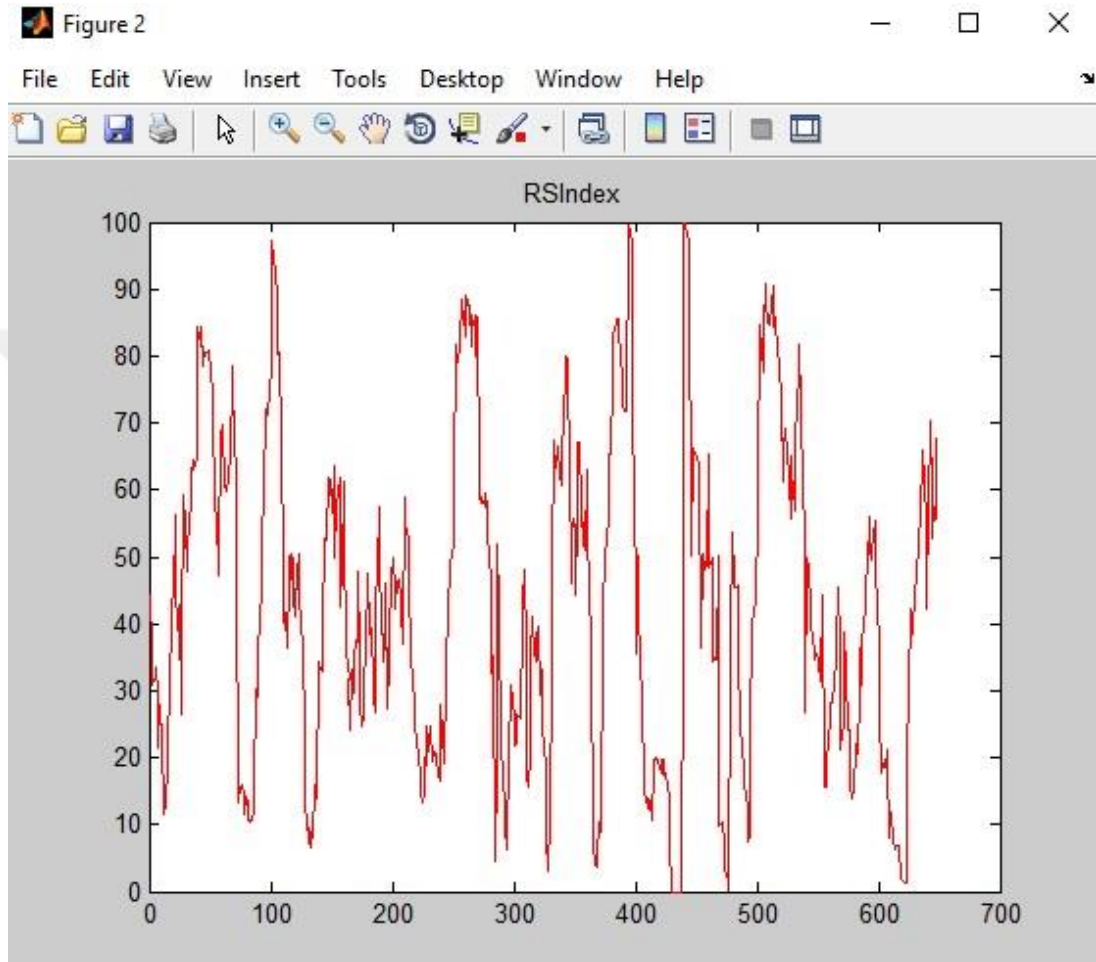

Figure 4.6**:** Drawing the RS index curve.
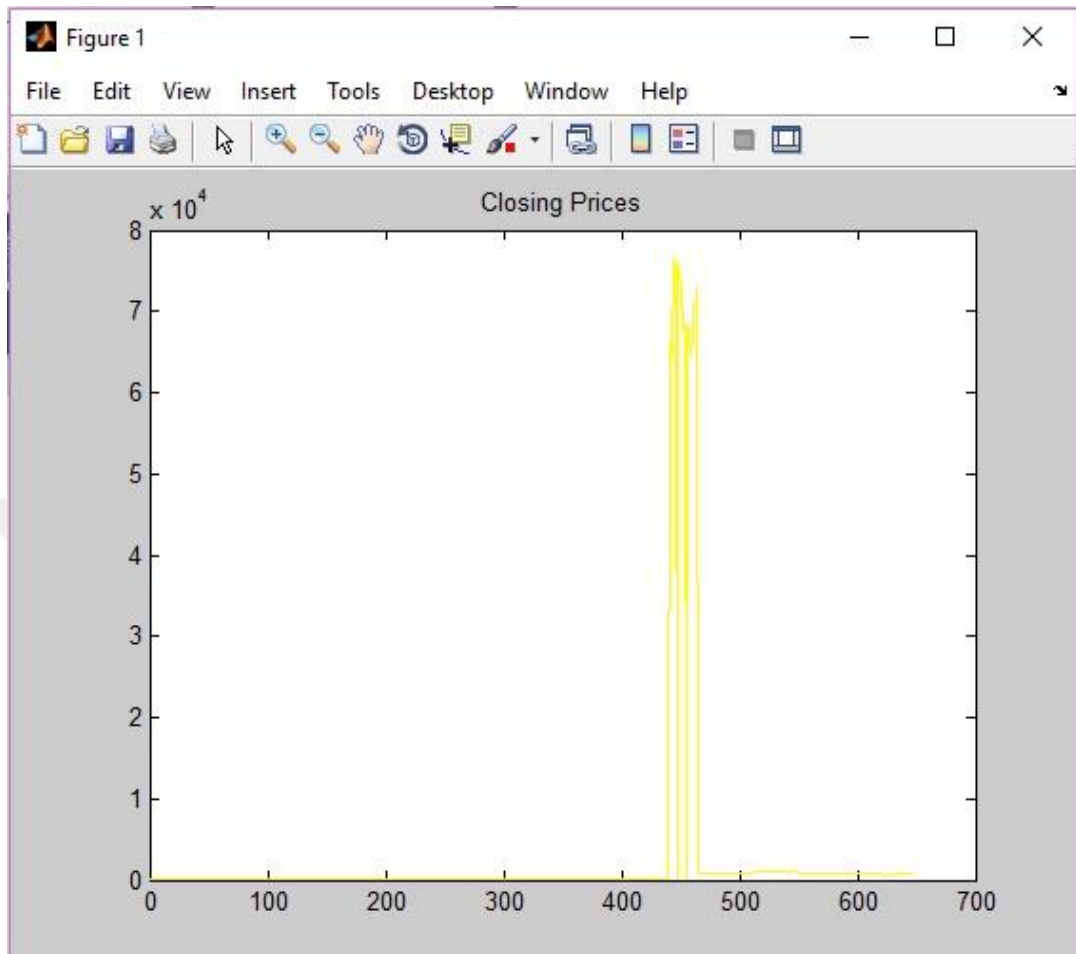
4. Plot the closing price

Figure 4.7: Drawing the closing price of Iraqi stock market dataset, the horizontal axis refers to days while the vertical axis refers to the closing price movement.
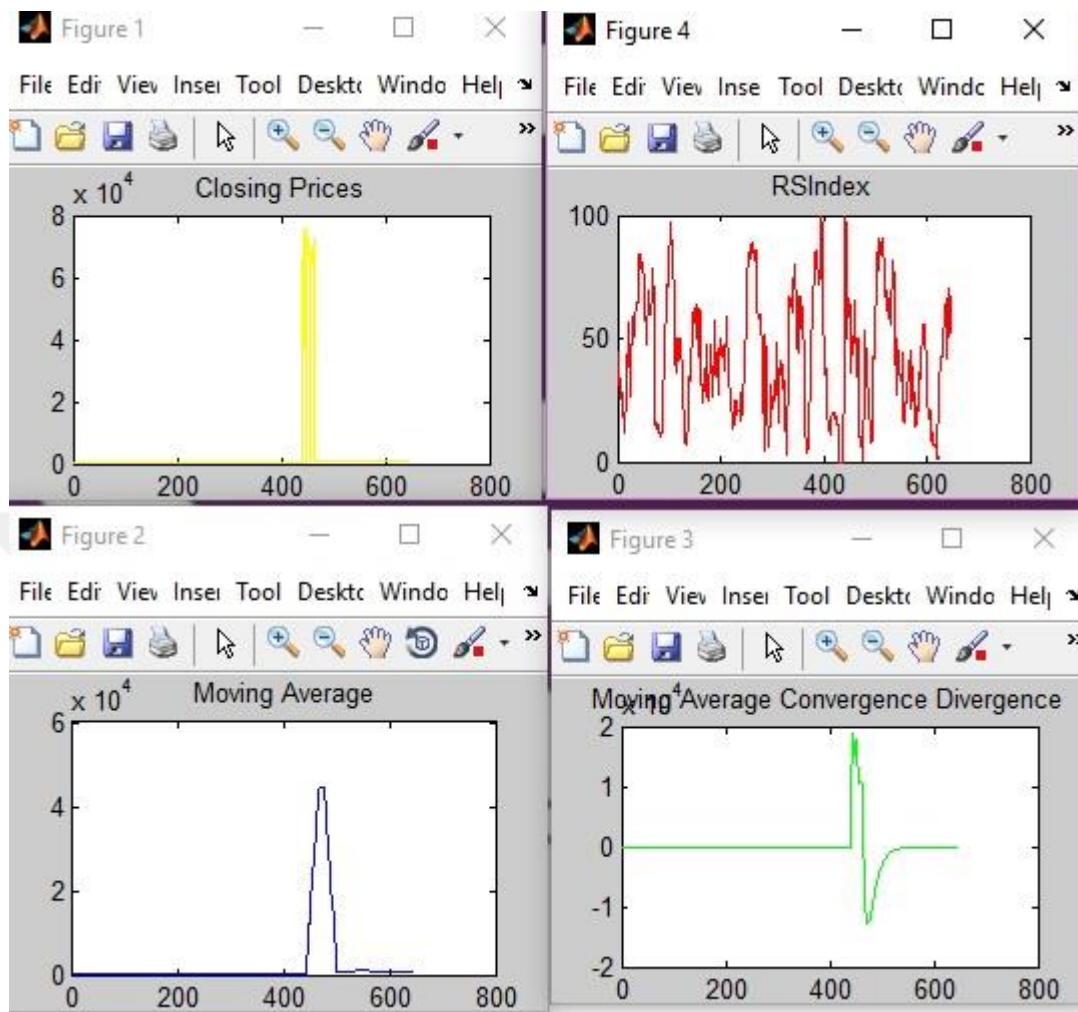
.

5. Plot all figures

Figure 4.8**:** Plot all figures after applying each determination (closing price, moving average, and moving average convergence / divergence and RS index) on Iraqi stock market dataset.
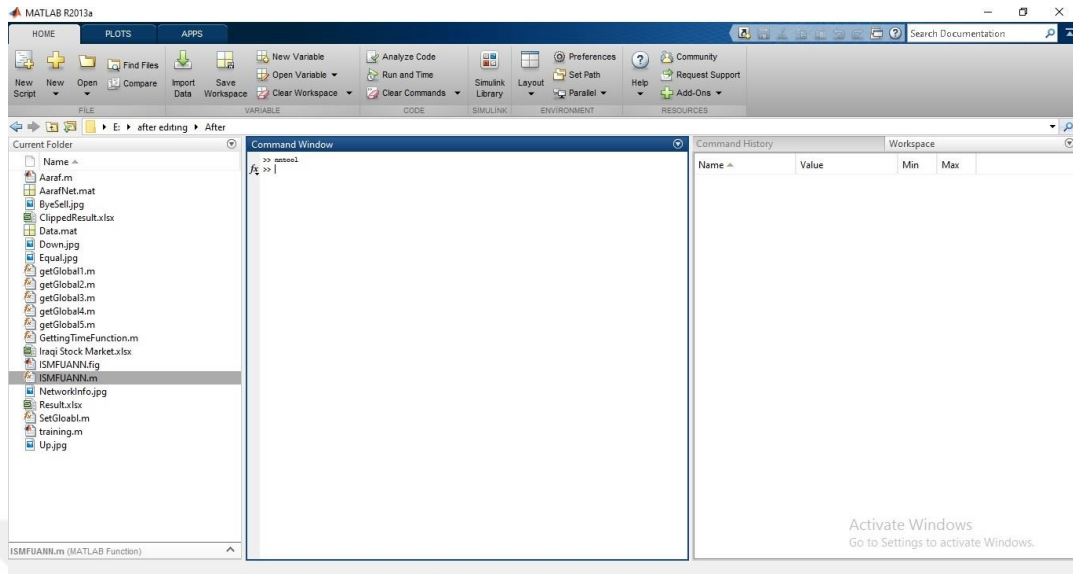.

4.4 Neural Network training using MATLAB

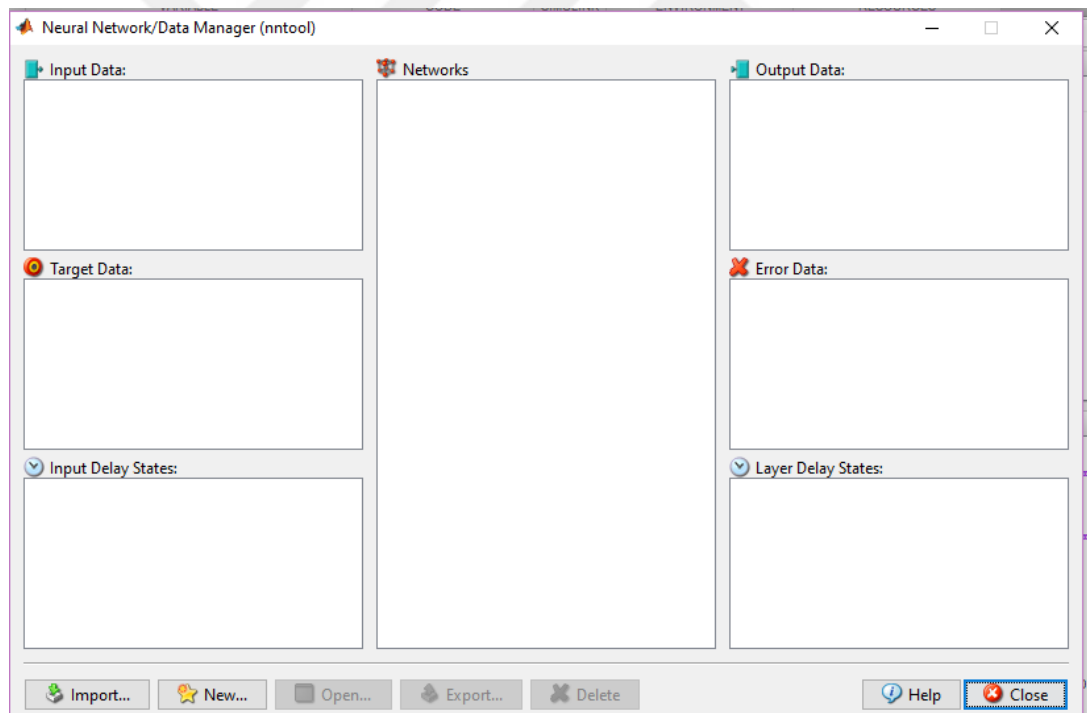**Figure 4.**9: Now faculties training neural network using MATLAB by calling "nntool".

Figure 4.10: The "nntool" interface, to prepare our own settings for the neural network which will be used and trained.
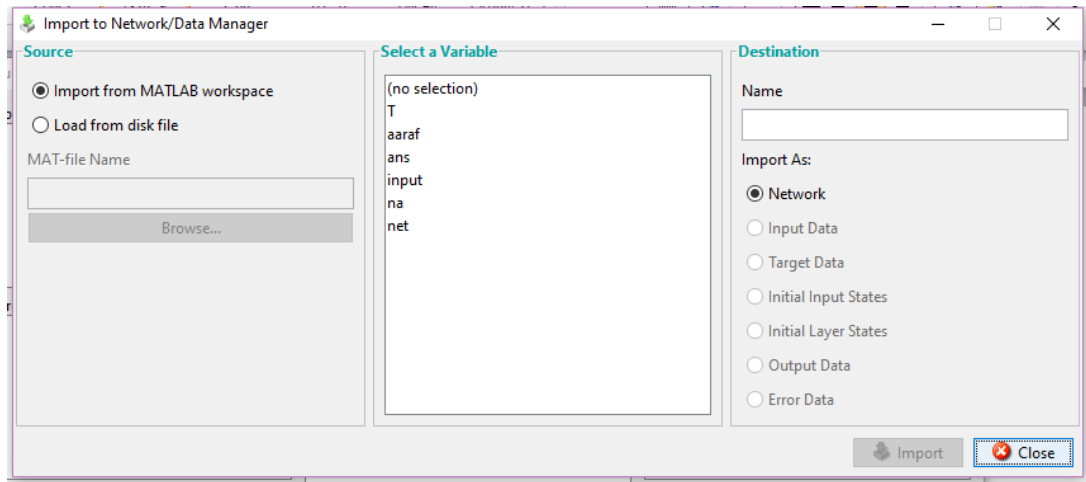
Figure 4.11**:** Programming and training the neural network by selecting variables and symbols and give these icons their definition on the network.
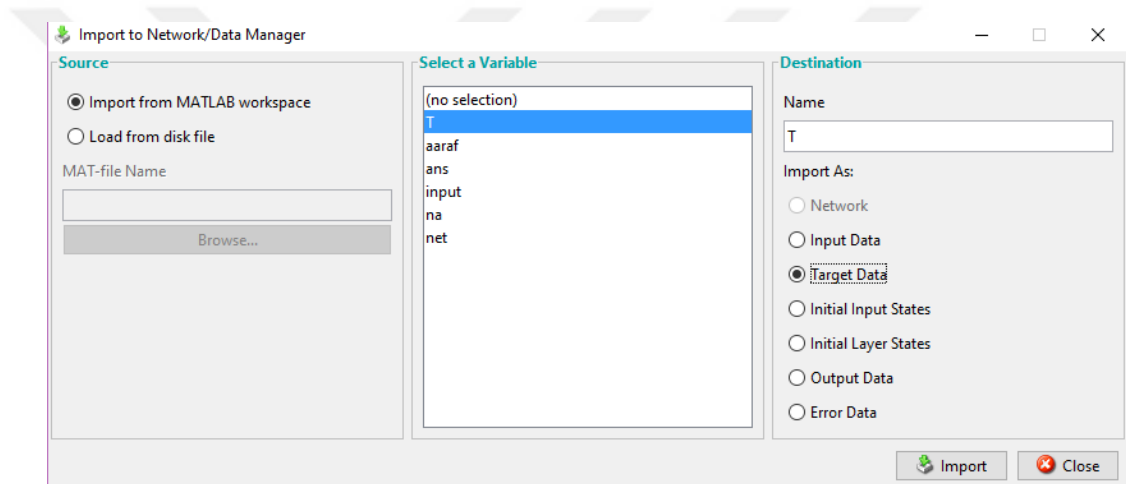

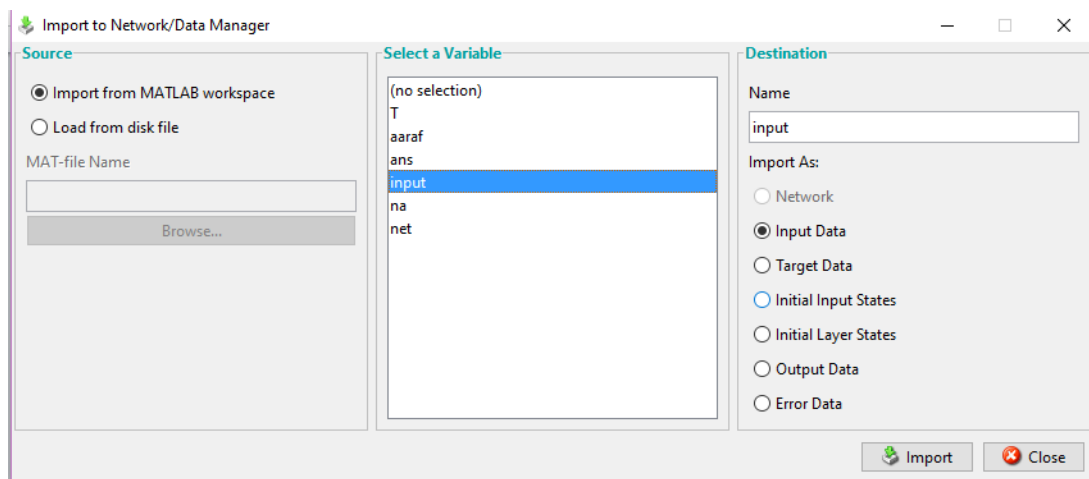**Figure 4.**12**:** To define the variable T "the Target data".

Figure 4.13**:** To define the input data which will be used.
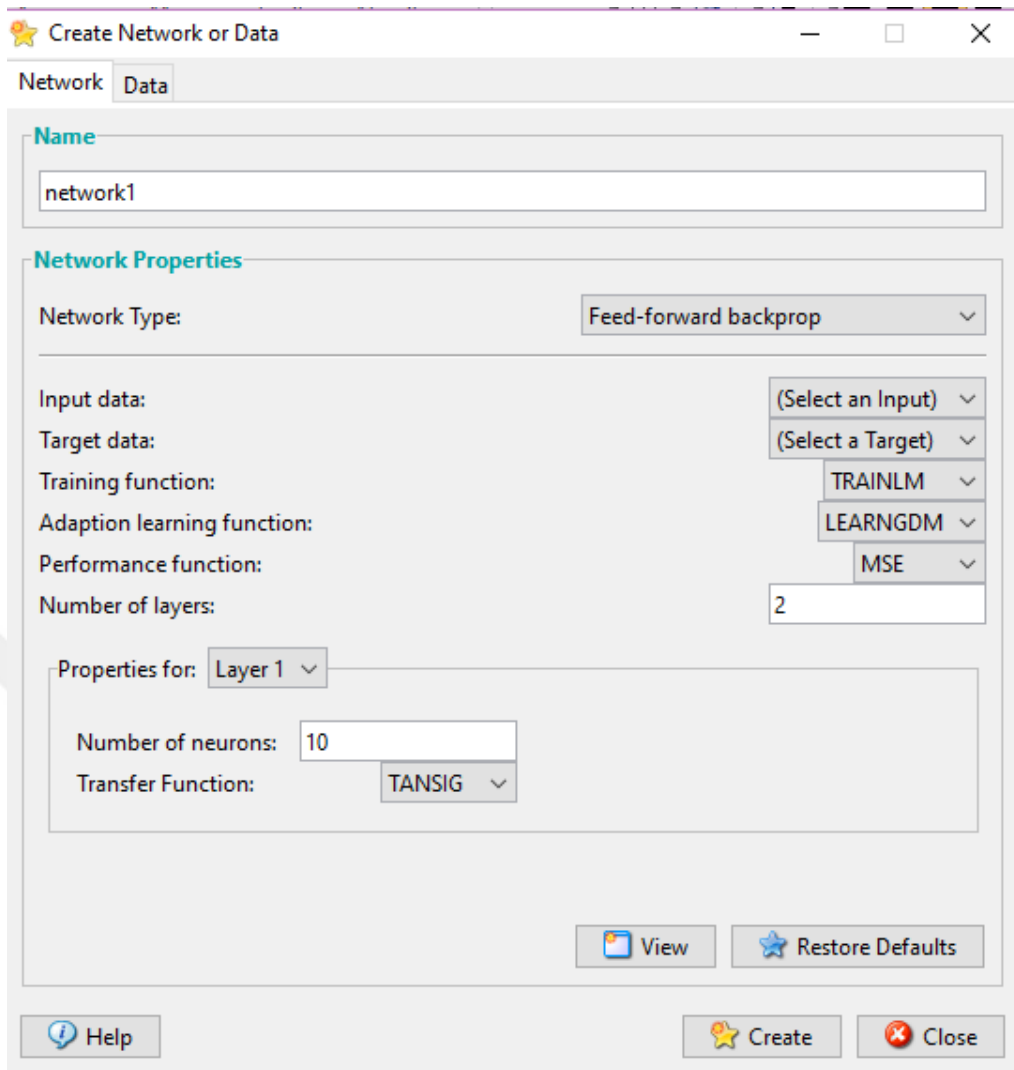
Figure 4.14: After identifying of our special variables the training of a neural network begins for each layer.
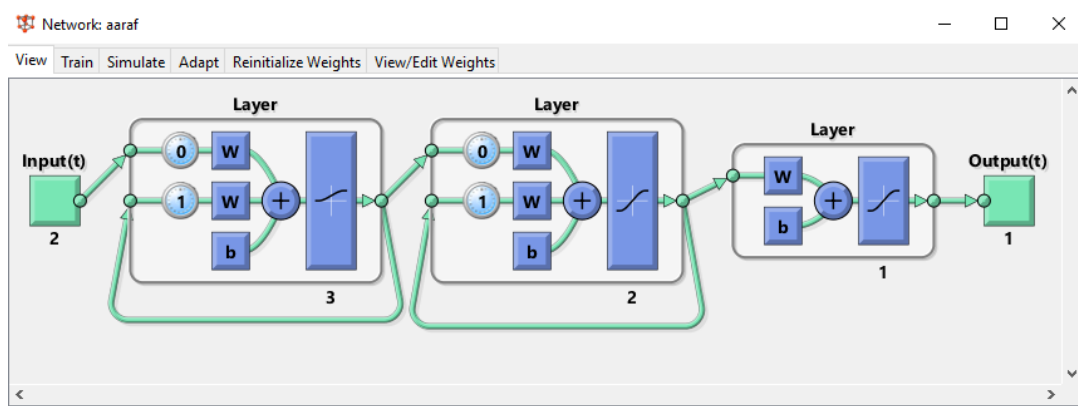

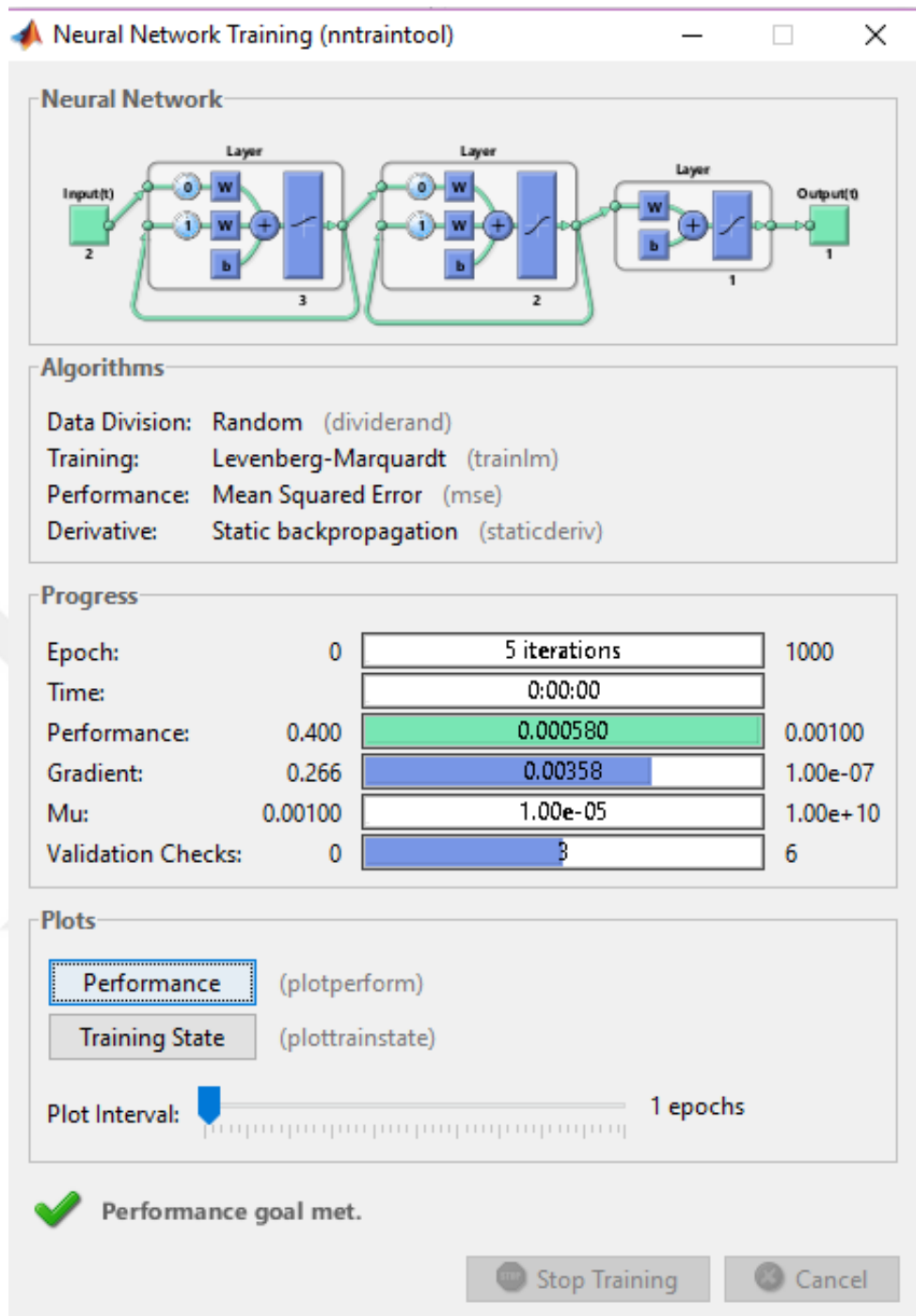**Figure 4.**15: The configured network according to the upper chosen layers with input and output.

Figure 4.16: The final form of the network has been trained with our specifications and shows the Epoch equal five iterations and the time that spent on training equal to zero, The performance is very good (0.00100).

CHAPTER FİVE

CONCLUSION

In this thesis, the importance of markets forecasting for a naive customer who does not have a sufficient information to enter the securities market, the ability to discover numerical models, which is able to reliably forecast the route of the future stock prices, academics, traders, and trading experts are always looking for a stock market model, which could gain them with higher earnings and how to use the other data mining techniques as classification; pattern matching, etc. using evaluating previous events, a prediction can be made by us for future. Forecasting or prediction means discovering the future knowledge based on past knowledge. As an example mixture of decision tree analysis of every historical data with classification and previous pattern, matches are being used to recognize the next following day's opening price of the stock market, using closing prices and a past day's opening.

The artificial neural network (ANN) model utilizes their indexes as input parameters to find the rules that describe the change of indices by the dependence of the change of closing price utilizing the training data set, we determine several conclusions; the main of these revolves around the existence of statistical value in the probability of reliance on these indicators along the way of prediction. The trend of stock prices for the bank sector detailed in the Iraqi market for securities to be modified to the circumstances of the Iraqi environment. This study completes recommendations that urged traders to improve perception and knowledge of technical analysis, and the necessity for diversification in the utilization of technical analysis methods prior to making a financial decision, and urged academia enhance focus on the technical analysis using motivating study and researchers.

Future Work:

In the future works, we plan to use adaptive and predictive control theory, it may represent a good method to approximate the daily changes of any stock market, especially Iraqi market. Also, we are planning to achieve the same idea as a final product (Android, iPhone or Microsoft based application).

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French	Good	Good	Good	Good
Turkish	Good	Good	Good	Good