GOLD PRICE FORECAST USING NEURAL NETWORK

by

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CERTIFICATION OF APPROVAL

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UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

September 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

HAMADUKAN SALAE

ABSTRACT

Gold is precious metal once widely used as standard for monetary exchange but was replaced by paper currency mostly used today. However interest in gold trading and investment has resurfaced. Recently, the gold future price is very important role for economic as well as it is under pressure of crude oil and inflation. And its price is always relatively higher, changing fast and difficult to forecast. Therefore, how to forecast the gold futures price is the main objective of this project. This project wants to bring up a neural network by using artificial neural network (ANN) model. Hoping this model can forecast the gold futures price to give the investor to make the reference in deciding the best time in the future buy or sell gold. This project background study will include problem statement to justify this study, objective and scope of study, the relevancy of the project and feasibility of the project within the scope as well as time frame. Literature review of history of gold will also cover aspects of the method of forecast the gold future price.

ACKHOWLEDGEMENT

Bismillahirrahmanirrahim, Alhamdulillah.

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CHAPTER 1

INTRODUCTION

1.1 Background of study

In the past for several years until now, the gold has been played very important role in the human's life especially investor. Gold has proved itself to be an effective way to manage wealth. Every year the price of gold has kept pace with inflation. Its performance tends to move independently of other investments and key of economic indicators. And it does not damage with time therefore it has the ability of high store value. Thus the forecasting for the future gold prices now become an important to help the investor to pick a right time to do the selling or buying transaction of gold.

Forecasting is a planning tool that helps management in its attempts to deal with the improbability of the future, relying mainly on data from the past and present analysis of trends. Therefore, neural networks emerge to be a highly promising approach to financial forecasting and decision-making in financial analysis. Initial experimentation with neural networks has been successful in a variety of domains with differing financial instrument.

1.2 Problem statement

The investors are not venture for gold investment because the price of gold is changing every day. Factors influencing gold prices are many such as due to weakening of us dollar, growth in demand for jewelry and increase in demand for exchange-traded paper backed products.

In this study, the forecast model to predict the future gold prices using Artificial Neural Network (ANN) is proposed.

1.3 Objectives

The objectives of the project are shown as follows;

- To outline the principle of ANN method
- To outline the history data of gold prices index
- To develop a forecast model to predict gold prices using ANN method

1.4 Scope of study

Generally, the scope of study will cover the following areas;

- Fundamentals of ANN method solving forecast problem
- Historical data for gold price index
- Simulation of develop model by using MATLAB software
- Study gold demand

1.5 Relevancy

The significance of the project is to make people know about the future gold price. As many countries have economic stuffer and the economic is depends on gold and oil price. In consequence the relevancy of the project is helps analyst for analyze the economic role in the future and have ability to know what will economic happen in the future is. While analyst know about the economic, analyst have ability to control the economic role and able to make the better economic for each country.

1.6 Feasibility study

The feasibility of this project is to complete the project within the scope and time frame, while maintaining substance to this project.

During the final year second semester (FYP I), the scope and task that will be covered are;

- Research on forecast method
- Analyze the history gold price

And for the final year third semester (FYP II), the scope and task that will be

covered are;

- Study and analyze data
- Design the forecast method
- Forecast and Simulation
- Analyze result and conclusion
- Decision for the best forecast method

CHAPTER 2

LITERATURE REVIEW

2.1 Gold summary

Gold is a fairly soft metal with a beautiful golden color. It is unusually ductile and malleable and can be hammered into very thin sheets with a thickness of only 0.00001 in (0.00025 cm). Gold foil of this thickness is used to make lettering on window signs. Gold has a melting point of 1,947°F (1,064°C), a boiling point of about 5,070°F (2,800°C), and a density of 19.3 grams per cubic centimeter. Gold is an excellent conductor of electricity and has a high optical reflectivity (Gale, 2005-2006).

Gold occurs in both elemental and compound states. At one time, large nuggets of gold could be found lying on the Earth's surface. Pieces of such size have long since been collected, although very finely divided gold dust still exists in a number of locations. The most common minerals of gold are the tellurides, such as gold telluride (AuTe2), present in the mineral calavarite. About a quarter of the world's gold comes from South Africa. Other leading producers of the metal are the United States, Australia, Canada, China, and Russia (Gale, 2005-2006).

In the few years ago, the economic has suffered; the price of oil stays at high level as well as all country was dropping in stock the oil. However, this problem are not affected to the gold price, which could resist the inflation, hedging and has a good conservative value. In addition the gold price has risen rapidly (Ismail, et al., 2009).

The main demand of gold comes from industry electronic industry and jewelry (Ismail, et al., 2009). However it a shreds with gold price change. The other demand comes from the government and investor's purchase that is the main factor to influence gold price (Xu, et al., 2009).

2.2 Gold function

Gold is the standard currency exchange for many countries. Most the gold is use for make jewelry. Some of industry also needs gold such as electronic industry user gold and alloy to weld, even though medical treatment and generally as investment tool (Xu, et al., 2009).

Intended for gold future function is divided in three categories which are hedging, price discovery and speculation (Xu, et al., 2009).

- Hedging means the best way to avoid loss by the price fluctuation who wants to buy and sell gold in the future
- Price discovery means let people understand the gold expectation in the future
- Speculation means the people who have the ability and willing to accept the risk from the hedgers

2.3 History gold price

Appropriate gold price must be considered. Data are obtained from (History Gold Price, 2011). (History Gold Price, 2011) provide daily, monthly and yearly gold price data since 1975 until recent. The graph for gold price index from January 2000 to December 2011 is depicted in the Figure 1.

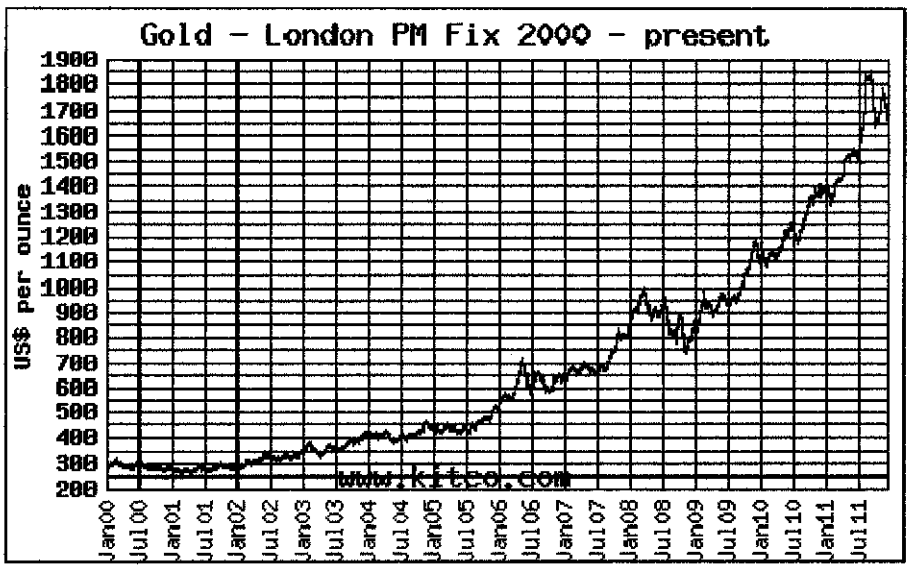


Figure 1: Daily gold price from January 2000 to December 2011 (Kitco, 2001)

This project is forecast daily gold price. Thus the daily gold price has been illustrate in Figure 2,3,4,5,6,7,8,9,10,11,12,and 13 respectively for daily gold price in year 2011

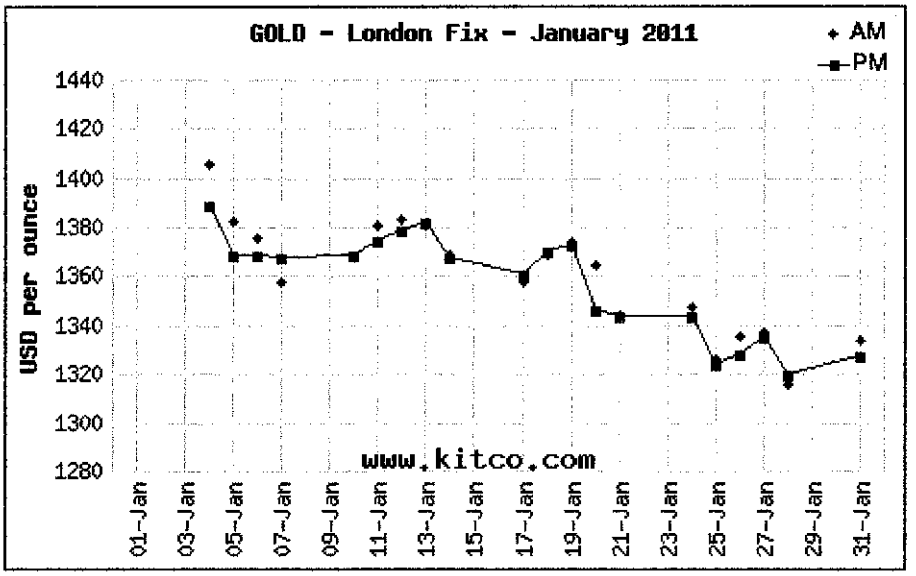


Figure 2: Daily gold price from 1 January 2011 to 31 January 2011 (Kitco, 2001)

Observed from the Figure 2, the gold prices for the month of January 2011 were decreasing. The highest price was 1388.5 USD per ounce which was on 4 January 2011. The lowest price was 1319 USD per ounce which was on 28 January 2011and the average price was 1356 USD per ounce.

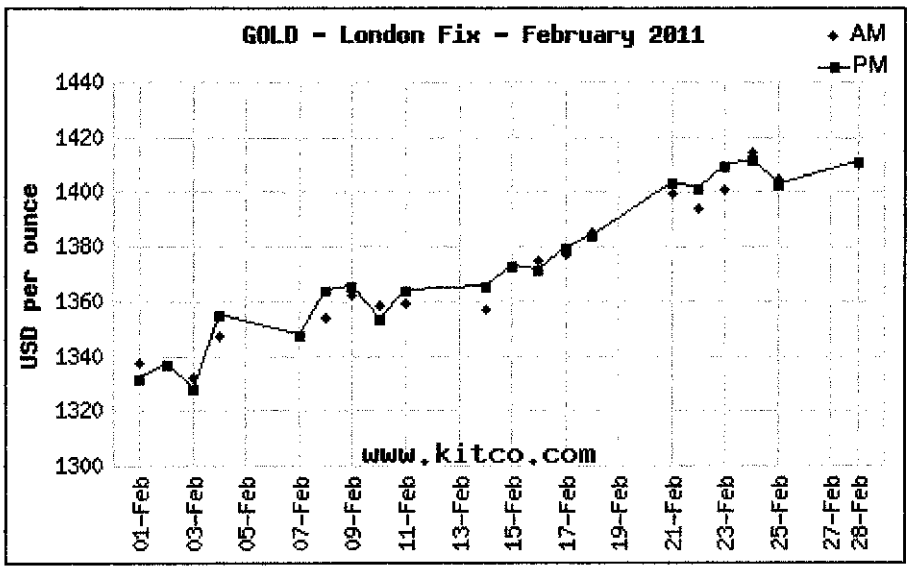


Figure 3: Daily gold price from 1 February 2011 to 28 February 2011 (Kitco, 2001)

Observed from the Figure 3, the gold prices for the month of February 2011 were increasing. The highest price was 1410.4 USD per ounce which was on 24 February 2011. The lowest was 1328 USD per ounce which was on 3 February 2011and the average price was 1356.4 USD per ounce.

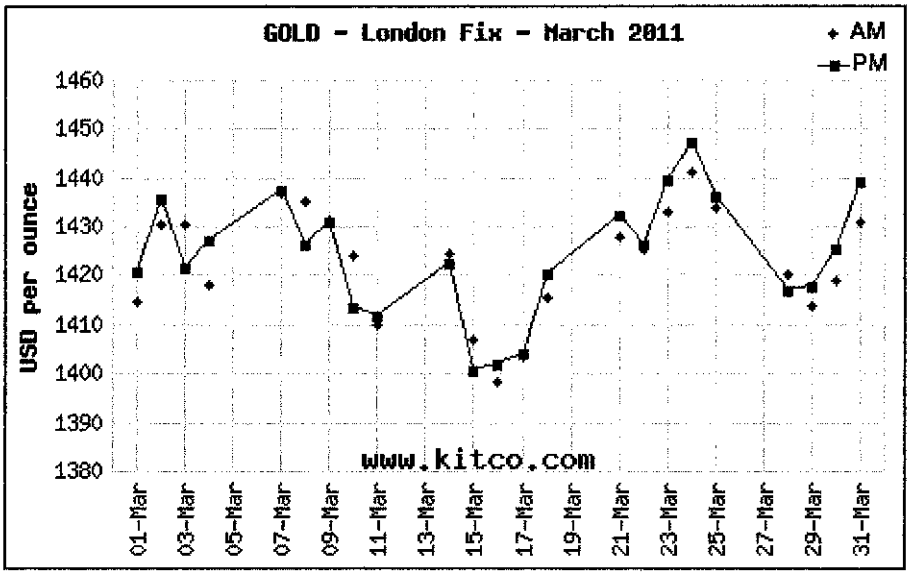


Figure 4: Daily gold price from 1 March 2011 to 31 March 2011 (Kitco, 2001)

Observed from the Figure 4, the gold prices for the month of March 2011 were not stable. The gold price was dropped in the middle of the month with the lowest price of the gold is 1400 USD per ounce which was on 15 March 2011. And then the gold price was increasing after that day until 24 Mach 2011 and the gold prices were dropped again on 26 March 2011 but in the end on the month gold price was increasing all most nearly the highest price of the month. The highest price of this month was 1447 USD per ounce which on 23 March 2011 and the average price was 1424.01 USD per ounce.

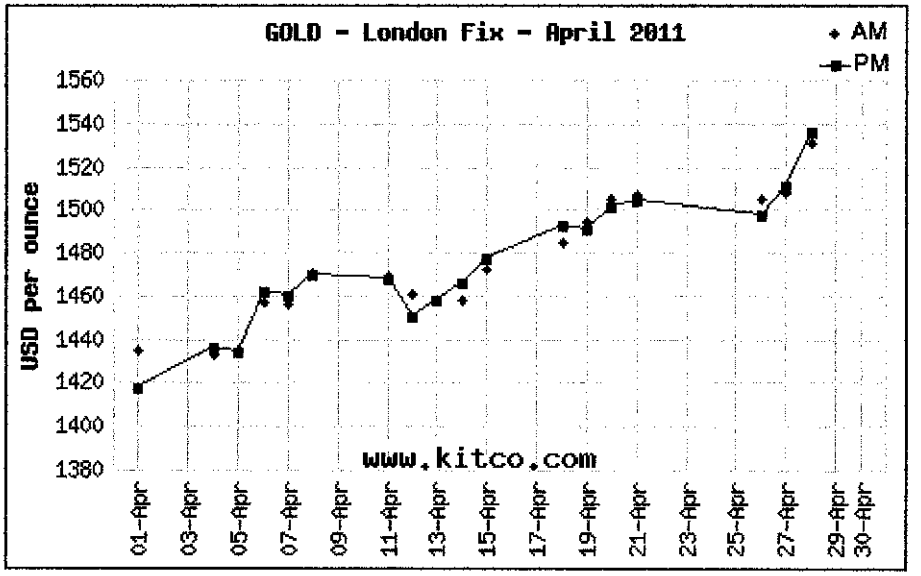


Figure 5: Daily gold price from 1 April 2011 to 30 April 2011 (Kitco, 2001)

Observed from the Figure 5, the gold prices for the month of April 2011 were increasing from the beginning of the month until the end of the month. The highest price is 1535.5 USD per ounce which was on 28 April 2011. Therefore, the date of 29 and 30 April 2011 was holiday due to this reason the price are not provided. The lowest price was 1418 USD per ounce which was on 1 April 2011 and the average price was 1424.01 USD per ounce.

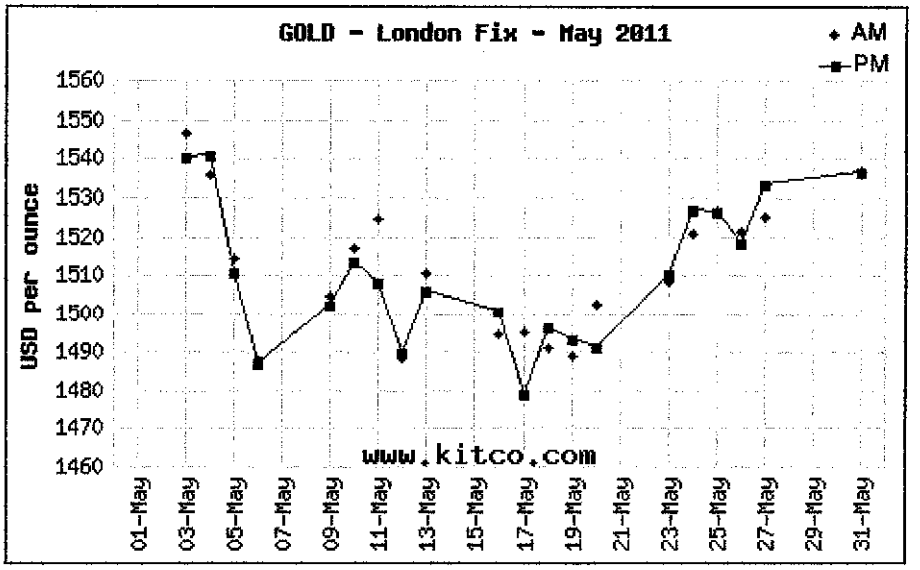


Figure 6: Daily gold price from 1 May 2011 to 31 May 2011 (Kitco, 2001)

Observed from the Figure 6, the gold prices for the beginning of month for May 2011 were highest with the price was 1541 USD per ounce which was on 4 May 2011 and the prices were dropping in the middle of the month with lowest price

was1478.5 USD per ounce which was on 17 May 2011. However the prices were increasing subsequently until the end of month. The average price was 1510 USD per ounce.

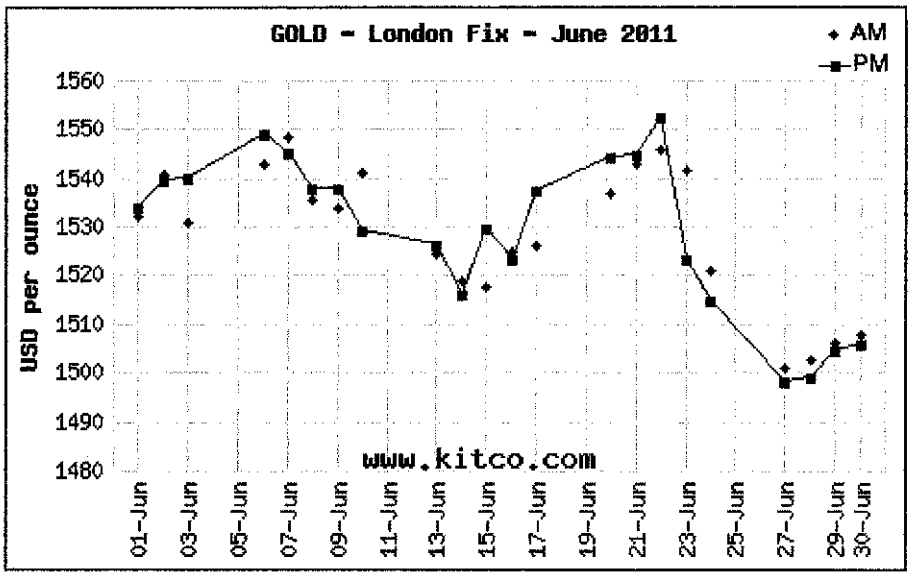


Figure 7: Daily gold price from 1 June 2011 to 30 June 2011 (Kitco, 2001)

Observed from the Figure 7, the highest price for the month of June 2011 was 1552.5 USD per ounce which was on 22 June 2011 and the lowest price was 1498 USD per ounce which was on 27 June 2011. The average price was1528 USD per ounce.

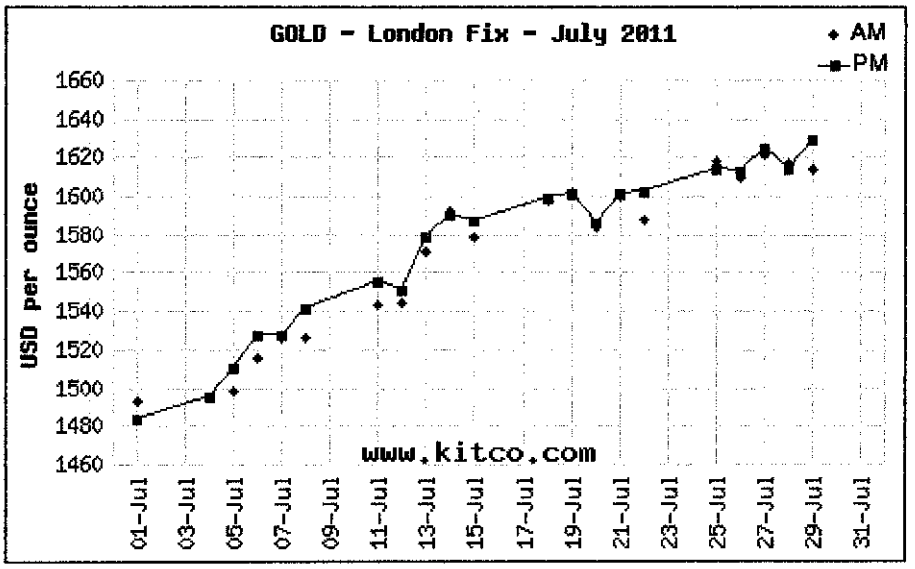


Figure 8: Daily gold price from 1 July 2011 to 29 July 2011 (Kitco, 2001)

Observed from the Figure 8, the gold prices for the month of July 2011 were increasing. The lowest price was 1483 USD per ounce which was on 1 July 2011. The highest price was 1628.5 USD per ounce which was on the end of the month (29 July 2011). The average price was 1572.81 USD per ounce.

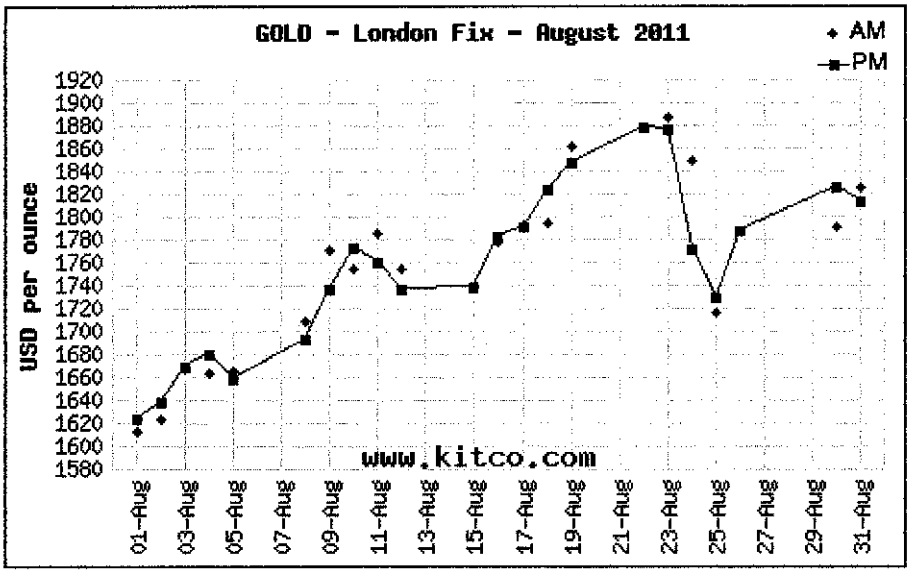


Figure 9: Daily gold price from 1 August 2011 to 31 August 2011 (Kitco, 2001)

Observed from the Figure 9, the highest gold price for the month of August 2011 was 1877.5 USD per ounce which was on 22 August 2011 and the lowest prices was 1623 ounce which was the beginning of the month (1 August 2011). The average price was 1755.81 USD per ounce.

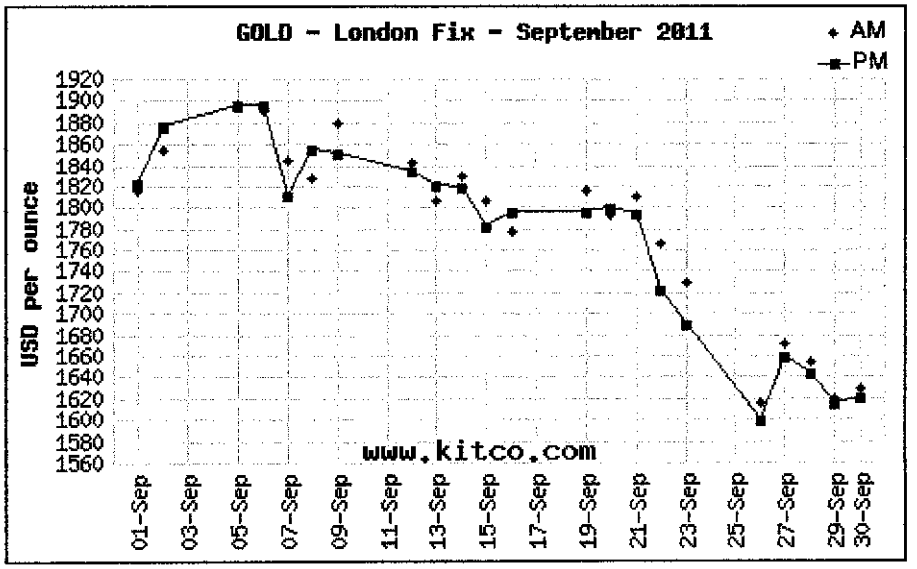


Figure 10: Daily gold price from 1 September 2011 to 30 September 2011 (Kitco, 2001)

Observed from the Figure 10, the gold price for the month of September 2011 was decreasing the lowest price was 1598 USD per ounce which was nearly the end of the month (16 September 2011). However, the highest gold price of the year 2011 was this month with the price of 1895 USD per ounce which was on 6 September 2011 and the average price was 1771.88 USD per ounce.

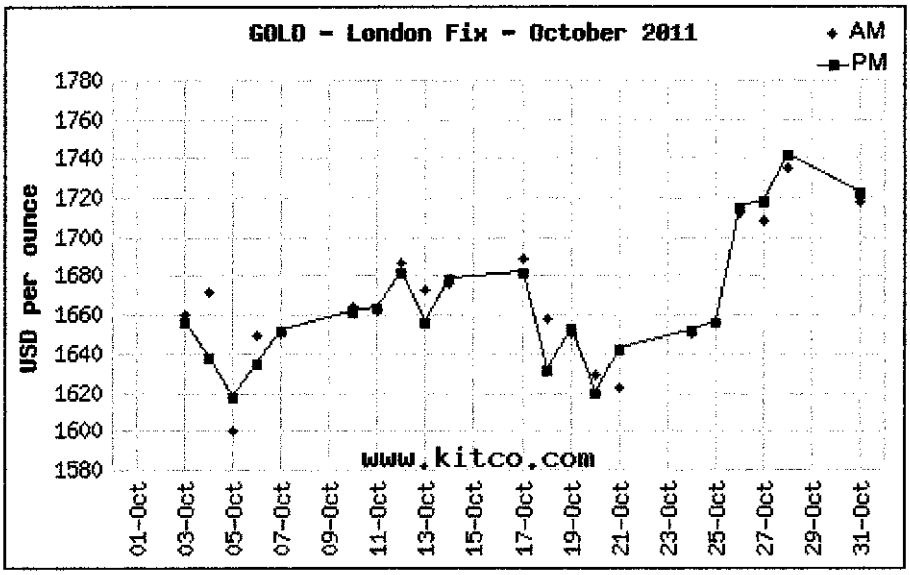


Figure 11: Daily gold price from 1 October 2011 to 31 October 2011 (Kitco, 2001)

Observed from the Figure 11, the gold price for the month of October 2011 was a little bit increasing of the end of month. The highest price was 1741 USD per ounce which was on 28 October 2011. The lowest was 1617 USD per ounce which was on 5 October 2011 and the average price was 1665.21 USD per ounce.

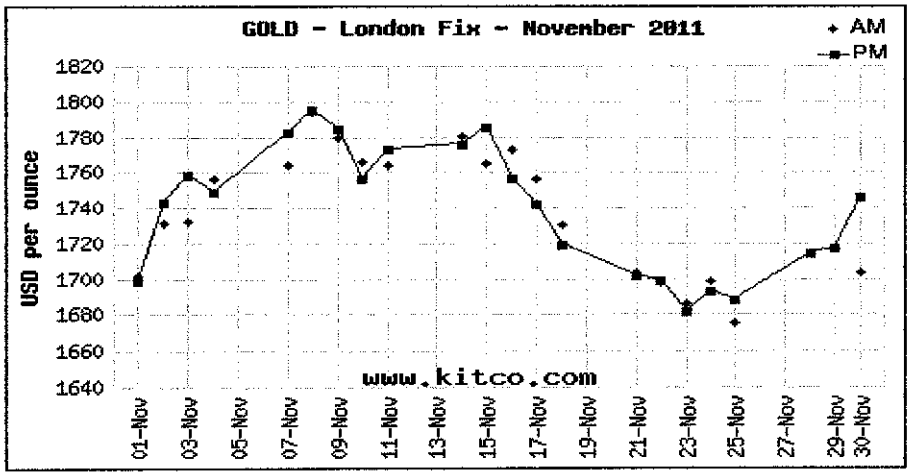


Figure 12: Daily gold price from 1 November 2011 to 31 November 2011 (Kitco, 2001)

Observed from the Figure 12, the highest gold price for the month of November 2011 was 1795 USD per ounce which was on 8 November 2011. The lowest price was 1682 USD per ounce which was on 23 November 2011 and the average price was 1738.98 USD per ounce.

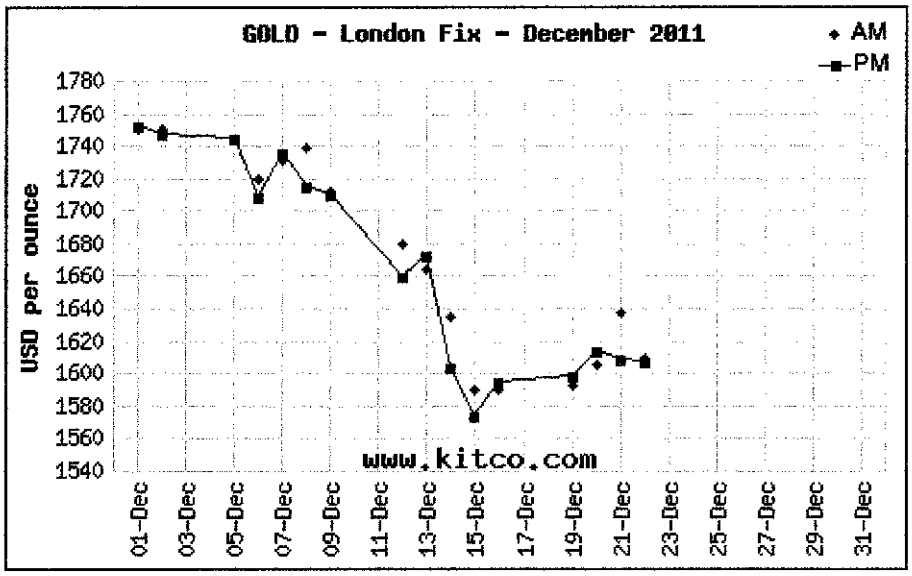


Figure 13: Daily gold price from 1 December 2011 to 22 December 2011 (Kitco, 2001)

Observed from the Figure 13, the gold price for the month of December 2011 was drastically from the beginning of the month until the middle of the month. The highest price was 1752 USD per ounce which was on 1 December 2011. The lowest price was 1574 USD per ounce which was on 15 December 2011 and the average price was1664.97

2.4 Prediction method

Many of forecasting methods have been used for gold prices prediction in the past such as Multiple Linear Regression Method, Radial Basis function neural network, genetic algorithms, Back propagation, Multi layered feedforward, group method of data handling, moving data forecast (Ismail, et al., 2009). (Ismail, et al., 2009, Hussein, et al., 2009,Liu,2009, Varahrami,2011) The descriptions of some of the methods are shown as follows:

Table1: Description of Prediction Methods

Method	Description
Multiple Linear Regression	• The linear relationship between response variable and one or more explanatory variables by appropriate a linear equation to observed data (Ismail, et al., 2009)
Radial Basis function neural network	• A nourish forward three-layered network • Apposite to use in nonlinear time series forecasting (Hussein, et al., 2009)
Back Propagation network	• Consists of two parts: the input signal's positive transmission and the error signal's back propagation • The input information is transmitted to the transmit system, if the output got error signal will finally return to the input (Liu,2009)
Genetic algorithm	• Optimize the parameters of coding according to certain fitness function and a series of genetic operation it screens individuals (Liu,2009)
MLFF neural network	• Interconnected in a feed forward way. Each neuron in one layer has directed connections to the neurons of the subsequent layer (Varahrami, 2011)
GMDH neural network	• Sets of neurons in which different pairs of them in each layer are connected through a quadratic polynomial and thus produce new neurons in the next layer (Varahrami, 2011)
Artificial Neural Network	• Has a natural property for storing experiential knowledge and making it

	available for use (Hung, et al., 2008) • Used to model complex relationships between inputs and outputs to find patterns in data (Haykin, 1998) • An information processing paradigm that is inspired by the way biological nervous system (Dr.S.K.Dss, 2006)

Table 1 shows the description of some of the methods used for price forecasting. ANN is used to model complex relationships between inputs and outputs to find patterns in data as well as an information processing paradigm that is inspired by the way biological nervous system. Hence the methods that suitable for developing forecast tool is ANN method.

2.5 Artificial neural network

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information (Dr.S.K.Dss, 2006).The ANN consists of many artificial neurons. It is more or less duplicate brain neuron and it gets data from outside or other artificial neurons. It is use of easy operation, and output results to outside or other artificial neurons (NeuroAI, 2011)

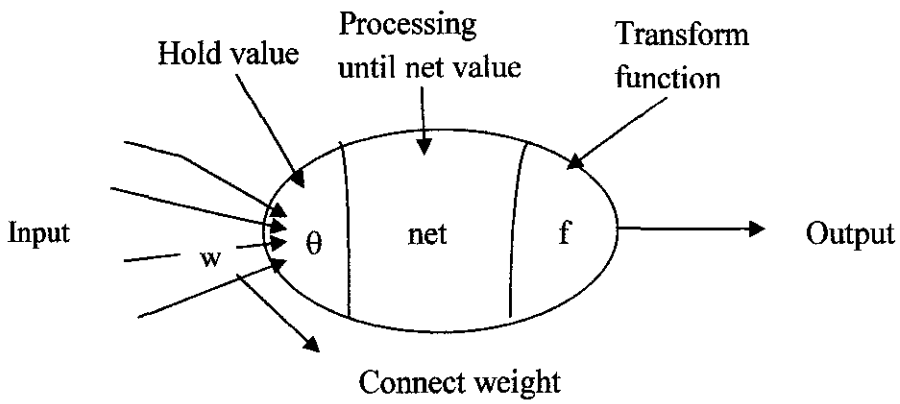


Figure 14: Artificial Neural Network Concept (NeuroAI, 2011)

Fundamentally, ANN is a system. A system is a structure that receives an input, process the data, and provides an output. Generally, the input consists in a data

array which can be anything such as data from an image file. Once an input is presented to the neural network, and a corresponding desired or target response is set at the output, an error is composed from the difference of the desired response and the real system output. (NeuroAI, 2011) and illustrates as below:

Figure 15: Simple ANN System Block Diagram

2.6 Network architecture

The basic architecture consists of three (3) types of neuron layers which is input, hidden, and output layers. In the Feedforward, networks with interconnections that do not perform any of loops, while recurrent or network at least one loops of interconnection are used with a cycles (Dr.S.K.Dss, 2006).

- Single layer feedforward network

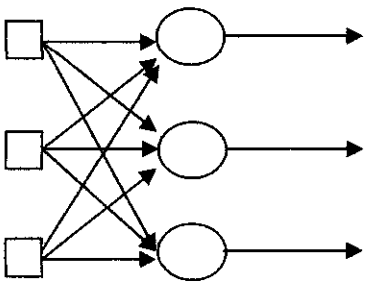


Figure 16: Single Layer Feedforward Network Block Diagram

The Single Layer Feedforward Network consists of input layer and output layer. Where the inputs are directly connect to the outputs, via a series of weights. The sum of the products of the weights and the inputs is calculated in each neuron node (NeuroAI, 2011).

- Multilayer feedforward network

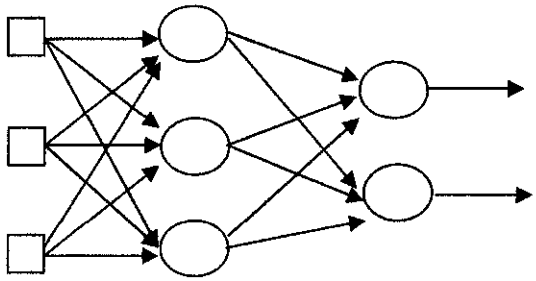


Figure 17: Multilayer Feedforwark Network Block Diagram

The Multilayer Feedforward nework consists of input layer, output layer and one or more intermediary layers called hidden layer (NeuroAI, 2011).

- Recurrent networks

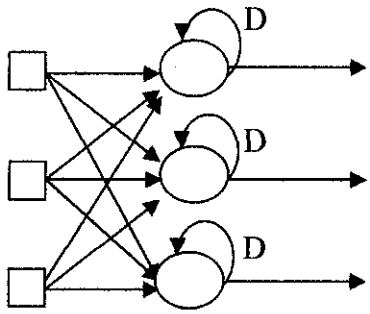
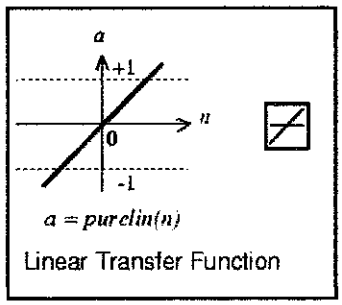
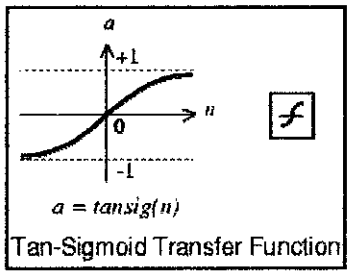


Figure 18: Recurrent Networks Block Diagram

The Recurrent networks differ from Single Layer Feedforward Network and Multilayer Feedforward Network architecture. A Recurrent networks has at least one feedback loop (NeuroAI, 2011).

The behavior of an ANN depends on both the weights and the input-output function (transfer function) that is specified for the units (NeuroAI, 2011). This function typically falls into one of three categories which are purelin, tansig and logsig.

Table 2: Description of Transfer Functions

Transfer functions	Description
Purelin (Linear transfer function)	Transfer functions calculate a layer's output from its net input (MarkWorks, 1984).  Figure 19: Linear transfer function • Syntax – A = purelin(N) – info = purelin(code)
Tansig (Hyperbolic tangent sigmoid transfer function)	Transfer functions calculate a layer's output from its net input (MarkWorks, 1984).  Figure 20: Tan-Sigmoid transfer function • Syntax – A = tansig(N) – info = tansig(code)
Logsig(Log sigmoid transfer function)	Transfer functions calculate a layer's output from its net input (MarkWorks, 1984).

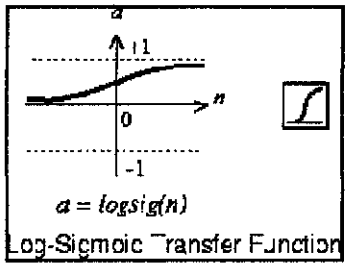


Figure 21: Log-Sigmoid transfer function

- Syntax
  - A = logsig(N)
  - info = logsig(code)

2.7 Network Learning

The network learning is dividing in three different prototypes used to train neural network. The three of different prototypes are supervised learning, unsupervised learning and reinforced learning.

- Supervised Learning

Every input pattern is used to train the network while learning process is based on comparison between network's computed output and the correct expected output and the error generate is used to change network parameters that result improved performance (Feedforward Neural Network, 2010).

- Unsupervised Learning

The expected or desired output is not presented the network as well as the system learns of its own by discovering and adapting to the structural features in the input patterns (Feedforward Neural Network, 2010).

- Reinforced Learning

The information proved helps the network in its learning process and reward is given for correct answer computed and penalty for a wrong answer (Feedforward Neural Network, 2010).

CHAPTER 3

METHODOLOGY

3.1 Research methodology

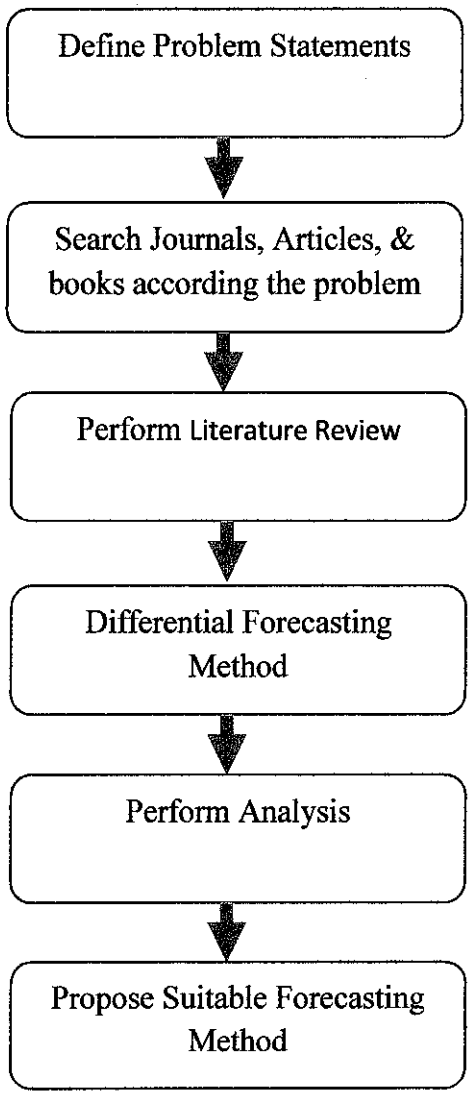


Figure 22: Research Methodology Flow Chart

3.2 Procedure identification

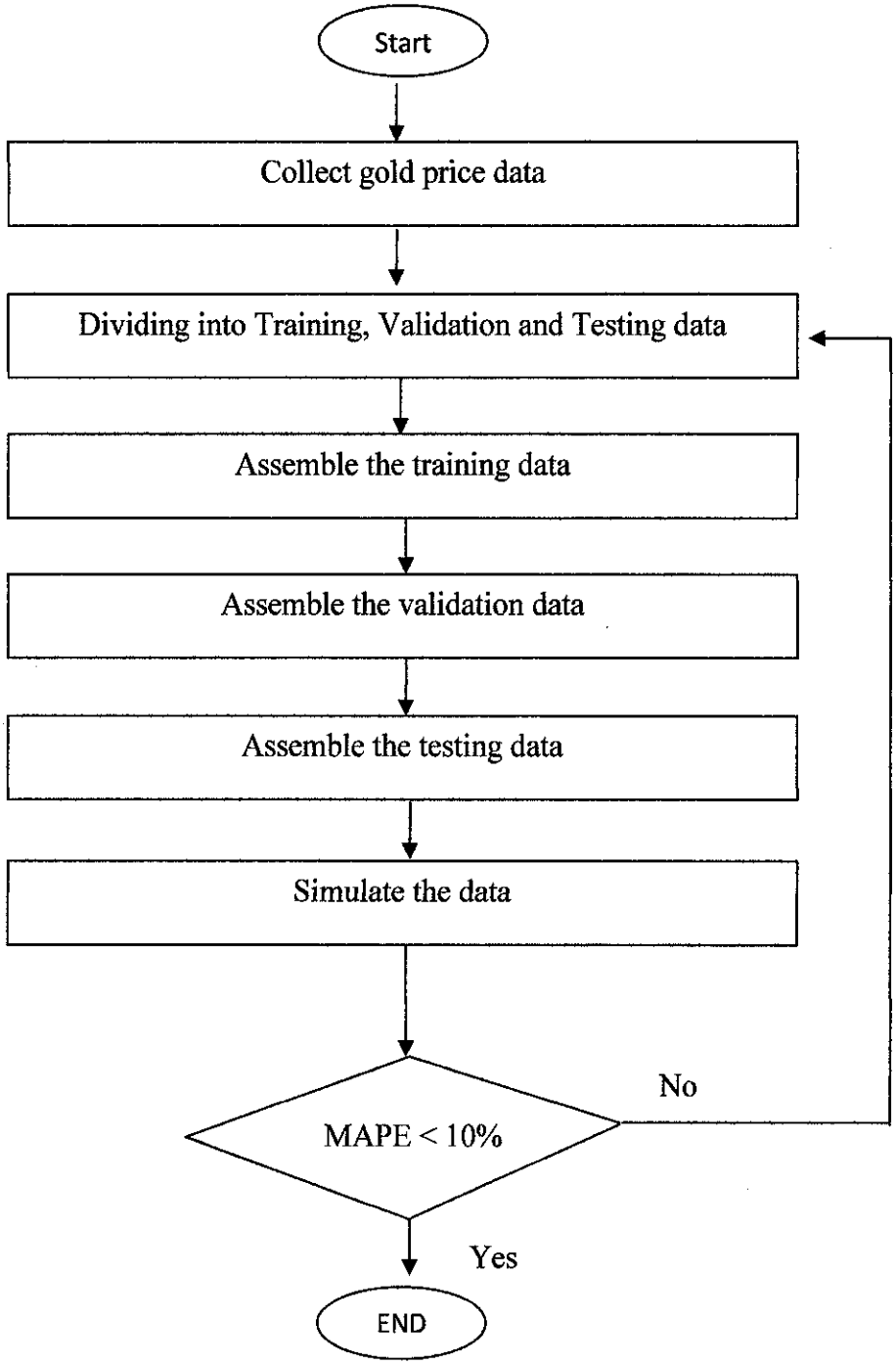


Figure 23: Project's Methodology

3.2.1 Collect gold price data

The historical daily gold prices data have been gathered from 4th January 2005 until 14 December 2011.

3.2.2 Dividing into Training, Validation and Testing data

The gathered data has been partitioned into three (3) partitions for the purpose of training, validation and testing as follows:

1) Training data
2) Validation data
3) Testing data

The partition has been done based on the total data of 1745. The partitioning of the data is based on the non-randomization data that need to done to the historical data in order to obtain accurate result accept holiday and weekend. For the weekend data has been done by average data.

3.2.3 Assemble the training data

The training data involves of the beginning of gathered data. The numbers of training data is depended on each model because different models are different number of training. Example of model 1, the training data is 40 percent thus the training number of this model is 698 data.

3.2.4 Assemble the validation data

The validation data involves of the middle of the gathered data. The numbers of validation data also depended on each model because different models are also different number of validation. Example of model 1, the validation data is 10 percent thus the validation number of this model is 175 data.

3.2.5 Assemble the testing data

The testing data involves of remaining from training data and validation data. Example of model, the training data is 40 percent and validation is 10 percent therefore the remaining data is 50 percent as a result the testing data is 872 data

3.2.6 MAPE

MAPE or Mean Absolute Percentage Error is calculated once the forecasting gold prices obtained. The program will compare the actual gold prices with forecast gold prices and the errors have been calculated base on the following formula:

$$RE = \frac{Fg - Ag}{Ag} x\ 100\ \% \quad \text{..... (1)}$$

Where,

RE is Relative Error

Fg is Forecast gold price

Ag is Actual gold price

$$Absolute\ Relative\ Error = |\ RE| \quad \text{..... (2)}$$

$$MAPE = \frac{\sum |RE|}{N} \quad \text{..... (3)}$$

Where,

$MAPE$ is Mean Absolute Percentage Error

RE is Relative Error

N is the number of trail

3.3 Project duration

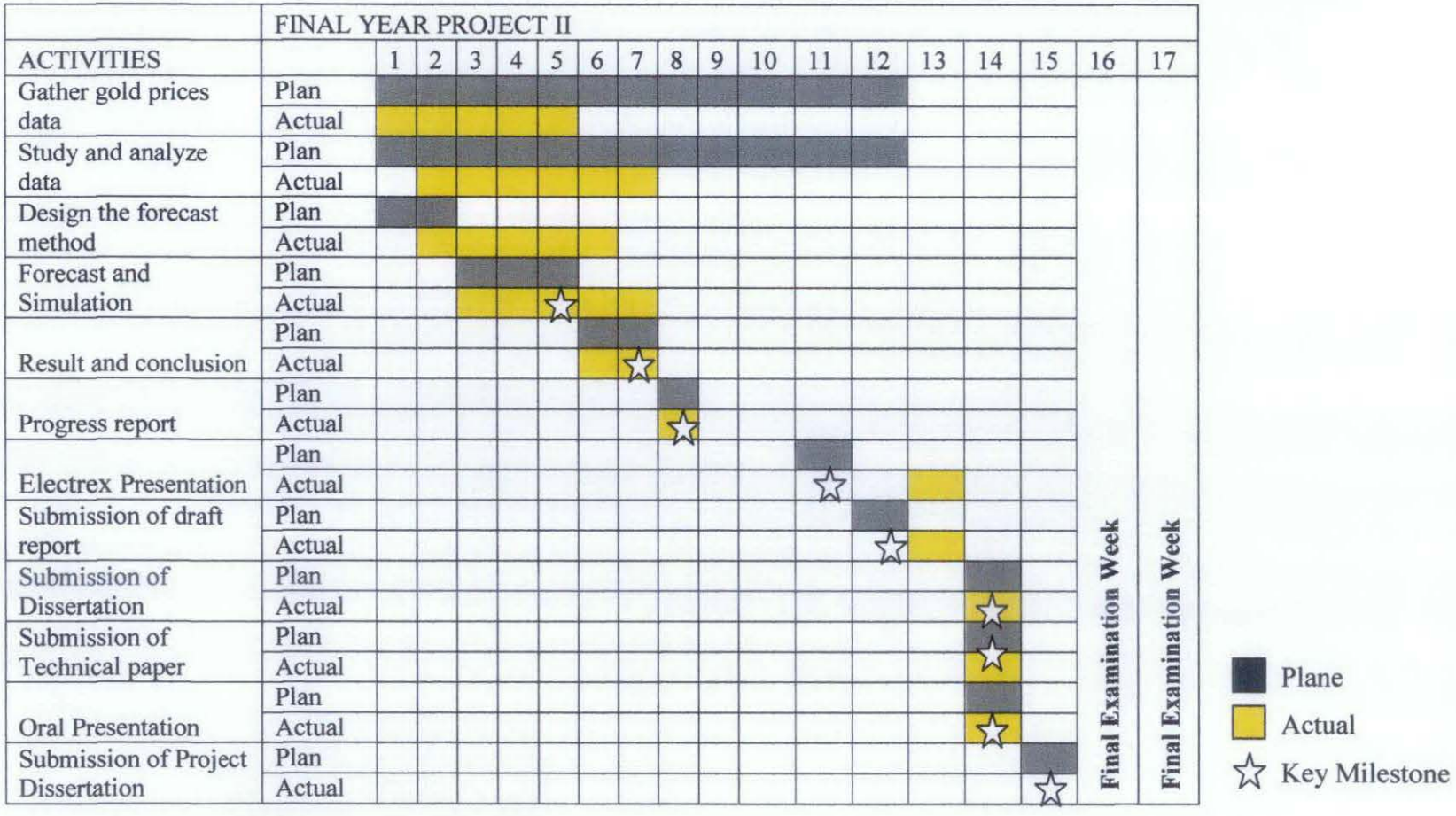
A Gantt chart is one of the tools that monitor the progress of the project. The Gantt chart consist of one year duration planning had been construct.

Table 3: Gantt Chart for Final Year Project I

		FINAL YEAR PROJECT I																
ACTIVITIES		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Topic selection	Plan															Study week	Final Examination Week	Final Examination Week
	Actual																	
Search information	Plan																	
	Actual																	
Study on research	Plan																	
	Actual																	
Literature review	Plan																	
	Actual					☆												
Extended proposal	Plan																	
	Actual						☆											
Proposal defence	Plan																	
	Actual																	
Draft interim report	Plan																	
	Actual														☆			
Interim report	Plan																	
	Actual														☆			

Plane
Actual
☆ Key Milestone

Table 4: Gantt Chart for Final Year Project II



3.4 Project activities

The project activities for this project are;

- Reading and research about the gold prices and the method of prices forecasting
- Study the method of forecasting for apply and develop method for this project.
- Compare different method of each journals, research papers and articles for forecasting method
- Designing and developing method for prices forecasting

3.5 Key milestone

Table 5: Key Milestone

Milestone	Plane timescale	progress
Literature review	Week 5 of Semester 1	COMPLETE
Extended proposal	Week 5 of Semester 1	COMPLETE
Draft interim report	Week 14 of Semester 1	COMPLETE
Interim report	Week 5 of Semester 1	COMPLETE
Forecast and Simulation	Week 7 of Semester 2	COMPLETE
Result and conclusion	Week 8 of Semester 2	COMPLETE
Progress report	Week 11 of Semester 2	COMPLETE
Electrex Presentation	Week 13 of Semester 2	COMPLETE
Draft dissertation report	Week 13 of Semester 2	COMPLETE
Dissertation	Week 14 of Semester 2	COMPLETE
Technical paper	Week 14 of Semester 2	COMPLETE
Oral Presentation	Week 15 of Semester 2	COMPLETE
Submit Project Dissertation	Week 16 of Semester 2	COMPLETE

3.6 Tool required

This project will use MATLAB software as the main tool for the gold forecast model. It is more performing vector and matrix calculations therefore MATLAB is the best software for it.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Results

The following content illustrate the gold price prediction using Neural Network. The project is using 3 layer feedforwark network and the number of neurons in the each hidden layer for the model is 9 and the transfer function for the model are Purelin for the input, Purelin for the output and Trainlm for the training. The input data is the previous data with the number of 1745 and data partitioning for each of the models has been shown in the table 6.

Table 6: Data Partitioning

Model	**Data Partitioning**		
	Training Data	*Validation Data*	*Testing Data*
Model 1	40 %	10 %	50 %
Model 2	40 %	30 %	30 %
Model 3	40 %	40 %	20 %
Model 4	40 %	50 %	10 %
Model 5	50 %	10 %	40 %
Model 6	50 %	20 %	30 %
Model 7	50 %	30 %	20 %
Model 8	50 %	40 %	10 %
Model 9	60 %	10 %	30 %
Model 10	60 %	20 %	20 %
Model 11	60 %	30 %	10 %
Model 12	70 %	10 %	20 %
Model 13	70 %	20 %	10 %

The average MAPE of each portioning data are carried by 15 simulations has been shown in table 8,9,10,11,12,13,14,15,16,17,18,19,and 20 respectively

Table 7: Data Partitioning 40 percent for training data, 10 percent for validation data and 50 percent for testing data

	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
Trial	***Actual***	***Forecast***	***Actual***	***Forecast***	***Actual***	***Forecast***	***Actual***	***Forecast***	***Actual***	***Forecast***	**%**
1	1603	1611.8	1672.5	1671.3	1659.5	1665.9	1709	1710	1715	1717.8	0.1351
2	1603	1598	1672.5	1666	1659.5	1654.1	1709	1702.8	1715	1709.1	0.5192
3	1603	1602.7	1672.5	1671.9	1659.5	1659.2	1709	1708.5	1715	1714.6	0.0569
4	1603	1601.6	1672.5	1671.1	1659.5	1658.1	1709	1707.6	1715	1713.6	0.1184
5	1603	1600.1	1672.5	1669.2	1659.5	1656.5	1709	1705.8	1715	1711.8	0.2616
6	1603	1604.6	1672.5	1673.5	1659.5	1660.9	1709	1710.1	1715	1716.2	0.1104
7	1603	1602.2	1672.5	1671.4	1659.5	1658.6	1709	1708	1715	1714	0.0942
8	1603	1603	1672.5	1672.1	1659.5	1659.4	1709	1708.7	1715	1714.8	0.0386
9	1603	1603.6	1672.5	1680	1659.5	1661.7	1709	1714.9	1715	1719.6	0.6143
10	1603	1623.2	1672.5	1692.9	1659.5	1679.9	1709	1729.6	1715	1735.6	1.5634
11	1603	1603.1	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	3.00E-03
12	1603	1588.8	1672.5	1657.5	1659.5	1645.1	1709	1694.1	1715	1700.3	1.2242
13	1603	1598.6	1672.5	1669	1659.5	1655.3	1709	1705.2	1715	1711	0.2107
14	1603	1604.5	1672.5	1674	1659.5	1661	1709	1710.5	1715	1716.5	0.1322
15	1603	1602.3	1672.5	1672.4	1659.5	1659	1709	1708.8	1715	1714.7	0.0248
Average	1603	1603.207	1672.5	1672.32	1659.5	1659.613	1709	1708.907	1715	1714.973	0.340467

According to table 7, the daily gold price for 1745 days is used. The price of the first 698 days is used for training, the price of the next 175 days is used for validation and the remaining 872 days is used for training. The average of MAPE is 0.340467 percent.

Table 8: Data Partitioning 40 percent for training data, 30 percent for validation data and 30 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	1611.8	1672.5	1671.3	1659.5	1665.9	1709	1710	1715	1717.8	0.1184
2	1603	1598	1672.5	1666	1659.5	1654.1	1709	1702.8	1715	1709.1	0.4869
3	1603	1602.7	1672.5	1671.9	1659.5	1659.2	1709	1708.5	1715	1714.6	0.0513
4	1603	1601.6	1672.5	1671.1	1659.5	1658.1	1709	1707.6	1715	1713.6	0.1103
5	1603	1600.1	1672.5	1669.2	1659.5	1656.5	1709	1705.8	1715	1711.8	0.2461
6	1603	1604.6	1672.5	1673.5	1659.5	1660.9	1709	1710.1	1715	1716.2	0.1
7	1603	1602.2	1672.5	1671.4	1659.5	1658.6	1709	1708	1715	1714	0.0871
8	1603	1603	1672.5	1672.1	1659.5	1659.4	1709	1708.7	1715	1714.8	0.035
9	1603	1603.6	1672.5	1680	1659.5	1661.7	1709	1714.9	1715	1719.6	0.5641
10	1603	1623.2	1672.5	1692.9	1659.5	1679.9	1709	1729.6	1715	1735.6	1.4848
11	1603	1603.1	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	2.70E-03
12	1603	1588.8	1672.5	1657.5	1659.5	1645.1	1709	1694.1	1715	1700.3	1.1479
13	1603	1598.6	1672.5	1669	1659.5	1655.3	1709	1705.2	1715	1711	0.2119
14	1603	1604.5	1672.5	1674	1659.5	1661	1709	1710.5	1715	1716.5	0.1227
15	1603	1602.3	1672.5	1672.4	1659.5	1659	1709	1708.8	1715	1714.7	0.0219
Average	1603	1603.207	1672.5	1672.32	1659.5	1659.613	1709	1708.907	1715	1714.973	0.319407

According to table 8, the daily gold price for 1745 days is used. The price of the first 698 days is used for training, the price of the next 524 days is used for validation and the remaining 523 days is used for training. The average of MAPE is 0.319407 percent.

Table 9: Data Partitioning 40 percent for training data, 40 percent for validation data and 20 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE %
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	
1	1603	1611.8	1672.5	1671.3	1659.5	1665.9	1709	1710	1715	1717.8	0.1132
2	1603	1598	1672.5	1666	1659.5	1654.1	1709	1702.8	1715	1709.1	0.4256
3	1603	1602.7	1672.5	1671.9	1659.5	1659.2	1709	1708.5	1715	1714.6	0.040713
4	1603	1601.6	1672.5	1671.1	1659.5	1658.1	1709	1707.6	1715	1713.6	0.09496
5	1603	1600.1	1672.5	1669.2	1659.5	1656.5	1709	1705.8	1715	1711.8	0.2168
6	1603	1604.6	1672.5	1673.5	1659.5	1660.9	1709	1710.1	1715	1716.2	0.0805
7	1603	1602.2	1672.5	1671.4	1659.5	1658.6	1709	1708	1715	1714	0.0735
8	1603	1603	1672.5	1672.1	1659.5	1659.4	1709	1708.7	1715	1714.8	0.0279
9	1603	1603.6	1672.5	1680	1659.5	1661.7	1709	1714.9	1715	1719.6	0.4673
10	1603	1623.2	1672.5	1692.9	1659.5	1679.9	1709	1729.6	1715	1735.6	1.3368
11	1603	1603.1	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	2.40E-03
12	1603	1588.8	1672.5	1657.5	1659.5	1645.1	1709	1694.1	1715	1700.3	1.004
13	1603	1598.6	1672.5	1669	1659.5	1655.3	1709	1705.2	1715	1711	0.2145
14	1603	1604.5	1672.5	1674	1659.5	1661	1709	1710.5	1715	1716.5	0.1049
15	1603	1602.3	1672.5	1672.4	1659.5	1659	1709	1708.8	1715	1714.7	0.2145
Average	1603	1603.207	1672.5	1672.32	1659.5	1659.613	1709	1708.907	1715	1714.973	0.294505

According to table 9, the daily gold price for 1745 days is used. The price of the first 698 days is used for training, the price of the next 698 days is used for validation and the remaining 349 days is used for training. The average of MAPE is 0.294505percent.

Table 10: Data Partitioning 40 percent for training data, 50 percent for validation data and 10 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	1611.8	1672.5	1671.3	1659.5	1665.9	1709	1710	1715	1717.8	0.1306
2	1603	1598	1672.5	1666	1659.5	1654.1	1709	1702.8	1715	1709.1	0.3844
3	1603	1602.7	1672.5	1671.9	1659.5	1659.2	1709	1708.5	1715	1714.6	0.0336
4	1603	1601.6	1672.5	1671.1	1659.5	1658.1	1709	1707.6	1715	1713.6	0.0847
5	1603	1600.1	1672.5	1669.2	1659.5	1656.5	1709	1705.8	1715	1711.8	0.197
6	1603	1604.6	1672.5	1673.5	1659.5	1660.9	1709	1710.1	1715	1716.2	0.0675
7	1603	1602.2	1672.5	1671.4	1659.5	1658.6	1709	1708	1715	1714	0.0644
8	1603	1603	1672.5	1672.1	1659.5	1659.4	1709	1708.7	1715	1714.8	0.0234
9	1603	1603.6	1672.5	1680	1659.5	1661.7	1709	1714.9	1715	1719.6	0.4032
10	1603	1623.2	1672.5	1692.9	1659.5	1679.9	1709	1729.6	1715	1735.6	1.2374
11	1603	1603.1	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	2.10E-03
12	1603	1588.8	1672.5	1657.5	1659.5	1645.1	1709	1694.1	1715	1700.3	0.9073
13	1603	1598.6	1672.5	1669	1659.5	1655.3	1709	1705.2	1715	1711	0.2164
14	1603	1604.5	1672.5	1674	1659.5	1661	1709	1710.5	1715	1716.5	0.0928
15	1603	1602.3	1672.5	1672.4	1659.5	1659	1709	1708.8	1715	1714.7	0.0136
Average	1603	1603.207	1672.5	1672.32	1659.5	1659.613	1709	1708.907	1715	1714.973	0.257227

According to table 10, the daily gold price for 1745 days is used. The price of the first 698 days is used for training, the price of the next 873 days is used for validation and the remaining 174 days is used for training. The average of MAPE is 0.257227 percent.

Table 11: Data Partitioning 50 percent for training data, 10 percent for validation data and 40 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	160.8	1672.5	1671.8	1659.5	1663.3	1709	1709.7	1715	1716.7	0.0814
2	1603	1602.6	1672.5	1671.4	1659.5	1658.9	1709	1708.1	1715	1714.2	0.0729
3	1603	1603.4	1672.5	1672.8	1659.5	1659.9	1709	1709.4	1715	1715.4	0.021
4	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.0395
5	1603	1601.5	1672.5	1670.8	1659.5	1657.9	1709	1707.3	1715	1713.4	0.1246
6	1603	1604.2	1672.5	1673.5	1659.5	1660.7	1709	1710.1	1715	1716.1	0.0989
7	1603	1602.3	1672.5	16717	1659.5	1658.8	1709	1708.3	1715	1714.3	0.0611
8	1603	1602.8	1672.5	1672.1	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0327
9	1603	1607.8	1672.5	1681.8	1659.5	1665.3	1709	1717.1	1715	1722.3	0.7336
10	1603	1617.3	1672.5	1686.9	1659.5	1673.9	1709	1723.5	1715	1729.5	1.0579
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	1.70E-03
12	1603	1589.1	1672.5	1658.4	1659.5	1645.5	1709	1694.9	1715	1700.9	1.0837
13	1603	1603.9	1672.5	1673.8	1659.5	1660.5	1709	1710.3	1715	1716.2	0.0793
14	1603	1603.2	1672.5	1672.8	1659.5	1659.7	1709	1709.2	1715	1715.2	0.0197
15	1603	1602.5	1672.5	1672.2	1659.5	1659.1	1709	1708.7	1715	1714.6	0.0262
Average	1603	1507.127	1672.5	2675.987	1659.5	1660.08	1709	1709.52	1715	1715.533	0.235613

According to table 11, the daily gold price for 1745 days is used. The price of the first 873 days is used for training, the price of the next 174 days is used for validation and the remaining 698 days is used for training. The average of MAPE is 0.235613 percent.

Table 12: Data Partitioning 50 percent for training data, 20 percent for validation data and 30 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	1608.3	1672.5	1671.8	1659.5	1663.3	1709	1709.7	1715	1716.7	0.0742
2	1603	1602.6	1672.5	1671.4	1659.5	1658.9	1709	1708.1	1715	1714.2	0.0687
3	1603	1603.4	1672.5	1672.8	1659.5	1659.9	1709	1709.4	1715	1715.4	0.0212
4	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.0364
5	1603	1601.5	1672.5	1670.8	1659.5	1657.9	1709	1707.3	1715	1713.4	0.1165
6	1603	1604.2	1672.5	1673.5	1659.5	1660.7	1709	1710.1	1715	1716.1	0.0876
7	1603	1602.3	1672.5	16717	1659.5	1658.8	1709	1708.3	1715	1714.3	0.0557
8	1603	1602.8	1672.5	1672.1	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0292
9	1603	1607.8	1672.5	1681.8	1659.5	1665.3	1709	1717.1	1715	1722.3	0.6633
10	1603	1617.3	1672.5	1686.9	1659.5	1673.9	1709	1723.5	1715	1729.5	0.9957
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	1.60E-03
12	1603	1589.1	1672.5	1658.4	1659.5	1645.5	1709	1694.9	1715	1700.9	1.0068
13	1603	1603.9	1672.5	1673.8	1659.5	1660.5	1709	1710.3	1715	1716.2	0.0782
14	1603	1603.2	1672.5	1672.8	1659.5	1659.7	1709	1709.2	1715	1715.2	0.0182
15	1603	1602.5	1672.5	1672.2	1659.5	1659.1	1709	1708.7	1715	1714.6	0.0237
Average	1603	1603.627	1672.5	2675.987	1659.5	1660.08	1709	1709.52	1715	1715.533	0.218467

According to table 12, the daily gold price for 1745 days is used. The price of first 873 days is used for training, the price of the next 349 days is used for validation and the remaining 523 days is used for training. The average of MAPE is 0.218467 percent.

Table 13: Data Partitioning 50 percent for training data, 30 percent for validation data and 20 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	1608.3	1672.5	1671.8	1659.5	1663.3	1709	1709.7	1715	1716.7	0.0698
2	1603	1602.6	1672.5	1671.4	1659.5	1658.9	1709	1708.1	1715	1714.2	0.0651
3	1603	1603.4	1672.5	1672.8	1659.5	1659.9	1709	1709.4	1715	1715.4	0.0214
4	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.0336
5	1603	1601.5	1672.5	1670.8	1659.5	1657.9	1709	1707.3	1715	1713.4	0.1091
6	1603	1604.2	1672.5	1673.5	1659.5	1660.7	1709	1710.1	1715	1716.1	0.0773
7	1603	1602.3	1672.5	16717	1659.5	1658.8	1709	1708.3	1715	1714.3	0.0508
8	1603	1602.8	1672.5	1672.1	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0261
9	1603	1607.8	1672.5	1681.8	1659.5	1665.3	1709	1717.1	1715	1722.3	0.6008
10	1603	1617.3	1672.5	1686.9	1659.5	1673.9	1709	1723.5	1715	1729.5	0.9392
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	1.40E-03
12	1603	1589.1	1672.5	1658.4	1659.5	1645.5	1709	1694.9	1715	1700.9	0.9369
13	1603	1603.9	1672.5	1673.8	1659.5	1660.5	1709	1710.3	1715	1716.2	0.0772
14	1603	1603.2	1672.5	1672.8	1659.5	1659.7	1709	1709.2	1715	1715.2	0.0168
15	1603	1602.5	1672.5	1672.2	1659.5	1659.1	1709	1708.7	1715	1714.6	0.0213
Average	1603	1603.627	1672.5	2675.987	1659.5	1660.08	1709	1709.52	1715	1715.533	0.20312

According to table 13, the daily gold price for 1745 days is used. The price of the first 873 days is used for training, the price of the next 524 days is used for validation and the remaining 348 days is used for training. The average of MAPE is 0.20312 percent.

Table 14: Data Partitioning 50 percent for training data, 40 percent for validation data and 10 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	1608.3	1672.5	1671.8	1659.5	1663.3	1709	1709.7	1715	1716.7	0.0778
2	1603	1602.6	1672.5	1671.4	1659.5	1658.9	1709	1708.1	1715	1714.2	0.0606
3	1603	1603.4	1672.5	1672.8	1659.5	1659.9	1709	1709.4	1715	1715.4	0.0216
4	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.0303
5	1603	1601.5	1672.5	1670.8	1659.5	1657.9	1709	1707.3	1715	1713.4	0.1007
6	1603	1604.2	1672.5	1673.5	1659.5	1660.7	1709	1710.1	1715	1716.1	0.0657
7	1603	1602.3	1672.5	16717	1659.5	1658.8	1709	1708.3	1715	1714.3	0.0453
8	1603	1602.8	1672.5	1672.1	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0224
9	1603	1607.8	1672.5	1681.8	1659.5	1665.3	1709	1717.1	1715	1722.3	0.5273
10	1603	1617.3	1672.5	1686.9	1659.5	1673.9	1709	1723.5	1715	1729.5	0.875452
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	1.30E-03
12	1603	1589.1	1672.5	1658.4	1659.5	1645.5	1709	1694.9	1715	1700.9	0.8578
13	1603	1603.9	1672.5	1673.8	1659.5	1660.5	1709	1710.3	1715	1716.2	0.0759
14	1603	1603.2	1672.5	1672.8	1659.5	1659.7	1709	1709.2	1715	1715.2	0.0152
15	1603	1602.5	1672.5	1672.2	1659.5	1659.1	1709	1708.7	1715	1714.6	0.0188
Average	1603	1603.627	1672.5	2675.987	1659.5	1660.08	1709	1709.52	1715	1715.533	0.18641

According to table 14, the daily gold price for 1745 days is used. The price of the first 873 days is used for training, the price of the next 698 days is used for validation and the remaining 174 days is used for training. The average of MAPE is 0.18641 percent.

Table 15: Data Partitioning 60 percent for training data, 10 percent for validation data and 30 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	1606	1672.5	1672.2	1659.5	1661.7	1709	1709.4	1715	1716	0.0511
2	1603	1603.8	1672.5	1673	1659.5	1660.2	1709	1709.6	1715	1715.6	0.0433
3	1603	1603.8	1672.5	1673.3	1659.5	1660.3	1709	1709.8	1715	1715.8	0.0508
4	1603	1602.8	1672.5	1672.3	1659.5	1659.3	1709	1708.8	1715	1714.8	0.0161
5	1603	1602.6	1672.5	16720	1659.5	1659.1	1709	1708.6	1715	1714.6	0.0298
6	1603	1604	1672.5	1673.4	1659.5	1660.5	1709	1709.9	1715	1715.9	0.0771
7	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.0393
8	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0244
9	1603	1611.1	1672.5	1683.2	1659.5	1668.2	1709	1719	1715	1724.5	0.7924
10	1603	1614.1	1672.5	1683.7	1659.5	1670.7	1709	1720.3	1715	1726.3	0.778
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	1.00E-03
12	1603	1590.8	1672.5	1660.3	1659.5	1647.3	1709	1696.8	1715	1702.8	0.8703
13	1603	1607.3	1672.5	1677	1659.5	1664	1709	1713.6	1715	1719.6	0.2753
14	1603	1602.9	1672.5	1672.4	1659.5	1659.4	1709	1708.9	1715	1714.9	0.0079
15	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0204
Average	1603	1604.007	1672.5	2676.647	1659.5	1660.507	1709	1709.973	1715	1715.98	0.205147

According to table 15, the daily gold price for 1745 days is used. The price of the first 1047 days is used for training, the price of the next 175 days is used for validation and the remaining 523 days is used for training. The average of MAPE is 0.205147 percent.

Table 16: Data Partitioning 60 percent for training data, 20 percent for validation data and 20 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE %
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	
1	1603	1606	1672.5	1672.2	1659.5	1661.7	1709	1709.4	1715	1716	0.0439
2	1603	1603.8	1672.5	1673	1659.5	1660.2	1709	1709.6	1715	1715.6	0.039
3	1603	1603.8	1672.5	1673.3	1659.5	1660.3	1709	1709.8	1715	1715.8	0.0484
4	1603	1602.8	1672.5	1672.3	1659.5	1659.3	1709	1708.8	1715	1714.8	0.0148
5	1603	1602.6	1672.5	1672	1659.5	1659.1	1709	1708.6	1715	1714.6	0.0284
6	1603	1604	1672.5	1673.4	1659.5	1660.5	1709	1709.9	1715	1715.9	0.0679
7	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.0359
8	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0219
9	1603	1611.1	1672.5	1683.2	1659.5	1668.2	1709	1719	1715	1724.5	0.7183
10	1603	1614.1	1672.5	1683.7	1659.5	1670.7	1709	1720.3	1715	1726.3	0.7328
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	9.17E-04
12	1603	1590.8	1672.5	1660.3	1659.5	1647.3	1709	1696.8	1715	1702.8	0.81
13	1603	1607.3	1672.5	1677	1659.5	1664	1709	1713.6	1715	1719.6	0.2735
14	1603	1602.9	1672.5	1672.4	1659.5	1659.4	1709	1708.9	1715	1714.9	0.0071
15	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0186
Average	1603	1604.01	1672.5	1673.4	1659.5	1660.507	1709	1709.97	1715	1715.98	0.190761

According to table 16, the daily gold price for 1745 days is used. The price of the first 1047 days is used for training, the price of the next 349 days is used for validation and the remaining 349 days is used for training. The average of MAPE is 0.340467 percent.

Table 17: Data Partitioning 60 percent for training data, 30 percent for validation data and 10 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE %
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	
1	1603	1606	1672.5	1672.2	1659.5	1661.7	1709	1709.4	1715	1716	0.044
2	1603	1603.8	1672.5	1673	1659.5	1660.2	1709	1709.6	1715	1715.6	0.0343
3	1603	1603.8	1672.5	1673	1659.5	1660.3	1709	1709.8	1715	1715.8	0.0458
4	1603	1602.8	1672.5	1672.3	1659.5	1659.3	1709	1708.8	1715	1714.8	0.0134
5	1603	1602.6	1672.5	1672	1659.5	1659.1	1709	1708.6	1715	1714.6	0.0268
6	1603	1604	1672.5	1673.4	1659.5	1660.5	1709	1709.9	1715	1715.9	0.0575
7	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.032
8	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0191
9	1603	1611.1	1672.5	1683.2	1659.5	1668.2	1709	1719	1715	1724.5	0.6329
10	1603	1614.1	1672.5	1683.7	1659.5	1670.7	1709	1720.3	1715	1726.3	0.6818
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	8.24E-04
12	1603	1590.8	1672.5	1660.3	1659.5	1647.3	1709	1696.8	1715	1702.8	0.742
13	1603	1607.3	1672.5	1677	1659.5	1664	1709	1713.6	1715	1719.6	0.2715
14	1603	1602.9	1672.5	1672.4	1659.5	1659.4	1709	1708.9	1715	1714.9	0.0063
15	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0167
Average	1603	1604.01	1672.5	1673.43	1659.5	1660.51	1709	1709.97	1715	1715.98	0.174995

According to table 17, the daily gold price for 1745 days is used. The price of the first 1047 days is used for training, the price of the next 524 days is used for validation and the remaining 174 days is used for training. The average of MAPE is 0.174995 percent.

Table 18: Data Partitioning 70 percent for training data, 10 percent for validation data and 20 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	1605.7	1672.5	1672.3	1659.5	1661.4	1709	1709.4	1715	1715.9	0.0427
2	1603	1603.9	1672.5	1673.1	1659.5	1660.3	1709	1709.7	1715	1715.7	0.0458
3	1603	1603.8	1672.5	1673.3	1659.5	1660.3	1709	1709.8	1715	1715.8	0.0521
4	1603	1602.8	1672.5	1672.3	1659.5	1659.3	1709	1708.8	1715	1714.8	0.0128
5	1603	1602.8	1672.5	1672.3	1659.5	1659.3	1709	1708.8	1715	1714.8	0.0132
6	1603	1604	1672.5	1673.4	1659.5	1660.4	1709	1709.9	1715	1715.9	0.0673
7	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.0337
8	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0211
9	1603	1611.7	1672.5	1683.5	1659.5	1668.7	1709	1719.4	1715	1724.9	0.7523
10	1603	1613.6	1672.5	1683.2	1659.5	1670.2	1709	1719.8	1715	1725.8	0.7067
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	8.46E-04
12	1603	1591.3	1672.5	1660.8	1659.5	1647.7	1709	1697.2	1715	1703.2	0.7898
13	1603	1607.9	1672.5	1677.6	1659.5	1664.6	1709	1714.2	1715	1720.2	0.3086
14	1603	1602.9	1672.5	1672.4	1659.5	1659.4	1709	1708.9	1715	1714.9	0.0097
15	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0179
Average	1603	1604.087	1672.5	1673.54	1659.5	1660.567	1709	1710.053	1715	1716.053	0.191636

According to table 18, the daily gold price for 1745 days is used. The price of the first 1222 days is used for training, the price of the next 174 days is used for validation and the remaining 349 days is used for training. The average of MAPE is 0.191636 percent.

Table 19: Data Partitioning 70 percent for training data, 20 percent for validation data and 10 percent for testing data

Trial	14-Dec-11		13-Dec-11		12-Dec-11		9-Dec-11		8-Dec-11		MAPE
	Actual	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	*Actual*	*Forecast*	%
1	1603	1605.7	1672.5	1672.3	1659.5	1661.4	1709	1709.4	1715	1715.9	0.0387
2	1603	1603.9	1672.5	1673.1	1659.5	1660.3	1709	1709.7	1715	1715.7	0.0398
3	1603	1603.8	1672.5	1673.3	1659.5	1660.3	1709	1709.8	1715	1715.8	0.0487
4	1603	1602.8	1672.5	1672.3	1659.5	1659.3	1709	1708.8	1715	1714.8	0.0114
5	1603	1602.8	1672.5	1672.3	1659.5	1659.3	1709	1708.8	1715	1714.8	0.0128
6	1603	1604	1672.5	1673.4	1659.5	1660.4	1709	1709.9	1715	1715.9	0.0557
7	1603	1602.5	1672.5	1672	1659.5	1659	1709	1708.5	1715	1714.5	0.0296
8	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0181
9	1603	1611.7	1672.5	1683.5	1659.5	1668.7	1709	1719.4	1715	1724.9	0.6521
10	1603	1613.6	1672.5	1683.2	1659.5	1670.2	1709	1719.8	1715	1725.8	0.6505
11	1603	1603	1672.5	1672.5	1659.5	1659.5	1709	1709	1715	1715	7.47E-04
12	1603	1591.3	1672.5	1660.8	1659.5	1647.7	1709	1697.2	1715	1703.2	0.7145
13	1603	1607.9	1672.5	1677.6	1659.5	1664.6	1709	1714.2	1715	1720.2	0.3061
14	1603	1602.9	1672.5	1672.4	1659.5	1659.4	1709	1708.9	1715	1714.9	0.0084
15	1603	1602.7	1672.5	1672.2	1659.5	1659.2	1709	1708.7	1715	1714.7	0.0159
Average	1603	1604.087	1672.5	1673.54	1659.5	1660.567	1709	1710.053	1715	1716.053	0.173536

According to table 19, the daily gold price for 1745 days is used. The price of the first 1222 days is used for training, the price of the next 349 days is used for validation and the remaining 174 days is used for training. The average of MAPE is 0.173536 percent.

The fifteen (15) simulations gold price for all third teen (13) models was evaluated by calculating the average of MAPE of forecasted gold price with actual gold price have been described in the table 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20 respectively. It was observed that the average MAPE of all models seemed to be small at less than MAPE that have proposed which is less that 10 percent.

Model one (1) gave very low accuracy forecast compared with the other models with average MAPE of 0.34 percent. While the model third teen (13) gave more accuracy forecast compared with model 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 and 12 respectively with average MAPE of 0.17 percent. It is also more accuracy forecast model compared with another forecast tools of some journals (Ongsritrakul & Soonthornphisaj, 2003). The forecast tools using SVR, the first experiment with the MAPE of 1.937 percent and second experiment with the MAPE of 1.763 percent. The second forecast tool using linear regression, the first experiment with the MAPE of 1.898 percent and second experiment with the MAPE of 1.882 percent. Furthermore the third forecast tool using neural network, the first experiment with the MAPE of 3.043 percent and second experiment with the MAPE of 2.395 percent. The conference paper (Xu, et al., 2009) concluded that the MAPE was 5.05 percent for ARIMA (2, 1, 0) forecast model and 4.42 percent for ARIMA (2, 1, 5) model. The accuracy of two (2) models also less accuracy compare with model 13.

Further content illustrate the forecasted gold price compare with actual value from 22 March 2011 until 14 December 2011 has been shown is Figure.24 and 25 respectively

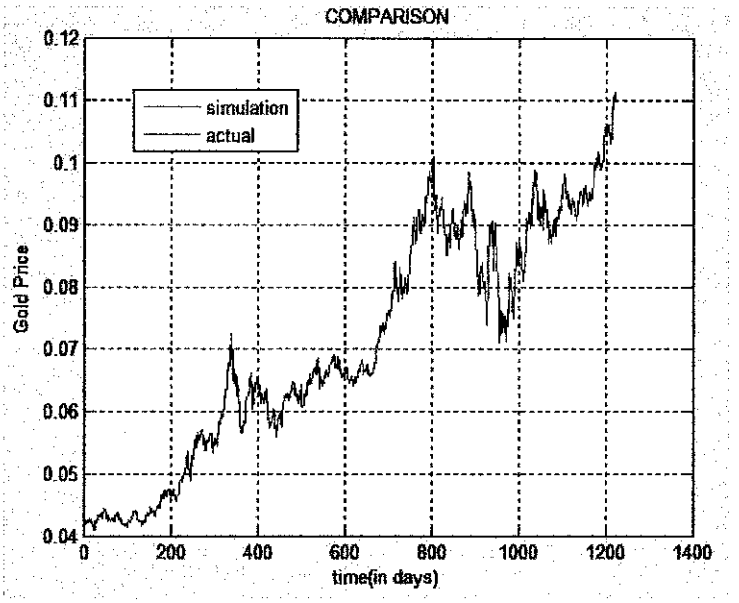


Figure 24: Comparison between Simulation and Actual

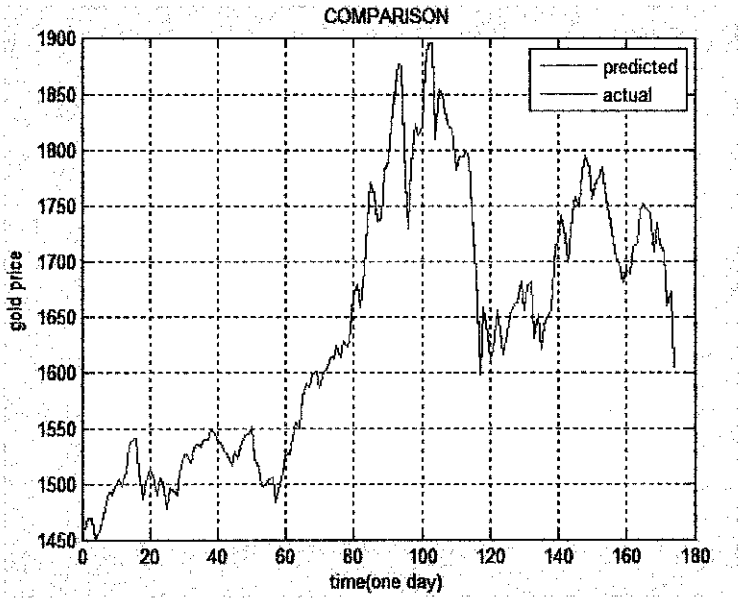


Figure 25: Comparison between Gold Price Predicted and Gold Price Actual

The simulation data is very important for the gold price forecast model. It is directly affected to prediction value hence gold price prediction is proportional to simulation data. According to Fig. 24, simulation graph line is overlap with actual graph line as a result of the simulation value is more accuracy and very close to the actual value. Fig. 25 has been shown the comparing value between the gold price prediction value and gold price actual value. The gold prices predictions values are very close the gold prices actual value. So that, the graph line in the Fig. 15 is overlap. It is difficult to differential between the gold prices

prediction and gold prices actual. In addition Table 3 is some of prediction price has taken from the prediction prices which are the prediction price of 8 December 2011, 9 December 2011, 12 December 2011, 13 December 2011 and 14 December 2011 respectively for illustrating the differential between the gold prices prediction compared with gold prices actual.

Table 20: Example of Gold Price Forecasted

Date	Actual	forecast	MAPE (%)
8-Dec-11	1715	1716.053	0.061399
9-Dec-11	1709	1710.053	0.061615
12-Dec-11	1659.5	1660.567	0.064296
13-Dec-11	1672.5	1673.54	0.062182
14-Dec-11	1603	1604.087	0.06781

CHAPTER 5

CONCLUSION

5.1 Conclusion

The objectives of the project have been outlined. The results are improved compare to the previous one (the results of FYP1). From the results obtained, the MAPE values of the FYP2 are less than the previous one. The decrease in the MAPE values show that the accuracy of the FYP2 is improved and represents a high degree of accuracy in the gold prices prediction. However, the method can be modified to improve the result by changing of architecture of ANN such as changing of hidden layer, changing of input or output. The method also can be modified to improve the result by changing of data partition.

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APPENDIX

```
clear;
clc;
echo on;
pause
load input702010;
load golddata702010;
p=trdat';
pt=trtgdat';
VV.P=val';
VV.T=valtg';
ts=tsdat';
tst=tstgdat';
pause
net=newff((minmax(p)),[9 9 1],{'purelin' 'purelin' 'purelin'},'trainlm'); %asal 9
pause
net.trainParam.epochs = 1000;%asal 100
net.trainParam.goal = 0.0001;%asal 0.001
net.trainparam.show=1;%asal 1
%==========Start training the
model.%Please%wait.==============================
pause
net=train(net,p,pt,[],[],VV);
pause
test1=sim(net,p);
pause
day=[1:1:1222];
plot(day,test1,day,pt)
xlabel('time(in days)')
ylabel('Gold Price')
title('COMPARISON')
legend('simulation','actual',1)
grid on
```

```
error_test1=(sum(abs(test1-pt))/size(pt,2))*100;
pause
test2=sim(net,ts);
pause
error=(sum(abs(test2-tst))/size(tst,2))*100;
day=[1:1:174];
plot(day,test2,day,tst)
xlabel('time(in days)')
ylabel('Gold Price')
title('COMPARISON')
legend('testing','actual',2)
grid on
pause
ain=ain';
aout=aout';
pload=sim(net,ain);
pload=(10000*(pload));
pload
aload=(10000*(aout));
aload
pause
MAPE=(sum(abs(pload-aload))/sum(abs(aload)))*100
day=[1:1:174];
plot(day,pload,day,aload)
xlabel('time(one day)')
ylabel('gold price')
title('COMPARISON')
legend('predicted','actual',174)
grid on
pause
```