

# Application of Decision Making Tree in Developing an Expert Advisor in MQL5

Muhammad Al Terra 13517145  
Program Studi Teknik Informatika  
Sekolah Teknik Elektro dan Informatika  
Institut Teknologi Bandung, Jl. Ganesha 10 Bandung 40132, Indonesia  
13517145@std.stei.itb.ac.id

**Abstract**—The foreign exchange market is a market used by traders all around the world to trade currencies. With the rise of advanced computers and high speed internet access, it became possible for traders to use automated trading systems with embedded algorithms as the strategy that guide them. Using the tree structure of information storage to design a decision tree which involves multiple currency pairs in decision making, it is discovered that the trades are profitable with a profit factor greater than 1.

**Keywords**—Forex, Expert Advisor, Decision-Tree, Multi currency trading.

## I. INTRODUCTION

Foreign exchange markets or Forex is, like any other market, a platform for people all around the world to trade commodities, however, unlike any other markets the goods that are being passed around to one another is money, in other words, the Foreign exchange markets exchange one form of currency for another. While this at first doesn't make any sense, the ever fluctuating value of money around the world influenced by socio-economical factors such as wars, political strife and the rise and fall of oil prices for example, could make such difference worth investing.

The recorded amount for the amount of money being traded each day has grown significantly. It was around USD 2 trillion back in 2007 (Bickford, J.L. 2007) and in 2014 it has grown into a whopping USD 5.3 trillion (McLeod, Gregory 2014). The technological growth that swiftly swept over Indonesia made it easy for us to gain access to this market and it had invited many brokers and investors to set up shop in Indonesia (FinanceFeeds, 2018). With such lucrative and tempting possibility of multiplying one's own money over the course of a few hours instead of working in a 9 to 5 job, there is of course a cause for concern. According to a study done in 2012 and one in 2004, the result is consistent, day traders lose twice the money they've earned (Ryu, 2012). There is even a saying that mentioned, "95% of traders lose money" (Cory Mitchell, 2018). It is for this reason that not all people became billionaires in an instant even if the money traded each day could make people everywhere richer than they can imagine.

There are of course helpful tips that could help someone to gain some success in the foreign exchange market. Ivan Susanto in his book *Forex Trading* mentioned that the main reason for people to fail is a lack of practice (Susanto, Ivan

2007). This is a very easily manageable issue, but most of the time, people who tried the FX market do so because they "wanted to try out their luck", they thought of it as a shortcut in gaining large amounts of money without doing much work (Susanto, Ivan 2007)., while in reality, to start earning money one needs to persevere and learn the knowledge and science behind each bars generated, each tick in the chart and why a price fall in a currency could occur.

A lot of people didn't have time to sit around and wait for the prices to show signs of a good buy or sell signal and at some other times people also let their emotions blind their reason and judgment. For this reason, the widely used MetaTrader 4 and MetaTrader 5 have developed their own programming language called the Meta Quotes Language or (MQL) and allowed its users to create clever and automated systems to manage the trades according to the chart based on a set of algorithms that is packed in a neat file with ex4 or ex5 extension in the back. This paper would discuss the possibility of using a multi currency pair expert advisor that would utilize multiple currency pairs in making a decision tree that would decide a trading operation after making sure that it had traversed down until its smallest leaves.

## II. BACKGROUND

### A. Tree

A tree is a non linear data structure that uses root, parent and children to organize their data and use nodes to direct from a root towards its child objects (Cs.cmu.edu, 2018). Trees in other words, could also be equated to a directionless graph that does not contain any circuit (Munir, Rinaldi 2012). It is a graph that traversed from its parent object down to its children.

A node within a tree that does not lead to other nodes is called a leaf node and it is one of the main subjects that will be discussed in this paper.

### B. Decision Tree

A decision tree is a type of data structure filled with items that are considered as criterions in making a decision. If one wants to make a decision or perform an action considered to be optimal and effective, it would be wise to consult a decision tree. The decision tree contains yes and no questions at every node. A user would move down the root towards its children as he answered the yes and no questions until he reached a leaf at the bottom. Decision tree would give the users a chance to see the multiple possible outcomes if they decide to act a certain

way. In an example below Bob has a decision tree that could help him see what's best for him:

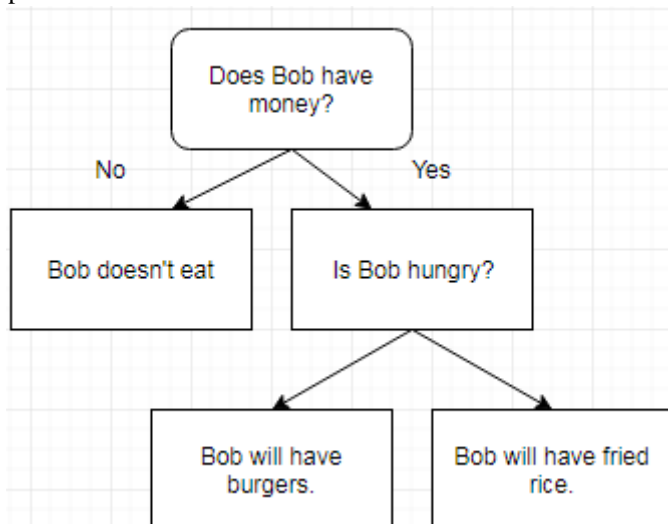


Figure 1.0 Bob's decision tree, note: left branch is no and right branch is yes

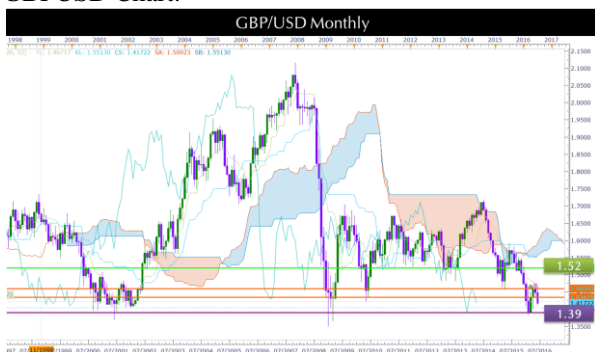
### C. Technical Analysis

Technical analysis is a method used by forex traders to assist them in making an order. Technical analysis is different from Fundamental analysis. Fundamental analysis used a variety of methods to decide when and what order should be placed in the market. These include but not limited to; macroeconomics, microeconomics, the events going on at the world and quantitative and qualitative data obtained not only in charts, but also news article and bank statements (Investopedia, 2018).

Technical analysis on the other hand used the chart within MetaTrader platform to make their decision. The chart is filled with tools to assess a market's strength, the current price of a currency pair and using trendlines or other tools such as Fibonacci lines, horizontal lines, Gann lines and Elliott wave lines. The collective tools that are used in predicting the general direction of a pair of currency within certain timeframes (1 hour chart, 30 minutes chart, 4 hours chart) is what a trader would call indicators.

The events, the statements and news articles published about the state of a currency are represented by what's happening in the graph. Back in 2016, when the British exited European Union, it caused a drop of around 1790 pips (points-in-percentage) (Urlic, 2018) in the GBPUSD pair and caused similarly massive drops in other pairs with GBP in front of their names.

GBPUSD Chart:



Source: NASDAQ

Therefore, it is crucial for any traders who specialize in technical analysis to keep an eye out for any massive changes in world economics or politics.

### D. Indicators

As mentioned before indicators are used as tools to assist a trader in making decisions as he is about to make an order. The indicators that came with MetaTrader 5 platform are numerous. They ranged from simple moving averages or trend lines to complex Elliot wave lines and Fibonacci ratios.

One of the most frequently used and most common indicators is called the Moving Average. It is, as the name suggests, a line that would take the average value of the sum of closed prices from a certain number of bars. If a person used a Moving Average with a parameter of 5 then it would take the value of each bars from now back to 5 bars ago and it will return their average value (BabyPips.com, 2018).

The moving average crossover is a very simple and basic strategy that involved two moving averages with different values and waiting for them to intersect or cross between each other. The general idea behind this strategy would involve taking account of the parameters with each moving average and afterwards making sure the shorter and quicker moving average to cross over the longer and slower moving average. When a moving average with lower parameter crossed above the moving average with a higher parameter, then a trader should place a long order (buy the pair). If it's the opposite then a trader should take a short order (sell the pair).

Example of crossover:

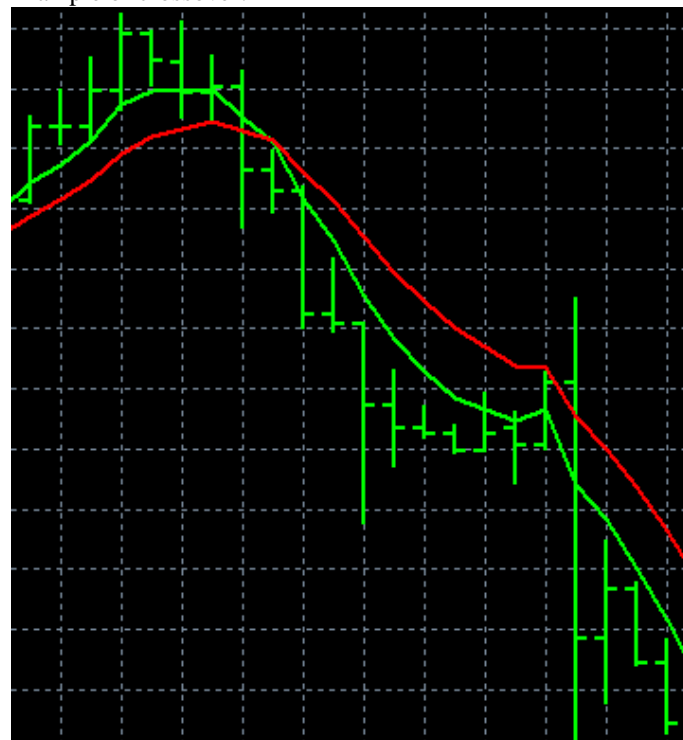


Figure 2.0 Crossover

The indicators that will be used in the development of this expert advisor are Moving Averages 5 with 10 and 10 with 30.

### III. METHODOLOGY

#### A. Research Method

This chapter describes the research methods used to determine the validity and the performance of the Expert Advisor using decision tree method. The method that will be used is experimentation with MetaTrader 5 strategy tester on timeframes in major currencies that all started with the same front names.

#### B. Instruments

As mentioned before the algorithm used in the expert advisor will use multiple pairs analysis as opposed to just a single pair. The indicators used are all identical moving averages 5 and 10. The decision tree is as follow:

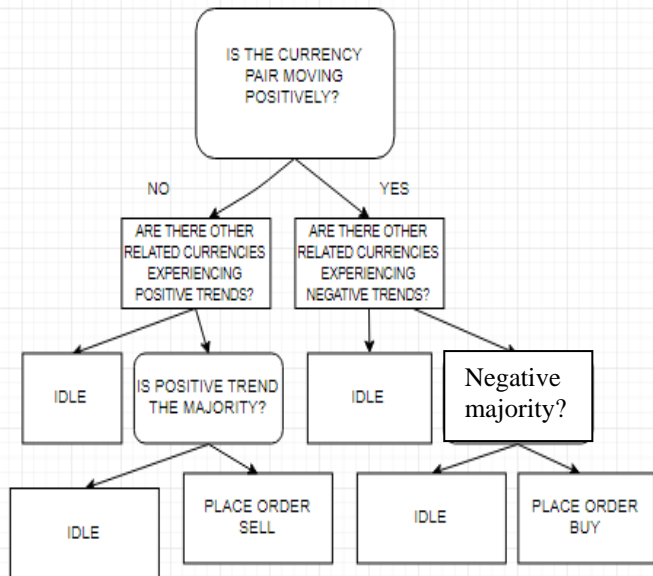


Figure 3.0 Decision Tree

The program for the Expert Advisor is written in MetaQuotes language which also contained elements of C++. The Expert Advisor's core program is as follows:

```

string Symb = Symbol(); //The name of
current opened symbol
int numsym = SymbolsTotal(1); //The
number of available symbol
int CurGrad = Gradient(Symb); //The
gradient of current symbol
char prefix[4]; //The front name of
the currency
char Word[7]; //Array to store the
name string as char array
char Temp[4]; //Temporary character
storage
Paris GradList[]; //Array to store
custom datatype which contained strengths
and names
string SymbList[]; //Array to contain
the list of all symbols
string SymbSaring[]; //Array to filter
the symbols being used
string finals; //Variable to store a
string to be placed an order to

```

```

int i,j,k,count; //Counting variables

/*Storing the current chart into array*/
StringToArray(Symb,Word,1,WHOLE_ARRA
Y,CP_ACP);

for (i = 1; i <= numsym; i++){
    ArrayResize(SymbList,i+1,0);
    SymbList[i] = SymbolName(i,true);
}

for (i = 1; i <= 3; i++){
    prefix[i] = Word[i];
}

/* Matching the front name of the
currency with the rest*/
k = 0;
count = 0;
for (i =1; i <= numsym; i++){
    for (j =1; j <= 3; j++){

StringToArray(SymbList[i],Temp,1,WHOLE
_ARRAY,CP_ACP);
        if (prefix[j] == Temp[j]){
            count++;
        }
    }
    if (count == 3){
        k++;

        ArrayResize(SymbSaring,k+1,0);
        SymbSaring[k] =
SymbList[i];
    }
    count = 0;
}

/*Collecting the gradient and its
corresponding names*/
for (i = 1; i <= k; i++){
    ArrayResize(GradList,i+1,0);
    GradList[i].symbol = SymbSaring[i];
    GradList[i].strength =
Gradient(SymbList[i]);
}

bool Buy_Condition_1 = false; //Variable
to store the confirmation of long position
bool Sell_Condition_1 = false;
//Variable to store the confirmation of
short position

/*Validity checking and the main
algorithm to check if there is a minor and
major currency strenghts and the program
will find the one who is still late*/
if (ValidityChecking(GradList,k)){
    finals = FindMin(GradList,k);
    if (finals != "NULL"){

```

```

Buy_Condition_1 = true;
}
}else{
finals = FindMax(GradList,k);
if (finals != "NULL"){
Sell_Condition_1 = true;
}
} C. Assumptions

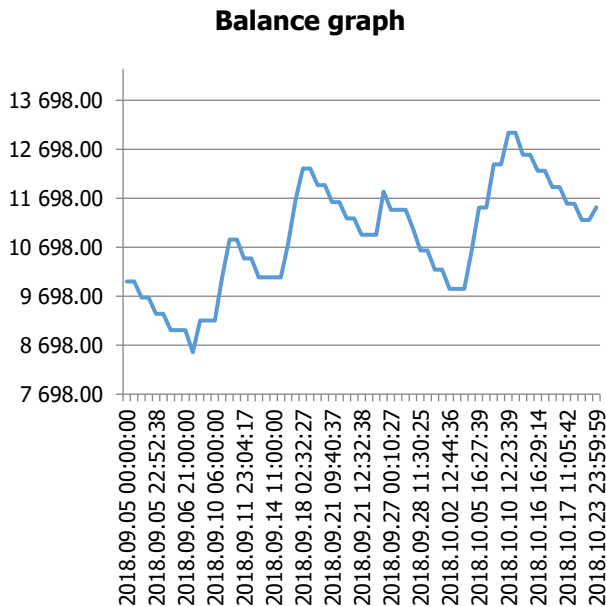
```

The researcher assumes that the multi currency decision tree trading expert advisor would be profitable when used within 1 hour charts and is used with at least one week of execution. The researcher also assumed that it would work in major currencies such as the GBP or other markets with volatile changes. The EA would scan all of them (GBPAUD, GBPUSD, GBPNZD, GBPCAD, GBPJPY) and if there's more with GBP behind them the EA would take it into consideration.

#### IV. RESULTS

##### I. Graph Representation

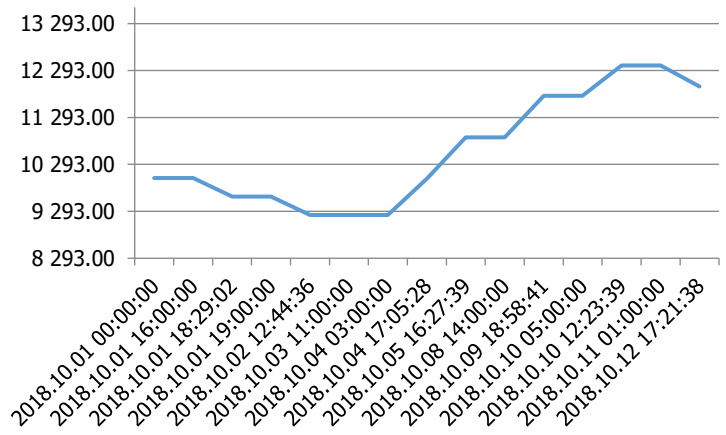
1. On first test of GBP pairs



The Y Axis represents capital, the X axis represents time.

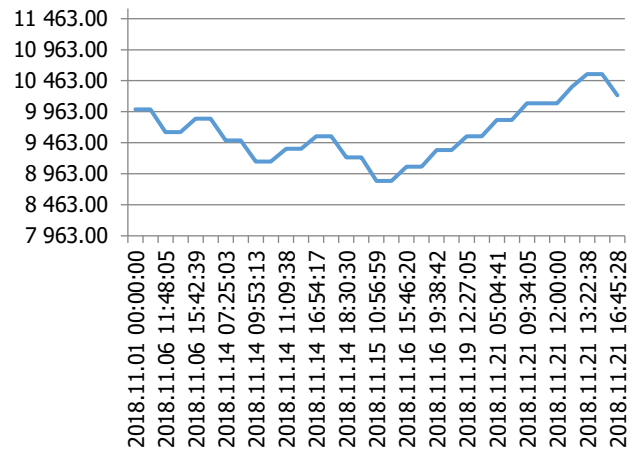
2. On second test of GBP pairs.

##### Balance graph



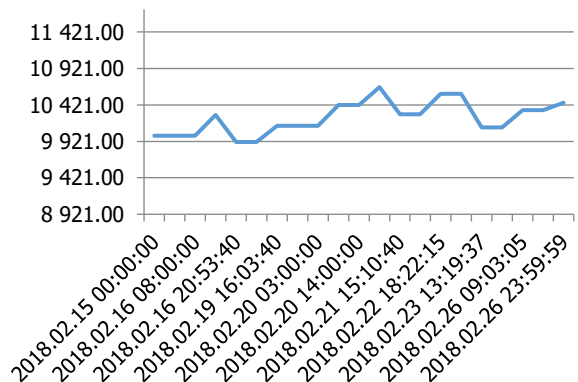
3. On EUR pairs

##### Balance graph



4. On AUD pairs

##### Balance graph



#### II. Statistics

1. On first GBP pairs

Results					
History Quality :	100%				
Bars:	840	Ticks:	3369 161	Symbol	4

				s:	
Total Net Profit:	<b>1 516,59</b>	Balance Drawdown Absolute:	<b>1 446,22</b>	Equity Drawdown Absolute:	<b>1 416,12</b>
Gross Profit:	<b>8 850,74</b>	Balance Drawdown Maximal:	<b>2 453.91 (19.95%)</b>	Equity Drawdown Maximal:	<b>3 038.21 (24.35%)</b>
Gross Loss:	<b>-7 334,15</b>	Balance Drawdown Relative:	<b>19.95% (2 453.91)</b>	Equity Drawdown Relative:	<b>24.35% (3 038.21)</b>
Profit Factor:	<b>1,21</b>	Expected Payoff:	<b>47,39</b>	Margin Level:	<b>262.17%</b>
Recovery Factor:	<b>0,50</b>	Sharpe Ratio:	<b>0,11</b>	Z-Score:	<b>-2.11 (96.51%)</b>
AHPR:	<b>1.0057 (0.57%)</b>	LR Correlation:	<b>0,68</b>	OnTester result:	<b>0</b>
GHPR:	<b>1.0044 (0.44%)</b>	LR Standard Error:	<b>827,06</b>		
Correlation (Profits, MFE):	<b>0,90</b>	Correlation (Profits, MAE):	<b>0,55</b>	Correlation (MFE, MAE):	<b>0,39</b>
Minimal position holding time:	<b>0:21:28</b>	Maximal position holding time:	<b>53:27:39</b>	Average position holding time:	<b>16:08:41</b>
Total Trades:	<b>32</b>	Short Trades (won %):	<b>0 (0.00%)</b>	Long Trades (won %):	<b>32 (37.50%)</b>
Total Deals:	<b>64</b>	Profit Trades (% of total):	<b>12 (37.50%)</b>	Loss Trades (% of total):	<b>20 (62.50%)</b>
		Largest profit trade:	<b>900,15</b>	Largest loss trade:	<b>- 452,28</b>
		Average profit trade:	<b>737,56</b>	Average loss trade:	<b>- 366,71</b>
		Maximum consecutive:	<b>4 (3 186.83)</b>	Maximum consecutive:	<b>5 (-1 988.84)</b>

			wins (\$):		losses (\$):	
			Maximal consecutive profit (count):	<b>3 186.83 (4)</b>	Maximal consecutive loss (count):	<b>-1 988.84 (5)</b>
			Average consecutive wins:	<b>2</b>	Average consecutive losses:	<b>4</b>

2. On second GBP pairs

<b>Results</b>					
History Quality:	<b>100%</b>				
Bars:	<b>240</b>	Ticks:	<b>1072 176</b>	Symbol:	<b>3</b>
Total Net Profit:	<b>1 955,22</b>	Balance Drawdown Absolute:	<b>785,05</b>	Equity Drawdown Absolute:	<b>1 195,29</b>
Gross Profit:	<b>3 186,83</b>	Balance Drawdown Maximal:	<b>785.05 (7.85%)</b>	Equity Drawdown Maximal:	<b>1 277.17 (12.67%)</b>
Gross Loss:	<b>-1 231,61</b>	Balance Drawdown Relative:	<b>7.85% (785.05)</b>	Equity Drawdown Relative:	<b>12.67% (1 277.17)</b>
Profit Factor:	<b>2,59</b>	Expected Payoff:	<b>279,32</b>	Margin Level:	<b>339.77%</b>
Recovery Factor:	<b>1,53</b>	Sharpe Ratio:	<b>0,47</b>	Z-Score:	<b>-0.79 (57.05%)</b>
AHPR:	<b>1.0275 (2.75%)</b>	LR Correlation:	<b>0,92</b>	OnTester result:	<b>0</b>
GHPR:	<b>1.0258 (2.58%)</b>	LR Standard Error:	<b>608,08</b>		
Correlation (Profits, MFE):	<b>0,78</b>	Correlation (Profits, MAE):	<b>0,52</b>	Correlation (MFE, MAE):	<b>0,20</b>
Minimal position holding time:	<b>2:29:02</b>	Maximal position holding time:	<b>53:27:39</b>	Average position holding time:	<b>23:30:06</b>

g time:				time:	
Total Trades:	<b>7</b>	Short Trades (won %):	<b>0 (0.00%)</b>	Long Trades (won %):	<b>7 (57.14%)</b>
Total Deals:	<b>14</b>	Profit Trades (% of total):	<b>4 (57.14%)</b>	Loss Trades (% of total):	<b>3 (42.86%)</b>
		Largest profit trade:	<b>885,00</b>	Largest loss trade:	<b>- 446,56</b>
		Average profit trade:	<b>796,71</b>	Average loss trade:	<b>- 410,54</b>
		Maximum consecutive wins (\$):	<b>4 (3 186.83)</b>	Maximum consecutive losses (\$):	<b>2 (- 785.05)</b>
		Maximum consecutive profit (count):	<b>3 186.83 (4)</b>	Maximum consecutive loss (count):	<b>- 785.05 (2)</b>
		Average consecutive wins:	<b>4</b>	Average consecutive losses:	<b>2</b>

### 3. On EUR pairs

<b>Results</b>					
History Quality :	<b>100%</b>				
Bars:	<b>359</b>	Ticks:	<b>1187 236</b>	Symbol s:	<b>4</b>
Total Net Profit:	<b>226,73</b>	Balance Drawdown Absolute:	<b>1 151,95</b>	Equity Drawdown Absolute:	<b>1 361,63</b>
Gross Profit:	<b>2 346,14</b>	Balance Drawdown Maximal:	<b>1 151,95 (11.52%)</b>	Equity Drawdown Maximal:	<b>1 432.25 (14.22%)</b>
Gross Loss:	<b>-2 119,41</b>	Balance Drawdown Relative:	<b>11.52% (1 151.95)</b>	Equity Drawdown Relative:	<b>14.22% (1 432.25)</b>
Profit Factor:	<b>1,11</b>	Expected	<b>14,17</b>	Margin Level:	<b>442.39%</b>

		Payoff:			
Recovery Factor:	<b>0,16</b>	Sharpe Ratio:	<b>0,06</b>	Z-Score:	<b>-0.55 (41.77%)</b>
AHPR:	<b>1.0018 (0.18%)</b>	LR Correlation:	<b>0,46</b>	OnTest er result:	<b>0</b>
GHPR:	<b>1.0014 (0.14%)</b>	LR Standard Error:	<b>444,73</b>		
Correlation (Profits ,MFE):	<b>0,90</b>	Correlation (Profits, MAE):	<b>0,93</b>	Correlation (MFE, MAE):	<b>0,85</b>
Minimal position holding time:	<b>1:09:38</b>	Maximal position holding time:	<b>15:56:59</b>	Average position holding time:	<b>4:37:45</b>
Total Trades:	<b>16</b>	Short Trades (won %):	<b>0 (0.00%)</b>	Long Trades (won %):	<b>16 (62.50%)</b>
Total Deals:	<b>32</b>	Profit Trades (% of total):	<b>10 (62.50%)</b>	Loss Trades (% of total):	<b>6 (37.50%)</b>
		Largest profit trade:	<b>270,16</b>	Largest loss trade:	<b>- 381,56</b>
		Average profit trade:	<b>234,61</b>	Average loss trade:	<b>- 353,24</b>
		Maximum consecutive wins (\$):	<b>7 (1 721.55)</b>	Maximum consecutive losses (\$):	<b>2 (- 721.87)</b>
		Maximum consecutive profit (count):	<b>1 721.55 (7)</b>	Maximum consecutive loss (count):	<b>- 721.87 (2)</b>
		Average consecutive wins:	<b>3</b>	Average consecutive losses:	<b>2</b>

### 4. On AUD pairs

<b>Results</b>					
History Quality :	<b>100%</b>				

Bars:	<b>192</b>	Ticks:	<b>815 511</b>	Symbol s:	<b>3</b>
Total Net Profit:	<b>451,71</b>	Balance Drawdown Absolute:	<b>88,16</b>	Equity Drawdown Absolute:	<b>358,50</b>
Gross Profit:	<b>1 657,20</b>	Balance Drawdown Maximal:	<b>553.79 (5.19%)</b>	Equity Drawdown Maximal:	<b>780.47 (7.20%)</b>
Gross Loss:	<b>-1 205,49</b>	Balance Drawdown Relative:	<b>5.19% (553.79)</b>	Equity Drawdown Relative:	<b>7.20% (780.47)</b>
Profit Factor:	<b>1,37</b>	Expected Payoff:	<b>45,17</b>	Margin Level:	<b>616.73%</b>
Recovery Factor:	<b>0,58</b>	Sharpe Ratio:	<b>0,17</b>	Z-Score:	<b>1.88 (93.99%)</b>
AHPR:	<b>1.0048 (0.48%)</b>	LR Correlation:	<b>0,48</b>	OnTester result:	<b>0</b>
GHPR:	<b>1.0044 (0.44%)</b>	LR Standard Error:	<b>214,78</b>		
Correlation (Profits, MFE):	<b>0,81</b>	Correlation (Profits, MAE):	<b>0,97</b>	Correlation (MFE, MAE):	<b>0,83</b>
Minimal position holding time:	<b>2:22:15</b>	Maximal position holding time:	<b>43:53:40</b>	Average position holding time:	<b>15:57:39</b>
Total Trades:	<b>10</b>	Short Trades (won %):	<b>0 (0.00%)</b>	Long Trades (won %):	<b>10 (70.00%)</b>
Total Deals:	<b>20</b>	Profit Trades (% of total):	<b>7 (70.00%)</b>	Loss Trades (% of total):	<b>3 (30.00%)</b>
		Largest profit trade:	<b>287,17</b>	Largest loss trade:	<b>-463,56</b>
		Average profit trade:	<b>236,74</b>	Average loss trade:	<b>-401,83</b>
		Maxim um consec	<b>3 (752.28)</b>	Maxim um consec	<b>1 (-463.56)</b>

				tive wins (\$):		utive losses (\$):	
				Maxim al consecutive profit (count):	<b>752.28 (3)</b>	Maxim al consecutive loss (count):	<b>-463.56 (1)</b>
				Averag e consecutive wins:	<b>2</b>	Averag e consecutive losses:	<b>1</b>

Based on the data above we can see there are fluctuations in profits gained and the number of losses. We can see in the GBPs balance graphs, there are massive points gained and those points were more than enough to cover the losses. The profit factor in the GBPs and the rest were greater than one which means with each trades performed the chances of profit is greater than the losses.

It is also observed that the greatest profit factor is in the first GBP pairs test. The profit ratio of 2.59 showed a significant amount of success with trades and a profit that's large enough to cover the expenses.

With the data it is also observed that GBP pairs earned the user greater profits and on average greater profit factor. This observation would give the impression that the greater the volatility of a set of pairs the greater the possibility of earning more profits as proved by data collected in 2018 which averages the GBP pairs as having volatility point of 213,38 whereas AUD pairs only have 93,04 and EUR pairs 114.

The greater profit factors also correspond to the volatility as it is observed the GBP profit factor surpassed both EUR and AUD whereas EUR and AUD are mostly similar.

The higher profit which corresponds to the greater volatility could be explained as one of the factors which would increase the chance of trend directional change. The Expert Advisor, which relied on the directional change of a group of currency and then searching for a currency which is late to follow the trend, benefited greatly from volatility as the rapid speed of directional change would increase the chance of pairs within the group to be late.

## V. CONCLUSION

The expert advisor relied on the volatility of the currency pairs being observed. The strategy which relied on the swift changing of a major currency pair's trend benefited greatly from the quick directional shift of volatile pairs. Even if the strategy used for the present EA is simple crossing over moving averages, the EA still proved capable of producing greater than 1 profit factors and even greater than 2. A recommendation would be to utilize a better more advanced system but still incorporate the currency's other siblings to form a more accurate decision tree.

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#### PERNYATAAN

Dengan ini saya menyatakan bahwa makalah yang saya tulis ini adalah tulisan saya sendiri, bukan saduran, atau terjemahan dari makalah orang lain, dan bukan plagiasi.

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Nama dan NIM  
Muhammad Al Terra  
13517145