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Research paper



Major FX Forecasting with Hybrid Moving Average Approach

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Abstract

Foreign Exchange (FX) is a conversion from one currency to another one and it can be seen as a discrete time series data. FX market has become one of the largest markets with more than trillions of dollars are traded every day. Therefore, the needs to capture FX transaction data pattern from historical data and used them to forecast future values have become a major issue. In this study, we tried to forecast the future values of FX transaction data using a relatively new moving average (MA) method, called as Weighted Exponential Moving Average (WEMA). Seven major currency pairs were being considered to be forecasted. Mean Square Error (MSE) and Mean Absolute Percentage Error (MAPE) criteria were used to measure the accuracy level of the applied method. From experimental results on Phatsa framework, we found that WEMA can be used to predict future values of all major currency pairs used in this study.

Keywords: *forecasting error; foreign exchange; major currency pairs; Phatsa; Weighted Exponential Moving Average.*

1. Introduction

Foreign Exchange, commonly shorted as Forex or FX, is a conversion from one currency to another [1], and it has taken part as a crucial factor in global economics. FX market is considered as one of the largest and the most liquid market in the world with more than trillions of dollars are traded everyday [2]. There are seven currency pairs which are called 'majors' since they are the most liquid and widely traded pairs in the FX world [3].

FX transactions can be seen as a time series data, i.e. a chronological or time oriented sequence of observations of a variable of interest [4]. More specifically, FX transactions are discrete time series data, where its observations are done at fixed rate interval [5].

There are many time series forecasting techniques have been developed by researchers around the world. Some conventional methods have been introduced, as we can see in the works of Wang [6], Klinker [7], and Papailias and Thomakos [8]. Other than the conventional approaches, soft computing methods such as fuzzy method, genetic algorithm, or even hybrids are also developed and applied in time series analysis [9-15].

In 2013, a new moving average (MA) technique has been introduced. The technique is called Weighted Exponential Moving Average (WEMA) [16], which combined the weight calculation found in Weighted Moving Average (WMA) with the common procedure of Exponential Moving Average (EMA). Its robustness and recognition can be seen from several derivative works, such as Chen et al. [17] who has implemented and modified the WEMA for differential physical layer secret key generation to improve security in wireless system, and Hansun [18] who has implemented the proposed method to forecast future data of IHSG (Jakarta Stock Exchange Composite Index).

With the increasing number of FX transactions, the needs of ability to predict and capture FX transaction pattern become a major issue. In this study, WEMA method will be used to predict the future value of FX transaction data. Mean Square Error (MSE) and Mean Absolute Percentage Error (MAPE) will be used to measure the error rate of the applied method in forecasting FX transaction data.

2. Research Method

In this section, we briefly explain the materials being observed in this study, i.e. major FX data transactions. Later, Weighted Exponential Moving Average (WEMA) method as hybrid MA method implemented in this study will also be explained together with two mostly used forecast error criteria, i.e. the MSE and the MAPE.

2.1. Major FX Data

As had been explained in Introduction section, there are seven 'major' currency pairs as shown in Table 1. All those data will be used in this study. Moreover Figure 1 shows the FX transaction graph for pound dollar pair.

Table 1: Majors FX Currency Pairs [3]

Pairs	Countries	FX Geek Speak
EUR/USD	"Eurozone/ United States"	"euro dollar"
USD/JPY	"United States/ Japan"	"dollar yen"
GBP/USD	"United Kingdom/ United States"	"pound dollar"
USD/CHF	"United States/ Switzerland"	"dollar swissy"
USD/CAD	"United States/ Canada"	"dollar loonie"
AUD/USD	"Australia/ United States"	"aussie dollar"
NZD/USD	"New Zealand/ United States"	"kiwi dollar"

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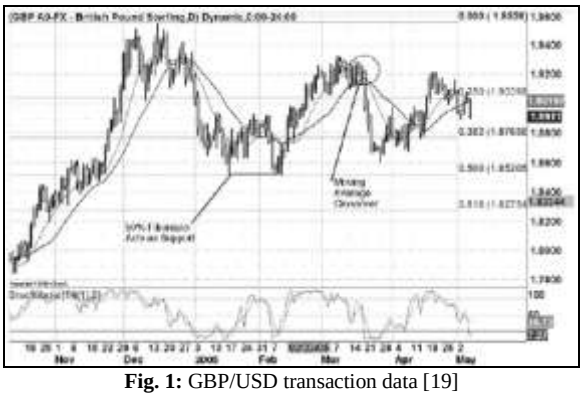

Fig. 1: GBP/USD transaction data [19]

2.2. Weighted Exponential Moving Average

WEMA is a variant of moving average method that combines the weighting factor calculation found in Weighted Moving Average (WMA) with Exponential Moving Average (EMA). This method consists of two phases. First, we need to find a new base dataset from the given time series data using WMA method, which then will be used in the second phase as dataset in EMA procedure. As explained in [16, 18], WEMA procedure is as follows.

1. First, we need to calculate the base dataset, H_t, using Eq.(1) for a given time series data

$$H_t = \frac{nP_t + (n-1)P_{t-1} + \cdots + 2P_{(t-n+2)} + P_{(t-n+1)}}{n + (n-1) + \cdots + 2 + 1} \quad (1)$$

2. Then using the dataset we get, we calculate the prediction value using Eq.(2)

$$WEMA_t = \alpha \cdot Y_t + (1 - \alpha) \cdot H_t \quad (2)$$

where Y_t is the real datum value at time t, H_t refers to the base value at time t, and α is the degree of weighting factor decrement [20] as formulated in Eq.(3)

$$\alpha = 2/(n+1) \quad (3)$$

However, rather than using the constant α value, we used brute force approach to get the best α value which minimizes the error rate.

3. Return to No. 1 until all the data point in a given period has been cycled.

2.3. Mean Square Error

MSE is a very popular and common technique used to measure forecast error level in time series analysis. MSE value represents the average square error sum of a forecasting method and can be formulated as [21],

$$MSE = \frac{\sum_{t=1}^{n} e_t^2}{n} \quad (4)$$

where n represents the number of data, e_t is the prediction error value that obtained from $X_t - \hat{X}_t$. In this case, X_t is the actual datum and $\hat{X}_t$ is the predicted value.

2.4. Mean Absolute Percentage Error

MAPE is another error measurement tool for forecasting that commonly used in researches. It shows the average absolute error value compare to the real value in a percentage form. As explained by Lawrence et al. [21], MAPE can be found as depicted in Eq.(5)

$$MAPE = \frac{\sum_{t=1}^{n} \left| \frac{e_t}{X_t} \right|}{n} \times 100 \quad (5)$$

where n represents the number of data and e_t is the prediction error value that was obtained from $X_t - \hat{X}_t$ as explained before.

3. Results and Analysis

In this study, we tried to predict future value of FX data transactions. There are seven major currency pairs in consideration, i.e. EUR/USD, USD/JPY, GBP/USD, USD/CHF, USD/CAD, AUD/USD, and NZD/USD. The closing values of all those currency pairs were recorded daily from January 2, 2017 to January 1, 2018 and collected from Forex Forum [22].

A web based application called Phatsa is also used in this study to do the calculation and graph the forecasting results of each currency pairs. Phatsa is a free to use web application with the main purpose to help researchers and practitioners forecasting future values of any time series data [23] and can be accessed on http://phatsa.com [24]. Interested readers are encouraged to read Ref.[25] to get more information on Phatsa.



Fig. 2: Forecasting results for EUR/USD



Fig. 3: Forecasting results for USD/JPY



Fig. 4: Forecasting results for GBP/USD



Fig. 5: Forecasting results for USD/CHF



Fig. 6: Forecasting results for USD/CAD



Fig. 7: Forecasting results for AUD/USD



Fig. 8: Forecasting results for NZD/USD

Figure 2 to Figure 8 show the forecasting results' graphs for the seven major currency pairs. Intuitively, we can see that WEMA successfully predicts the future values of each currency pair. Moreover in Table 2, we can see the forecasting error results for each currency pair using MSE and MAPE criteria as described in Section 2. From the table, we know that WEMA method can be used to forecast FX transaction data with small MSE and MAPE values, which in returns implicates that it has a good accuracy level.

Table 2: MSE and MAPE of FX Currency Pairs

Currency Pair	Mean Square Error	Mean Absolute Percentage Error
EUR/USD	2.46821E-05	0.33601
USD/JPY	0.30605418	0.38347
GBP/USD	4.64541E-05	0.39
USD/CHF	1.76741E-05	0.3218
USD/CAD	3.17685E-05	0.32726
AUD/USD	1.23194E-05	0.35171
NZD/USD	1.31196E-05	0.40291

4. Conclusion

Seven major currency pairs of FX transaction data have been successfully predicted using WEMA method. From the experimental results, USD/CHF has the smallest MAPE values (blue highlighted colour in Table 2); therefore the applied method is best to be implemented in USD/CHF currency pair. On the other hand, NZD/USD currency pair is the less suggested to be forecasted compare to all other currency pairs in this study.
Further researches to check other variants of WEMA, such as B-WEMA [26] and H-WEMA [27], on FX forecasting can be done. Comparative study on those three hybrid methods in time series analysis can also be analysed in the near future.

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