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Fuzzy Golden Cross and Fuzzy Death Cross as Stock Market Forecasting Indicator

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Stock market prediction is a very challenging since movement of the stock market is changes with political stability, technology advancement and economic situations. This paper reports on the prediction of the best buying and selling price of the stock market by using fuzzy golden cross and fuzzy death cross analysis. The fuzzy golden gross and fuzzy death cross are determined through combination of two Exponential Moving Average (EMA) namely EMA 12 and EMA 26. EMA 12 represents a shorter moving average and EMA 26 represents a longer moving average. Fuzzy algorithm is then developed and applied in order to identify the optimum price of the stock market, EMA (n). The price of fuzzy golden cross and fuzzy death cross is identified and compared. The results obtained in this study offer a realistic decision to determine the best buying and selling price of a stock market.

Keywords: share market forecasting; fuzzy model; shariah compliant

I. INTRODUCTION

Stock market prediction is the main area of interest to stock financial specialists, stock dealers and applied researchers to decide the force of the market. The force of the market helps in predicting the future market developments to make powerful purchase and selling decisions. However, the movement of stocks in the stock market is not always consistent (Balsara et al., 1996; Roy et al., 2015). Frequent changes in political stability, technology advancement and economic cycle will consistently impact the performance of asset's return in stock market (Eng et al., 2017). On top of that, economic growth is one of important issue to a country. Good economic growth reflects a good economic situation. In return, investors will be attracted to invest in the country. In stock trading, investors are advised to have capability to identify the movement of stock and market conditions in order to acquire highest profit and lowest losses. If investors are not equipped in such capability then they will endure losses due to their unawareness concerning the change of stocks (Fauziah et al., 2007). The golden cross and death cross are known as valuable method to predict market trends. The subsequent two patterns, depicted by the moving average lines, are measured as buy and sell signals. When a shorter moving average line crosses over a longer one, from below, while both lines are rising, it is a buying signal called golden cross (Ahmar et al., 2017). A death cross happens when the short term moving average drops below the long-term moving average which indicates that a selling trend is under way. Fuzzy logic has been effectively combined into numerous applications, in particularly in (Ismail et al., 2005; Ismail et al., 2013) which focused on modeling of economic problems and dealing with unpredictability of the stock return. However, there is no research has been done in integrating the fuzzy modeling and golden cross and death cross method. Therefore, this paper initiated to integrate the golden cross and death cross method with fuzzy approach. The optimized fuzzy golden cross and fuzzy death cross will reduce the risk of loss and maximize the profit in stock market investment.

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II. MATERIALS AND METHODS

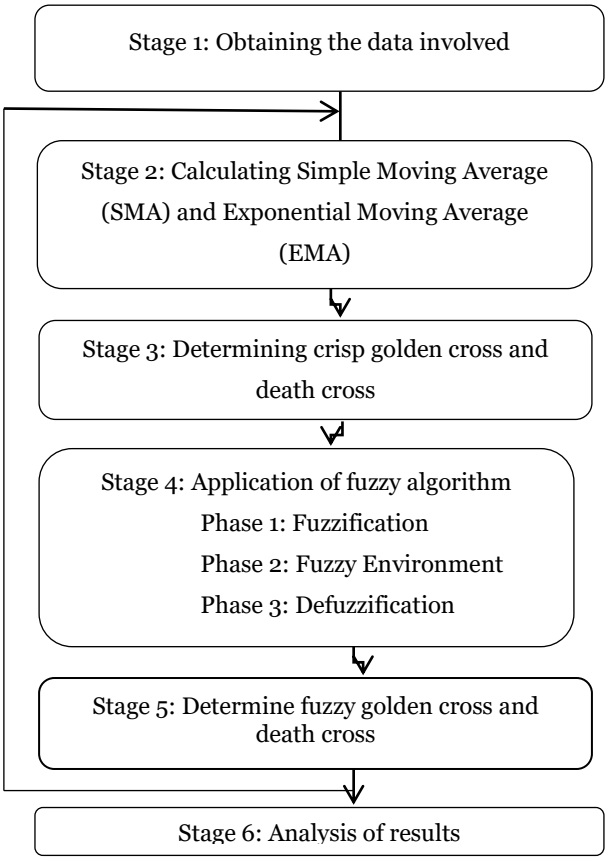

Figure 1. Research Methodology

The research methodology involved five stages as shown in Figure 1. Each stage is explained briefly as follows:

Stage 1 Obtaining the data involved

My E.G Services Berhad (MyEG) principally is engaged in the business of development and implementation of Electronic Government. MyEG provides the electronic link that allows smooth trades between government and citizens or businesses. The data used in this study isa daily price of My EG stock market extracted from 8th August,2017 until 7th December 2017viahttp://www.bursamalaysia.com.

Stage 2: Calculating SMA and EMA

Based on the data, Simple Moving Average (SMA) and Exponential Moving Average (EMA) value was calculated. The initial value of EMA is identified by the value of SMA. The SMA value is calculated by using the average of the closing prices of n^{th} day using formula below

$$SMA(n) = \frac{(P_n + P_{n-1} + P_{n-2} + \ldots + P_1)}{n}$$

$$EMA(n) = \alpha.P_n + (1-\alpha)EMA(n-1)$$

$$\alpha = \frac{2}{(n+1)}$$

where the α value in the EMA(n) formula is known as the smoothing factor. The α value for EMA(n) can be obtained by substituting the value of n which represent the number of day time periods of the closing prices. The P_n is denoted as closing price of day n and EMA(n-1) denoted as previous EMA of day n.

In this study, two EMAs have been chosen to identify the existence of the golden cross and death cross. The two EMAs are EMA 12 and EMA 26. This is common combination used in market analysis to yield buy and sell signals (Klinker, 2011).

Stage 3: Determining crisp golden cross and death cross

In this stage, the value EMA 12 (short term moving average line) and EMA 26 (long term moving average line) are plotted to determine the crisp golden cross and the death cross. The intersections between EMA 12 and EMA 26 are then observed. Here, the golden cross represents the suitable buying price while the death cross represents the suitable selling price of the stock market.

Stage 4 Application of fuzzy Algorithm

At this stage, fuzzy golden cross and fuzzy death cross are determined by using fuzzy algorithm. There are three phases involved in the algorithm namely fuzzification, fuzzy environment and defuzzification. In the first phase, the crisp values of the stock market are converted to fuzzy values based on the following definition:

Definition: Fuzzy Linear Equation (FLE) [10]

$$S_{FL} : \tilde{y} = A\tilde{u}(t)$$

where t represent time, $\tilde{u}$ denotes fuzzified input vector, $\tilde{y}$ denotes the fuzzified output vector and A_{1xn} is the input matrix.

Each input prices are represented as an triangular fuzzy number (a_1, a_2, a_3) and the domain of the desired values for output price is then determined. Then fuzzy induced performance price, F_{ind} and fuzzy preferred performance price, F_{SFL} with respect to each particular alpha cut are processed during the fuzzification phase

using MATHLAB. The alpha cut range must be in between 0 to 1. The values of alpha cuts are used to calculate F_{ind} and F_{SFL}. Next, in the fuzzy environment phase, the graph of F_{ind} and F_{SFL} are plotted. The intersection point of the graphs is then identified and represented as fuzzy value F^*. Finally, the fuzzy value F^* is converted to crisp value in the defuzzification phase in order to calculate the best possible combination of the closing price of the stock market. The steps in the defuzzification phase are carried out by using back substitution and the combination of the endpoint's intervals of the stock market prices are then created. Selection of the optimal combination for the stock market prices is then determined by using Modified Optimization Defuzzifies Value Theorem [9]. Stage 2 until Stage5 is repeated to determine the optimized value of the stock market price for each day.

III. RESULTS AND DISCUSSIONS

This section discussed the result of applying fuzzy algorithm onto the price of stock market extracted from MyEg from 8th August,2017 until 7th December 2017.

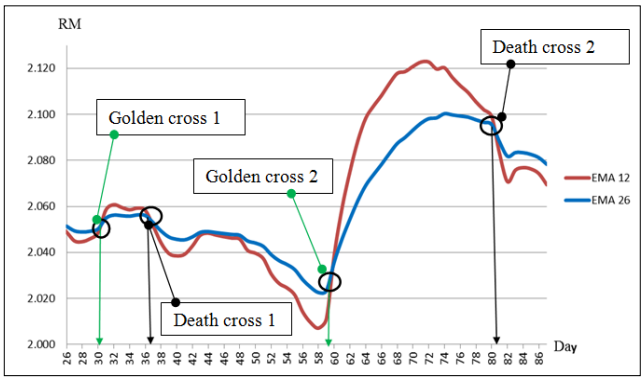

Figure 2. The graph of crisp EMA from day 26 to day 87

Graph of the stock market prices using EMA 12 and EMA26 from day 26 to day 87 is as shown below. The red colour in the graph represented the value for EMA 12 while the blue colour denoted the value for EMA 26. In the Figure 2, two intersection point representing golden cross is detected at point RM 2.0513 and RM 2.0334 at day 30 dated 14/09/2017 and day 59 dated 27/10/2017 respectively. Meanwhile, the death crosses are detected at two point of intersection at day 36 dated 25/09/2017 and day 80 dated 25/11/2017 at price RM 2.054 and RM 2.093 respectively.

Next, Figure 3 depicted graphs of defuzzified EMA12 and EMA26 from day 26 until day 87.

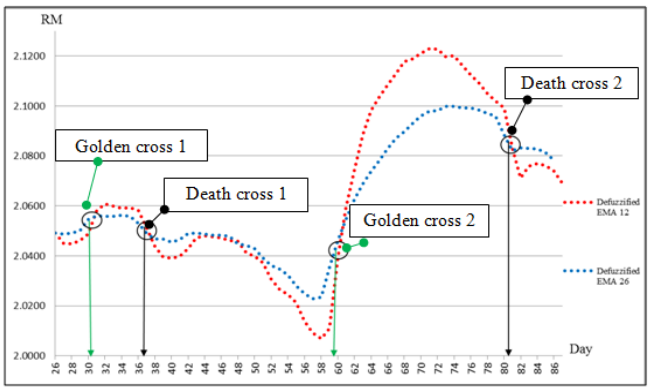

Figure 3. The graph of defuzzified EMA from day 26 to day 87

The red colour in the graph represents defuzzified value for EMA 12 while the blue colour denotes the defuzzified value for EMA 26. Meanwhile, the black colour of arrow in the graph indicates the fuzzy death cross and the green colour of arrow denoted as the fuzzy golden cross. Buying signal or the golden cross are identified at RM 2.0512 and RM 2.033 at day 30 dated 14/09/2017 and day 59 dated 27/10/207 respectively. Two selling signals or the death cross are detected at RM 2.0543 and RM 2.0932 at day 36 dated 25/09/2017 and day 80 dated 27/11/2017 respectively. The values are then summarized in Table 1.

Table 1. The golden gross and death cross signal values

	Crisp golden cross		Fuzzy golden cross	
	Day	RM		RM
Golden cross 1	30	2.0513		2.0512
Death cross 1	36	2.054		2.0543
Golden cross 2	59	2.0334		2.033
Death cross 2	80	2.093		2.0932

From Table 1, overall the fuzzy method gives a slightly better result. On day 30, the golden cross for both crisp EMA and fuzzy EMA occurred at different value. Crisp golden cross indicate the investor to buy the stock at price of RM 2.0513 while fuzzy golden cross indicate the investor to buy the stock at value of RM 2.0512. The buying value of fuzzy golden cross method is cheaper by RM 0.0001 less than the buying value of crisp golden cross method. Based on this result, the fuzzy method gives a better decision to buy the stock market with cheaper price.

Next, the death cross occurred at the same day which is at day 36. The crisp death cross indicates the investor to sell the stock market at RM 2.0540 while the fuzzy death

cross indicates the investor to sell the stock market at price of RM 2.0543. The fuzzy method gives higher price compare to the crisp method. As a result, the investor gained more profit when selling the stock market at the price recommended by fuzzy method. Subsequently, the golden cross 2 occurred at the same day in different price. The fuzzy golden cross provides better decision for buying the stock market. Hence, the investor gained more profit if buying the stock at RM 2.033 instead of buying at RM 2.0334.

Finally, at day 80 the prices start to fall which lead to death cross. The death cross occurred at value of RM 2.093 for crisp method and RM 2.0932 for fuzzy method. Therefore, it is advisable to sell the stock at day 80with fuzzy method suggested price in order to minimize the losses. In addition, the closing price on day 80 is RM 2.083 and the stock is predicted to be decreased at a certain period.

IV. SUMMARY

The prices suggested by fuzzy golden cross and fuzzy death cross method are better decisions which help in obtaining the maximum profit and the minimize losses compared to prices suggested by crisp method and actual closing price. This approach is very vital in order to reduce the risk of loss and maximize the profit in stock market investment.

V. ACKNOWLEDGEMENT

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VI. REFERENCES

Ahmar, A. S. (2017). Sutte Indicator: an Approach to Predicting the Direction of Stock Market Movement. *Songklanakarin Journal of Science and* Technology (SJST).

Balsara, N., Carlson, K., & Rao, N. V. (1996). Unsystematic futures profits with technical trading rules: A case for flexibility. *Journal of Financial and Strategic Decisions, 9*(1), 57-66.

Eng, W. K., Shukor, N. E. S. A., Ismail, N. R., & Halim, S. A. (2017). Golden cross as Buying Indicator for Stock Investment in Bursa Malaysia. *Terengganu International Finance and Economics Journal (TIFEJ), 2*(2), 94-102.

Fauziah, Taib, M., & Isa, M. (2007). Malaysian unit trust aggregate performance. *Managerial Finance, 33*(2), 102-121.

Hairullah, Siti Khadijah, (2018). *Prediction of Golden Cross and Death Cross for Syariah Stock Investment Using Fuzzy Algorithm Approach*. MSc. Universiti Teknologi Mara.

Ismail, R., Ahmad, T., Ahmad, S., & Ahmad, R. S. (2006). Optimal parameter estimation of MISO system based on fuzzy numbers. *Jurnal Teknologi Maklumat dan Sains Kuantitatif, 8(1), 1-10*.

Ismail, R. (2005). *Fuzzy state space modeling for solving inverse problems in multivariable dynamic systems*. Universiti Teknologi Malaysia.

Ismail, R. & Harish, N. (2013). Solving Inverse Problem in Reheater System Modeling Computers & Informatics (ISCI). IEEE Symposium.

Klinker, F. (2011). Exponential moving average versus moving exponential average. Mathematische Semesterberichte, 58(1), 97-107.

Miwa, K., & Ueda, K. (2002). *The Influence of Investor Sentiment on the Formation of Golden-cross and Dead cross*. Paper presented at the AAAI-02 Workshop on Multi-Agent Modeling and Simulation of Economic Systems, Edmonton, Alberta, Canada, July 2002.

Roy, P., Kumar, R., & Sharma, S. (2015). A fuzzy logic model to forecast stock market momentum. Int. J. Adv. Engg. Res. Studies/IV/II/Jan.-March, 98, 101.