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Forecasting Of Malaysia Gold Price with Exponential Smoothing

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Abstract: Gold is a precious asset has attract the investors to invest. Investors has interest to know the basic knowledge about gold price and the prediction price. Prediction price will help the investors to determine the benchmark of the gold price. However, various method can be predict the price. Therefore, the objective of this study to determine the best model to forecast the Malaysia gold price. This study focus used Exponential Smoothing (ETS) forecasting models which are Single Exponential Smoothing (SES), Double Exponential Smoothing (DES), and Holt-Winters Exponential Smoothing. The best model is used to forecast the gold price in Malaysia for the next 12 months by using data from March 2016 until February 2021.The best model is determined by choosing the lowest Root Mean Squared Error (RMSE) value. The outcome for the lowest RMSE shows that DES is the best model for forecasting the gold price in Malaysia for the next 12 months. The result of the forecasting shows that the gold price will decrease from March 2021 until February 2022, and this could be due to the COVID-19 pandemic in Malaysia. Therefore, it will be a good opportunity for investors to buy gold in this period since the price is decreased and investors can sell it at the highest price in the future.

Keywords: Gold, gold price, forecasting, exponential smoothing, double exponential smoothing

1. Introduction

Forecasting is used for estimation future situations and a process for decision making. It is useful in variety of areas. Forecasting price of gold is useful for investors, analysts, and academicians [1]. Gold is viewed as the most secure the investment in the world [2]. Gold is old plays multiple purposes in the world economy [3]. Gold is also an element used for long term investment [4]. Gold is an asset that has been universally recognized as a store of wealth since ancient times. Gold is very valuable and has gained attention from the investor as an investment during financial stress, as all kinds of assets' prices fluctuate intensively during this period. The gold price is particularly volatile, reacting to fluctuations in global pricing [5]. People who invested in gold, expect to get a low price at the time of purchase and a high selling price [6]. Gold price volatility can be handled by reducing uncertainty. Thus, forecasting or prediction instruments used in the process [7].

Several models can be used to predict gold prices such as Autoregressive Integrated Moving Average (ARIMA) [5,7], Exponential Smoothing Technique (ETS) [6,9] and Artificial Neural Network (ANN) [10,11]. A comparison on estimating Malaysia gold price via Nonlinear Prediction (NLP) method and Box-Jenkins model. The model used for

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forecasting is very important since the result of the model will be different. The best model is selected based on the lowest Root Mean Squared Error (RMSE). The accuracy of prediction will make investors more confident to invest [12]. Based on the technique, it is important to obtain the best result for future value.

This is study interested to determine the best model among SES, DES and Triple or Holt-Winters Exponential Smoothing method to forecast the gold price in Malaysia for the next 12 months period. The Exponential smoothing method gives better gold price forecasting [13]. There are three main types of exponential smoothing time series forecasting methods used, Simple (single) Exponential Smoothing (SES), Double Exponential Smoothing (DES) and Triple or Holt-Winters Exponential Smoothing [14]. The Simple Exponential Smoothing (SES) method is used when the pattern is shown approximately horizontal which the data fluctuating around a constant mean [14,15]. In addition, the SES technique is suitable for time series that randomly move above and below with a constant mean or a stationary series [16]. This model had no trend and no seasonal patterns. Not just that, this method is used only one smoothing constant α which is the weight value associated with historical values varying between 0 and 1 to obtain exponential smoothing time series [14]. Expanded single exponential smoothing to linear exponential to allow data with trends to be predicted [17]. In other words, DES is used when the data pattern shows a trend while the trend pattern is shown by historical data [14]. DES method was used to forecast bitcoin. This method can be used to support decision making in trading bitcoin [18]. In Thailand, forecast lime prices for one year in 2016 using DES technique and it gives significantly smallest error measured by MAPE [15]. An extension of exponential smoothing built for trendy and seasonal time series is Triple Exponential Smoothing or the other name called Holt-Winters Exponential Smoothing [16]. This method is also a commonly used method that provides seasonality, shifting trends and seasonal correlation for forecasting business data. In other words, Holt-Winters Exponential Smoothing is used when data pattern shows trend and seasonality [14]. The advantage of this method is that it can be used in forecasting stationary data types or not stationary [20]. The Holt-Winters Smoothing method depends on the parameters or smoothing constants α, β and γ to handle levels, trend and seasonality respectively [14,20].

2. Materials and Methodology

2.1 Data

This study used Gold Monthly Price Malaysia Ringgit per Troy ounce were obtained from the IndexMundi source by World Bank. The data is monthly data from March 2016 to February 2021 and have 60 observations. From the data obtained, the data contains months and prices. The variable of months starts from March 2016 until February 2021 while the variable of prices is in Ringgit Malaysia.

2.2 Exponential Smoothing

The smoothing constant for SES is alpha (α) while DES is alpha (α) and beta (β) and for Holt-Winters Exponential Smoothing is alpha (α), beta (β) and gamma (γ). Optimal smoothing constants are very important since it can minimize the error function. Exponential smoothing constants determine the accuracy of these approaches' predictions.

The method used for this study is the Exponential Smoothing (ETS) technique. There are three types of exponential smoothing models in this study which are the Single Exponential Smoothing (SES), Double Exponential Smoothing (DES) and Holt-Winters Exponential Smoothing model. The best model is selected from the lowest RMSE between the models.

The process of fitting the SES model begins with selecting the initial point. The process of selecting the initial point can be explained in Equation (1):

$$F_{t+m} = \alpha y_t + (1-\alpha)F_t \quad (1)$$

F_{t+m}: is the single exponentially smoothed value in period t + m, for m=1, 2,...,m
y_t: is the actual value in the period t
α: is the unknown smoothing constant
F_t: is the forecast or smoothed value for period t

Equation (2) shows a one-step forecast made at time t (with m=1). Y_t is the most recent observation. Now equate t=1,

$$F_{t+1} = \alpha y_t + (1-\alpha)F_0 \quad (2)$$

Taking a step back, by letting t=0, it will result in the following equation (3):

$$F_1 = \alpha y_0 + (1-\alpha)F_0 \tag{3}$$

In the above equation, values of y_0 and F_0 are required to generate the value of F_1 which is not possible to obtain since there are no such values. Since they are not available, the first value is chosen as the initial value.

DES method smooths the trend and the slope directly by using different smoothing constants but also provides more flexibility in selecting the rates at which the trend and slopes are tracked. Equation (4) shows the exponentially smoothed series. The equation is similar to the equation of the SES, except for the addition of the trend term, T_{t-1}. The trend estimate is calculated by taking the difference between two successive exponential smoothed values (S_t-S_{t-1}).

$$S_t = \alpha y_t + (1-\alpha)(S_{t-1} + T_{t-1}) \tag{4}$$

Equation (5) shows the trend estimate. In this equation, the estimate for the trend (S_t-S_{t-1}) is multiplied by the smoothing constant, β. This value is then being incorporated into the previous estimate of the trend that has been adjusted by the factor (1-β). As the smoothing is performed for the trend rather than for the actual data, without any randomness, this results in a smoothed trend.

$$T_t = \beta(S_t - S_{t-1}) + (1-\beta)T_{t-1} \tag{5}$$

Equation (6) shows the forecasts m period into the future. It provided the forecast for the m-step-ahead into the future. The trend estimate is multiplied by the number of periods to be forecasted, m, and the result is then added to the current level of the data smoothed S_t to estimate randomness.

$$F_{t+m} = S_t + T_t \times m \tag{6}$$

The alpha and beta are the parameters to be determined with values ranging from 0 to 1.

Holt-Winter's methodology consists of three basic equations that define the level of component (Equation (7), the trend component (Equation (8), and the seasonality component (Equation (9).

Level component:

$$L_t = \alpha \frac{y_t}{S_{t-s}} + (1-\alpha)(L_{t-1} + b_{t-1}) \tag{7}$$

Trend component:

$$b_t = \beta(L_t - L_{t-1}) + (1-\beta)b_{t-1} \tag{8}$$

Seasonality component:

$$S_t = \gamma \frac{y_t}{L_t} + (1-\gamma)S_{t-s} \tag{9}$$

The m-step-ahead forecasts is calculated as equation (10).

$$F_{t+m} = (L_t + b_t \times m) S_{t-s+m} \tag{10}$$

where

y_t: is the actual values which include seasonality.

L_t: is the level component of the series, comprising of the smoothed values but does not include the seasonality component.

b_t: is the estimate of the trend component.

S_t: is the estimate of the seasonality component

S: is the length of seasonality

α: is the smoothing constant for level (0<<1)

β: is the smoothing constant for the trend estimate (0<<1)

γ: is the smoothing constant for seasonality estimate (0<<1)

m: is the number of step-ahead to be forecast

F_{t+m}: is the forecast for m-step-ahead

2.3 Performance Evaluation

The performance evaluation is based on the error measure of out of sample data. The error measure used to choose the best model between SES, DES, and Holt-Winters Exponential Smoothing is Root Mean Squared Error (RMSE). The commonly used forecast error measurements are used to estimate the accuracy of forecasting methods and to choose the best forecasting mechanism or model. The best model of forecasting between the three models that used in this study to forecast the gold price in Malaysia can be determined by referring to the lowest error measure from the out of sample data. The main purpose is to generate a set of fitted values associated with each value of α and to compare the value against the actual values. Therefore, the value of α with a minimum value of errors is important to forecast the gold price. The general formula for RMSE is given as Equation (11),

$$RMSE = \sqrt{\frac{\sum_t^n e_t^2}{n}} \tag{11}$$

where

$e_t = y_t - \hat{y}_t$

y_t the actual observed value in time

$\hat{y}_t$ the fitted value in time

n the number of forecast error terms

3.0 Results and Discussion

This study was conducted by using secondary data of gold monthly price malaysia ringgit per troy ounce from March 2016 to February 2021 that have a total of sixty (60) monthly observations.

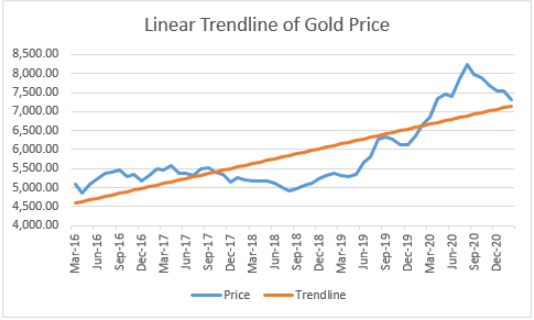

Fig. 1 - Trend analysis plot of malaysia's monthly gold price

Figure 1 shows the trend analysis plot of Malaysia's Monthly Gold Price per Troy ounce. Figure 1 shows an increasing trend but there was a sudden decrease in September 2017 and an increase again in September 2018 until September 2020 and then a decrease until the last observation which is February 2021.

Table 1 - Optimal smoothing constants of exponential smoothing

Model	Smoothing Constants			RMSE
	α	β	γ	
Single Exponential Smoothing	1.0000	-	-	177.5712
Double Exponential Smoothing	1.0000	0.1496	-	174.5417
Holt-Winters Exponential Smoothing	0.8150	0.0228	1.0000	241.7728

Table 1 shows the optimal value of smoothing constants for each exponential smoothing model. The optimal smoothing constants for the models by checking the lowest error measure. Based on Table 1, the optimal smoothing constant for the SES model is α=1.0000 means that this model is random walk. Therefore, DES model were selected as the best model because RMSE for DES is the lowest value.

Table 2 - Error measure of exponential smoothing for in-sample

Model	Error Measure
Single Exponential Smoothing	145.3776
Double Exponential Smoothing	142.6367
Holt-Winters Exponential Smoothing	157.1706

Table 2 shows the value of RMSE in the SES, DES, and Holt-Winter Exponential Smoothing model for the in-sample period. The model with the lowest error measure for in-sample between the three models in Table 2 is the DES model.

Table 3 - Error measure of exponential smoothing for out-sample

Model	Error Measure
Single Exponential Smoothing	177.5712
Double Exponential Smoothing	174.5417
Holt-Winters Exponential Smoothing	241.7728

Table 3 shows the value of RMSE in the SES, DES, and Holt-Winter Exponential Smoothing model for the out-sample period. The data used for the out-sample is from March 2020 until February 2021. Based on the information in Table 3, the error measure in the DES model for RMSE is 781.1679, lower than the SES model and Holt-Winters Exponential Smoothing model. Therefore, the DES model for the out-sample or validation set is the best model.

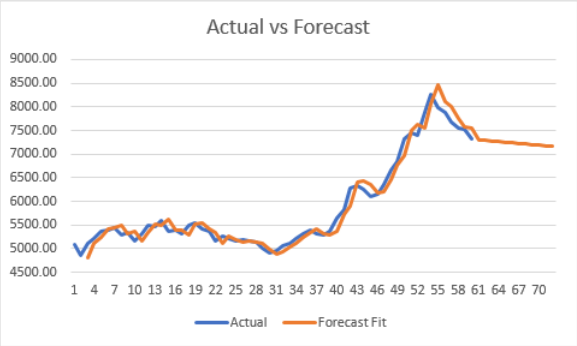

Fig. 2 - Forecasting of Gold Price in Malaysia

After analyzing and fitting Malaysia's gold price, the Double Exponential Smoothing (DES) model is the model for forecasting the gold monthly price in Malaysia for the next 12 months. In other words, the model can be used to know what will happen to the gold price from March 2021 until February 2022 either increase or decrease. Figure 2 shows the graph forecasting of gold price in Malaysia which is the actual data versus the forecast data. It shows that the gold price in Malaysia per troy ounce for the next 12 months from March 2021 until February 2022 will be decreased.

Table 4 - Forecasting gold monthly price from March 2021 until February 2022

Month	Gold Price Forecasting
Mar-21	7303.69
April -21	7291.53
May-21	7279.36
Jun-21	7267.2
Jul-21	7255.03
Aug-21	7242.87
Sep-21	7230.7
Oct-21	7218.53
Nov-21	7206.37
Dec-21	7194.2
Jan-22	7182.04
Feb-22	7169.87

4.0 Conclusion

Forecasting is a useful process to decide for the future. The forecasting of the gold price is needed to predict the price of gold for the next months or years. Gold is one of the metals that are now in high demand around the world that nowadays people will buy and invest in. Since the price of gold can change anytime, the investors want to predict the price of gold at the lowest price and sell it at the highest price. The problem is that many models can be used to forecast the gold price. It is good to select the best forecasting model to get more accurate result. Then, this study is focusing on forecasting the gold price in Malaysia by using the Exponential Smoothing (ETS) technique.

The model used for this study is the ETS model that is divided into three types of models which is Single Exponential Smoothing (SES), Double Exponential Smoothing (DES), and Holt-Winters Exponential Smoothing model. The objective of this study is to determine the best model to forecast the gold price in Malaysia. The best model used is very important especially for forecasting since different models will provide different outcomes. Accurate gold price forecasting can aid not only price discovery, but also investors and international institutional managers in making better equities investment decisions. The accuracy of the forecast can be measured by considering how well a model performs on a new data set that was not used when fitting the model. The best EST model is determined by choosing the lowest error measure of Root Mean Squared Error (RMSE) between SES, DES, and Holt-Winters Exponential Smoothing model in this study. The result shows that the DES model is the best model for forecasting the gold price in Malaysia because of the lowest RMSE between the three models.

Since the best model is the DES model, the model was used to forecast the gold price in Malaysia for the next 12 months by using the secondary data from the IndexMundi source by World Bank. The result of forecasting using the DES model shows the gold price in Malaysia will be decreased for the next 12 months from March 2021 until February 2022. This will be a good opportunity for investors to buy gold in this period since the price is decreased and investors can sell it at the highest price in the future.

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