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The Price of Research Octane Number 97 (RON97) in Malaysia: A Univariate Time Series Approach

Nurul Syakinah Binti Mohd Zaki¹, Noreha Mohamed Yusof^{1,*}

¹Fakulti Sains Komputer dan Matematik, Universiti Teknologi MARA, Cawangan Negeri Sembilan, Kampus Seremban, 70300, Seremban, Negeri Sembilan, Malaysia.

*noreh144@uitm.edu.my

Abstract

Modelling RON97 fuel prices can be challenging as it sometimes can be particularly difficult to select a suitable method to achieve accurate predictions. Different countries exhibit varying patterns of petrol (gasoline) usage, adding complexity to the forecasting process. The study emphasized the importance of selecting models that balance accuracy with simplicity while addressing data characteristics like trends. This research explored the effectiveness of various time series methods in predicting RON97 fuel prices by using Double Exponential Smoothing (DES) and Holt's Method. This paper tried to identify the most accurate and practical model for forecasting. Data that was being used was monthly data of RON97 price from January 2020 until January 2024. The error measurements which were Mean Squared Error (MSE) and Mean Absolute Percentage Error (MAPE) showed that the lowest value in deciding the best method within the two methods was Holt's method. Thus, with an MSE value of 0.0002977 and MAPE value of 0.1653 which was the smallest value. The result is significant for government of Malaysia and also to all Malaysian for energy security.

Keywords: RON97, univariate models, double exponential smoothing, holts' method

Introduction

The study of gasoline prices has long been a focal point for both theoretical and applied economists for numerous reasons [1]. The pricing dynamics of fuel exhibit considerable heterogeneity, both temporally and spatially, as observed across different geographical regions and over time [2]. This heterogeneity fosters a localized competition within the gasoline sector, where gas stations primarily regard nearby counterparts as their main competitors [3].

In Malaysia, there are three types of gasoline which are Diesel, RON95 and RON97. The findings indicated that the RON95 is the cheapest and economic compared to RON97 [4]. All three have a different type fuel. As for the RON97 industrial fuel is a bit different as this fuel has being widely used in automotive and industrial applications. The price of RON97 fuel, is a premium-grade gasoline that widely use. Even though it can be a bit different, this fuel is a critical determinant in economic activity, transportation cost and consumer spending patterns.

Ringgit Malaysia fluctuations more or less give impact to the fuel price particularly for non-subsidized fuels such as RON97, because its cost is directly connected to global crude oil prices, which are traded in US dollars. When the ringgit falls against the dollar, the cost of importing or acquiring crude oil and processed products rises, resulting in higher domestic fuel costs [5]. Given that global crude oil is primarily traded in US dollars, fluctuations in the Ringgit



Malaysia (MYR) against the USD can significantly impact the cost of imported crude oil for Malaysia. For non-subsidized fuels like RON97, which are directly linked to global crude prices, these exchange rate variations are likely to influence domestic RON97 prices. Conversely, if the Ringgit strengthens, it can help to stabilize or even cut fuel prices, making it less expensive to import these goods. This link demonstrates the sensitivity of fuel costs to currency exchange rates and other economic factors that influence the Ringgit's value.

Additionally, this study will facilitate people of learning new knowledge. This research surely increased people knowledge in gasoline and fuel terms. Through the research of past, findings and others, there is a lot of knowledge that can be obtained and use in daily life. Lastly, this study will facilitate the researcher on the scientific knowledge and opportunities for innovation in investigating RON97. Researcher also find a scientific contribution in understanding a new theory in the industry. This study addresses the need to determine the best forecasting model for monthly fuel price RON97 between Double Exponential Smoothing (DES) and Holt's Method model.

Methodology

Data Source

This study utilized secondary data that was collected from [6] website. Data were used in this research project was the monthly mean concentration price of RON97 in Malaysia starting from 4th January 2020 to 4th January 2024. Data was obtained from the open data portal website.

Double Exponential Smoothing

This method is also known as Brown's Method. It is helpful for series that show signs of a linear trend. Below are the model's equations:

$$S_t = \alpha y_t + (1 - \alpha)S_{t-1} \quad (1)$$

$$S'_t = \alpha S_t + (1 - \alpha)S'_{t-1} \quad (2)$$

$$a_t = 2S_t - S'_t \quad (3)$$

$$b_t = \frac{\alpha}{1 - \alpha} (S_t - S'_t) \quad (4)$$

$$F_{T+m} = a_T + b_T \times m \quad (5)$$

Holt's Method

The use of a single smoothing constant in Brown's method can lead to estimate linear trend values that are susceptible to random variations. Holt's two-parameter method was another commonly used data handling technique to get around this issue. This method was also chosen as it was suitable for use and was commonly used for analysis based on past research. Therefore, this study decides to apply this method to analyze the data.

$$S_t = \alpha y_t + (1 - \alpha)(S_{t-1} + T_{t-1}) \quad (6)$$



$$T_t = \beta(S_t - S_{t-1}) + (1 - \beta)T_{t-1} \tag{7}$$

$$F_{T+m} = S_T + T_T \times m \tag{8}$$

Comparing Holt’s Method and Double Exponential Smoothing

The evaluation of the model’s forecast performance was conducted using Mean Squared Error (MSE) and Mean Absolute Percentage Error (MAPE) values to decide the best model between Holt’s Method and the Double Exponential Smoothing Method. To assess model forecast performance using the one-step-ahead procedure, the equation for MSE was as follows,

$$MSE = \frac{\sum_{t=1}^n e_{t+1}^2}{n} \tag{9}$$

While for the MAPE, the equations was as follows:

$$MAPE = \sum_{t=1}^n \frac{(e_t) / (y_t) \times 100}{n} \tag{10}$$

where n denotes effective data points and |(et)/(yt) = 100| is defined as the absolute percentage error obtained from the fitted values for a certain forecasting method.

Analysis

Preliminary Analysis

The line chart of price of RON97 and trend values has been constructed in Figure 1.

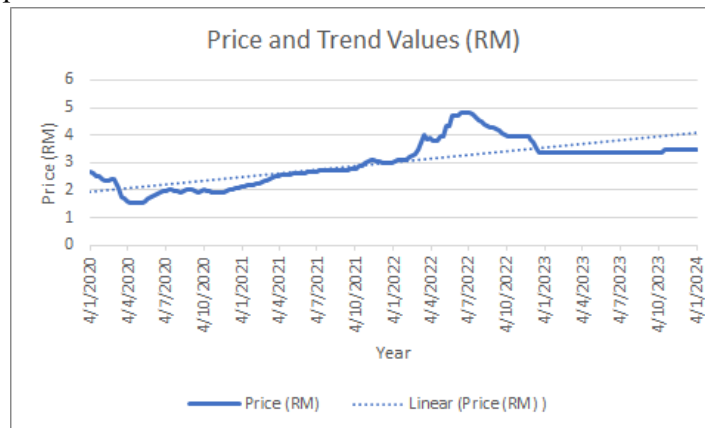


Figure 1: Price and Trend Values of RON97.

Line chart in Figure 1 shows that the trend line suggests a gradual upward trend in prices, indicating a general increase over the observed period. The line chart shows clear trend



component with a gradual upward movement in prices over time, as the line chart have no cyclical, no irregular and no seasonal trend. However, the actual price data shows significant fluctuations, particularly around June 2022 until August 2022, where prices reach a peak before declining sharply.

From late 2022 onward, the price stabilizes at a lower level, showing minimal fluctuations and suggesting that it may have reached a new equilibrium. This stability could indicate a balance in supply and demand or reduced market pressures that previously drove the price up.

Double Exponential Smoothing Method

The trend line plot of fitted value versus actual value of RON97 price described in Figure 2 using Double Exponential Smoothing Method.

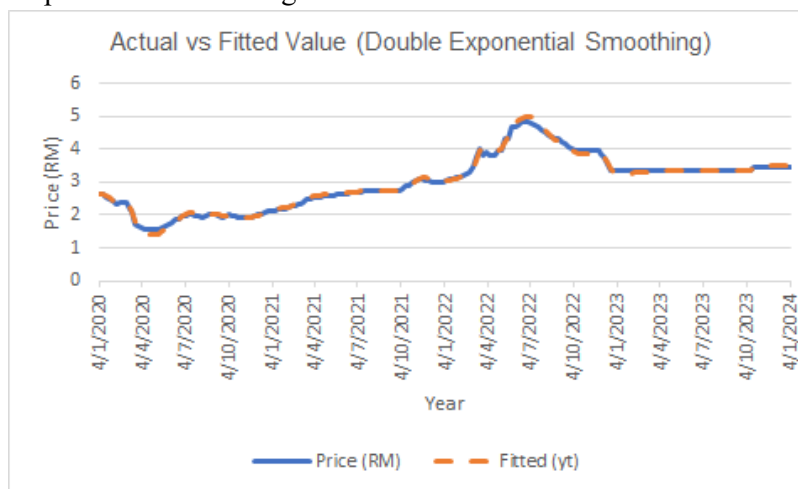


Figure 2: Actual and Fitted of RON97 prices using Double Exponential Smoothing.

The Double Exponential Smoothing (DES) model demonstrates strong accuracy in capturing the historical data of RON97 prices, as seen in the close alignment between the actual data and the fitted values. The model effectively adapts to the significant trends in the data, including the upward price trajectory starting in 2021 and peaking in early 2022, followed by a sharp decline later in 2022. After this decline, the model reflects a stabilization in prices from 2023 onward, which is projected to continue into 2024. The close match between the actual and fitted lines suggests that DES is well-suited for analysing and forecasting time series data with trends but without seasonality.

Holt's Method

The trend line plot of Fitted value versus Actual value using Holts Method of RON97 prices has shown in Figure 3.

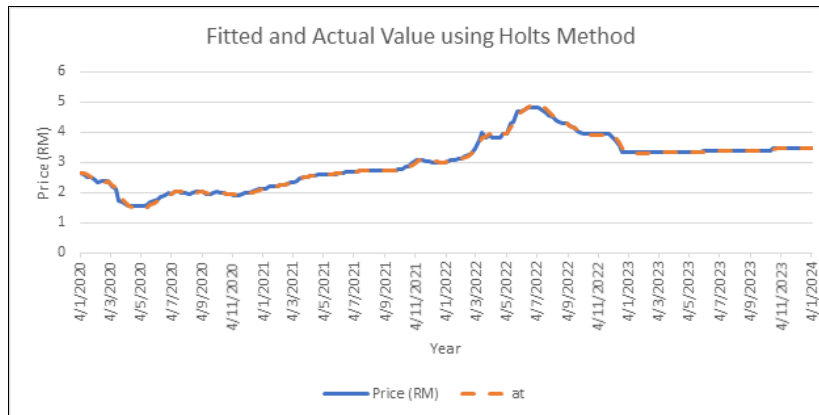


Figure 3: Actual and Fitted of RON97 prices using Holt's Method

The analysis using Holt's method shows a strong alignment between the fitted values and the actual RON97 prices, indicating that the method effectively captures both the level and trend components of the data. The model successfully tracks the upward price trend from 2021 to the peak in early 2022, as well as the subsequent sharp decline later that year. From 2023 onward, the model reflects a period of stabilization in prices, with the forecast extending this stability into 2024.

Comparing Holt's Method and Double Exponential Smoothing

The MSE and MAPE values for both Double Exponential Smoothing (DES) and Holt's Method are different, but all the values are nearly to zero, which is expected as they represent the same forecasting technique which is under the exponential smoothing technique. Using evaluation part (February 2023 until January 2024), to compare between the two methods.

Table 1: Summary of MSE and MAPE value of Double Exponential Smoothing and Holt's method in Evaluation part

Method	MSE	MAPE
Double Exponential Smoothing	0.0007076	0.4935
Holt's Method	0.0002977	0.1653

To conclude the summary of the table shows that for the value of Mean Square Error (MSE), Holt's method has the smallest value compared to the Double Exponential Smoothing method value. Holt's method also has the smallest value for MAPE compared to the Double Exponential Smoothing method. In conclusion, Holt's method has been chosen as the best method as it has the smallest value for MSE and MAPE compared to the Double Exponential Smoothing Method.

Conclusion

It was crucial to comprehend the price of the RON97 trend in Malaysia to know its fluctuations in growth and decline. The pattern encompassed a trend line and its components. Both upward



and downward movements represent elements of the trend. From early January 2020 until May 2020 the trend declined as the start of the pandemic of COVID-19 happened. The trend pattern starts to grow rapidly until it starts to drop again. From the middle of June 2022 until August 2022, it grew rapidly, Malaysia was dealing with its economic challenges, including managing the fiscal deficit and ensuring economic stability. These factors, combined with global influences, contributed to the fluctuations in fuel prices also Malaysia, like many other countries, was experiencing high inflationary pressures. The rising cost of commodities, including fuel, contributed to the overall increase in prices. The government had to manage these pressures while maintaining fuel subsidies [7].

The Double Exponential Smoothing model has significant alignment between real and fitted values, which successfully captures historical data trends. DES approach is best suited for datasets that exhibit trends but lack seasonality. Its capacity to handle these qualities makes it a dependable option for short- to medium-term forecasting. The low error metrics, such as MSE, RMSE, and MAPE, suggest that the model closely approximates the observed data while minimizing forecasting errors. Regardless of its virtues, DES assumes a linear trend, which may limit its performance in datasets with more complex patterns. [8] stated that using Double Exponential Smoothing can improve the Artificial Neural Network machine learning to exchange rate forecasting.

Holt's Method is highly accurate, with somewhat better performance metrics than DES. Holt's method builds on DES by adding a second smoothing parameter for trend estimation, making it significantly more advanced. Its higher performance indicators, such as lower MSE and MAPE, indicate that it captures the dataset's trend component more effectively than DES. [6], stated that Holt's Method is suitable to use within the seasonal trend and can improve the forecast accuracy in analyse the current dataset.

Based on the analysis, it clearly shown that Holt's method is the better model compared to Double Exponential Smoothing to visualize the price of RON97 in Malaysia.

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