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Forecasting International Tourist Arrivals in Malaysia Using Holt-Winters Model

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ABSTRACT

Malaysia's tourism sector has been significantly impacted by the COVID-19 pandemic, especially in terms of foreign visitor arrivals. The aim of this research is to forecast the future number of international tourist arrivals using the Holt-Winters additive method. Additionally, this study analyses the current trends of international tourist arrivals in Malaysia. The dataset employed spans from January 2012 to June 2023, encompassing periods before, during, and after the COVID-19 pandemic. The estimation of the Holt-Winters model is based on 126 observations (January 2012 until June 2022), while the validation of the model is based on 12 observations (from July 2022 to June 2023). Based on the estimated Holt-Winters model, the forecast value of monthly number of international tourist arrivals in Malaysia was generated for July 2023 to June 2024. The trend analysis shows that the number of Malaysia's tourist arrivals fluctuated significantly from one month to another from January 2012 to January 2020. Since then, the number of tourist arrivals progressively declined to its lowest level starting in April 2020 during the implementation of the travel restrictions policy due to the COVID-19 pandemic and the trend remained constant until March 2022. The number of tourist arrivals then slowly increased in May 2022 until now. As it turned out, the forecast generated for the next 12 months is closer in reaching Malaysia Tourism's target of 27.3 million tourists by the end of 2024. The results demonstrate that, despite short-term fluctuations, the overall trend indicates a gradual increase in the number of international tourist arrivals to Malaysia between July 2023 to June 2024. This indicates that the trend of international tourist arrivals in Malaysia is returning to the normal pattern observed prior to the COVID-19 pandemic.

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1. INTRODUCTION

Tourism is an economic and social activity involving the movement of people from one place to another with the aim of getting to know new places, cultures, landscapes, traditions, cuisine and other experiences. Tourism development is the way to attract tourists to a location in order to build and sustain a tourism sector (Baloch et al., 2023). It is one of the important areas that could assist a nation in eradicating poverty and fostering greater economic success (Nyagadza et al., 2022; Valtolina et al., 2020). The success of a tourism country truly depends on the volume of visitors that enter the country. Tourism has been considered among the most significant global industries (United Nations World Tourism Organization, 2020). In the case of Malaysia, most economic sectors are associated with travel and tourism, which has benefited greatly from foreign visitors (Puah et al., 2018). International tourist arrivals in developing economies are expected to expand at double the rate of advanced tourism economies. This has grown in worldwide relevance as globalization has made such travel simpler and more affordable. However, the number of tourists arriving in Malaysia dropped from 26.1 million in 2019 to 4.3 million in 2020 as the year of COVID-19 pandemic began (Tourism Malaysia, 2020). For the first time in ten years, in 2020, there were notably fewer visitors visiting in Malaysia. Like other countries, the COVID-19 pandemic has also significantly affected the tourism sector in Malaysia. Movement Control Orders (MCO) issued by the Prime Minister of Malaysia on March 18, 2020, had caused not only domestic tourism to fall, but also brought inbound travel to a sudden halt as countries locked their borders and restricted movement to stop the spread of the virus. Malaysia's government has recently announced a tourism strategy that was essentially launched with a ten year-span to help revive the country's tourism industry. One of the primary recovery methods highlighted in the National Tourism Policy 2020 to 2030 is the promotion and growth of sustainable tourism. The policy's objectives are to boost competitiveness, promote sustainable and inclusive tourism, and to prepare for any calamities as outlined by the Prime Minister (Amir, 2022).

Regardless of the impact of COVID-19 on tourism in 2020, tourism-related research is still worth investigating while the sector recovers. Tourism-related industries, such as tourism planners, retailers, and government agencies, rely on accurate daily forecasts to develop marketing strategies and management policies, making tourism management and forecasting relevant subjects for academic research (Song et al., 2019). International tourism in Malaysia is expected to reach record levels in 2023 as the number of visitors from major tourism markets in ASEAN, the Middle East, and Europe continue to recover, while Chinese tourist arrivals improve progressively (Biswas, 2023). Malaysia Tourism has set a target of 27.3 million visitor arrivals and RM102.7 billion in revenue for 2024 and is preparing for Visit Malaysia Year in 2026 (Tourism Malaysia. 2024). In developing a solid plan as the foundation for developing tourism policy, a valid and reliable estimation of the future tourist arrivals must be obtained. Forecasting is an essential part of tourism arrival in planning the future economic growth based on the number of tourist arrivals. Accurate tourist volume forecasting would help decision-makers and management to optimise resource allocation while balancing environmental and economic factors. Forecasting daily tourism arrivals necessitates trustworthy and valid forecasting models, which have received considerable interest in tourism research and practice (Xie et al., 2020).

Previously, several studies on forecasting international tourist arrivals have been conducted by prior researchers. Globally, several studies have been done by researchers in forecasting the number of international tourist arrivals in their countries such as in Sri Lanka (Gnanapragasam, 2018), India (Mishra et al., 2018), Zambia (Jere et al., 2019) and Thailand (Intarapak et al., 2022). Among these studies, one of the methods of forecasting used is the Holt-Winters and Box-Jenkins models. In Malaysia, there are also studies conducted in forecasting tourist arrival such as in a study done by Mohd Lip et al. (2020) which also utilised Holt-Winters and Box-Jenkins models. Other previous studies in Malaysia have also used different methods of forecasting such as in Fauzi et al. (2020) which used the Holt-Winters and Fuzzy time series model, while Halim (2020) used the Box-Jenkins model and singular spectrum analysis in forecasting the number of international tourist arrivals. However, all previous studies covered the data before the COVID-19 pandemic. Holt-Winters is a forecasting technique from exponential smoothing

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technique family that has been applied in many studies. It has also been used to isolate trends and seasonality from irregular variation (Chan et al., 2011). The technique eliminates the high fluctuations in signal while maintaining the important patterns of data. This criterion and the fact that the technique is easy to understand and be implemented have made it an attractive technique to be investigated in handling extreme data (Muhamad & Din, 2015). Hence, this study would fill the gap by investigating the performance of Holt-Winters model in forecasting international tourist arrivals in Malaysia using the data which cover pre- and post-pandemic of COVID-19. While previous studies used pre-pandemic data, this study incorporates both pre- and post-COVID periods, offering updated insights for policy formulation.

2. LITERATURE REVIEW

Several research has been conducted previously in forecasting tourist arrivals globally. Among others, Gnanapragasam (2018) focused on comparing the approaches used to model tourist arrivals and suggested a model that would be more accurate in predicting future tourist arrivals in Sri Lanka by using Holt-Winters and Box-Jenkins approaches based on the data of tourist arrivals from June 2009 to June 2017. It is determined that the Box-Jenkins approach surpasses the Holt-Winter's approach. A study was carried out on monthly forecasting foreign visitor arrivals in India by Mishra et al. (2018) by using two multiplicative univariate time-series models. Monthly statistics on inbound tourism to India from January 2001 to June 2018 were used to produce a projection for the period of July 2018 to June 2020. It is revealed that Holt-Winters' multiplicative model has superior forecasting capacity in the context of international visitor arrivals in India. In addition, Jere et al. (2019) found that Holt-Winters is better than ARIMA Box-Jenkins when conducting a study on the number of international tourist arrivals in Zambia from 1995 to 2014. In 2022, Intarapak et al. (2022) found that Holt-Winters model outperforms SARIMA Box–Jenkins in fitting and forecasting international visitor arrivals to Thailand from January 2008 to December 2019.

In the case of Malaysia, several studies have also been done in the past to forecast tourist arrivals in Malaysia. However, the previous studies only covered data before COVID-19 pandemic. Most of the previous studies also used Box-Jenkins and Holt-Winters model. One of the studies was conducted by Rafidah et al. (2019) which focused on the performance of several forecasting models for ASEAN tourist arrivals in Malaysia that covered monthly data from January 1999 to December 2015 of Brunei, Thailand, and Vietnam. It was found that hybrid SARIMA and Empirical Mode Decomposition (EMD) with Wavelet Support Vector Machine (WSVM) model is better than single model Support Vector Machine (SVM) and hybrid model WSVM SARIMA model, and single WSVM. Mohd Lip et al. (2020) used the Box-Jenkins and Holt-Winters model in finding the best model to forecast the arrival of international tourists in Malaysia which includes tourist arrivals from Singapore, Korea, and the United Kingdom from the years 2013 to 2017. They found that the Holt-Winters model is the most accurate for forecasting the number of tourists arriving from the UK and Korea, whilst the SARIMA model is the most suitable model for predicting the number of tourists arriving from Singapore. Meanwhile, Halim (2020) evaluated the Box-Jenkins model and Singular Spectrum Analysis in analysing the pattern and forecasting monthly foreign tourist arrivals from nine countries: Australia, Brunei, China, Indonesia, India, Japan, the Philippines, South Korea, and the United Kingdom from 1990 to 2014. It was found that the Box-Jenkins time series method is the best to be used in forecasting tourist demand in Malaysia for 2015. Fauzi et al. (2020) compared the performance of two forecasting techniques, Fuzzy Time Series and Holt-Winter, for the number of tourists expected to visit Langkawi between January 2015 and December 2019. Holt-Winter was found to be the best model.

Although models such as SARIMA, which are based on the Box-Jenkins methodology, demonstrate strong forecasting capabilities, the Holt-Winters model remains a robust choice for handling seasonal data particularly in forecasting tourist arrivals, as supported by previous research; thus, justifying its application in this study.

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3. METHOD

3.1 Data Description

The scope of the study is to forecast total number of international tourist arrivals in Malaysia. This study used secondary data of monthly Malaysia's number of international tourist arrival which included 138-month (or twelve-year) period from January 2012 to June 2023. The data were extracted from Tourism Malaysia, with the cooperation of the Immigration Department (Tourism Malaysia, 2023). The data set recorded the arrival of tourists from various countries to Malaysia on a monthly basis. Typically, the test set used to evaluate forecast accuracy comprises about 20% of the entire dataset. However, the exact percentage may vary depending on the forecasting horizon and the length of the dataset. Ideally, the test set should have a size that is at least equal to the desired maximum forecast horizon (Hyndman, 2018). Thus, the first 126 observations (January 2012 until June 2022) were employed for in-sample estimation while 12 observations (from July 2022 to June 2023) were used for out-of-sample evaluation which included data from the pandemic. Since this study intends to forecast 12 periods ahead, the out-sample data must be at least 12 periods.

3.2 Holt-Winter's Model

The Holt-Winters methodology, commonly known as triple exponential smoothing, is a prominent method for predicting time series data, particularly when dealing with trend and seasonality. This methodology consists of three basic equations that define the level, the trend and the seasonal component. This study applies the additive Holt-Winters additive model since the seasonal variations of the data show the roughly constant throughout the series. The additive effect assumes that time series components such as level, trend, seasonality and error interacted additively. It represents the smoothed variation of the y_t time series of tourist arrival as the sum of three elements is in its additive version. The basic equations are presented in Eq.1 to Eq. 3 (Lazim, 2013).

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

$$b_t = \beta(L_t - L_{t-1}) + (1 - \beta)b_{t-1} \quad (2)$$

$$S_t = \gamma(y_t - L_t) + (1 - \gamma)S_{t-s} \quad (3)$$

y_t is the actual values of the number of tourist arrivals in time t, s is the length of the seasonal periodicity, L_t is the level component of the tourist arrival series comprising of the smoothed values which does not include the seasonal component, b_t represents the estimate the trend component and S_t is the estimate of seasonal component of the time series with $\alpha, \beta, and\ \gamma$ as smoothing constants for level, trend estimate and seasonality estimate respectively. The smoothing constants $\alpha, \beta, and\ \gamma$ take the values between 0 to 1. The additive Holt-Winters model requires three initial values for level, trend, and seasonality components respectively before proceeding with the estimation. $L_0 = \frac{y_1 + y_2 + y_3 + \ldots + y_n}{12}$ is the initial value for the level component, $b_0 = \frac{1}{s}\left(\frac{y_{s+1} - y_1}{s} + \frac{y_{s+2} - y_2}{s} + \frac{y_{s+3} - y_3}{s} + \cdots + \frac{y_{s+n} - y_n}{s}\right)$ is the initial value for the first component of trend and $S_n = y_n - L_n$ is the initial value of the seasonal components where n is the total number of months, and s is the number of seasons. In other words, the observed values are formed by the variations in the data added. Under the additive effect assumption, the m-step ahead forecast with F_{t+m} is the forecast for the m period ahead is calculated as follows.

$$F_{t+m} = L_t + b_t m + S_{t-s+m} \quad (4)$$

Holt-Winters methodology involves a systematic approach in forecasting where the process begins with data preparation (Hyndman, 2018), which includes cleaning the dataset to ensure it is free of missing

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values and outliers and structuring it appropriately for time series analysis. Next is the model specification stage, where the choice between the additive or multiplicative form of the Holt-Winters model is made based on the nature of the data specifically, whether the seasonal variation remains constant (additive) or varies proportionally with the level (multiplicative), and whether a trend is present. Following this, the model proceeds to component estimation, where three main parameters; level (Lt), trend (b□), and seasonal effect (S□) are computed recursively using exponential smoothing equations. These parameters are then integrated during the forecasting phase to predict future values. The way in which these components are combined (additively or multiplicatively) is determined by the model type specified earlier. Once forecasts are generated, model evaluation is carried out using accuracy metrics root mean square error (RMSE), mean absolute percentage error (MAPE) and mean absolute error (MAE), which help assess how well the model captures the actual data patterns. Finally, in the refinement and future predictions stage, model parameters can be fine-tuned based on evaluation results to enhance forecasting performance, enabling the generation of more accurate and reliable predictions to support decision-making.

3.2 Model Estimation and Evaluation

In estimating and evaluating the performance of the models, the tourist arrivals data are split into two parts; the train data for estimation (in-sample data) and the test data for evaluation (out-sample data) (Kavalci & Hartshorn, 2023). The Holt-Winters model has been estimated using in-sample data set. Then, the model is evaluated using out-sample data to check on the forecast accuracy generated by the model. Three measurement errors are used to evaluate the model which are RMSE, MAPE and MAE. The performance of the model is evaluated based on the minimum value of the measurement errors, as calculated in Eq. 5 to Eq. 7 (Lazim, 2013), where $e_t = y_t - \hat{y}_t$, in which y_t is the actual number of international tourist arrivals at time t and $\hat{y}_t$ is the forecasted number of international tourist arrivals at time t.

$$RMSE = \sqrt{\frac{\sum_{t=1}^{n} e_t^2}{n}} \tag{5}$$

$$MAPE = \sum_{t=1}^{n} \frac{\left|\left(\frac{e_t}{y_t}\right)*100\right|}{n} \tag{6}$$

$$MAE = \frac{|\sum_{t=1}^{n} e_t|}{n} \tag{7}$$

4. FINDING & DISCUSSION

The main aim of this study is the application of the Holt-Winters model in forecasting international tourists' arrival in Malaysia. The estimation of the model begins by analysing the trend pattern of tourist arrival in Malaysia from January 2012 to June 2023 through the time plot which intends to explain the main pattern of Malaysian tourist arrival and therefore identify any unusual features that exist in the series. Fig. 1 depicts the monthly trend pattern of Malaysian tourist arrival from January 2012 to June 2023. The data displayed a trend and seasonal pattern in relation to ongoing data. This may result to an increase in the number of monthly tourist arrival in Malaysia over time. Malaysia received 1,839,892 tourists in December 2022, up from 1,330,700 in previous month. In July 2012, the data reached a high number of 2,306,675 tourists and dropped to 5,411 tourists in May 2020. This is because the Malaysian government established travel restrictions from March 2020 to 2021 to limit the spread of COVID-19 (Ministry of Health Malaysia, 2020), resulting to the greatest reduction in a decade. The graph shows the decrease pattern in February 2020 to the lowest point in April 2020 and it remained constant until March

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2022. Furthermore, after the pandemic, there is an increase in the number of international tourist arrivals in Malaysia as highlighted by Tourism Malaysia (2023).

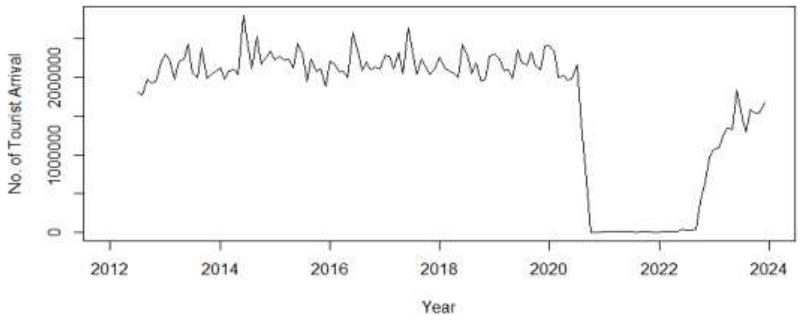

Fig. 1 International tourist arrivals in Malaysia from January 2012 to June 2023

The plot shows that the Holt-Winters model is useful in forecasting international tourists' arrival in Malaysia since the seasonality exists in the series. The Holt-Winters additive model is applied since the seasonal variations of the data are roughly constant throughout the series. Decomposition time series is separated into three constituent components: trend, random, and seasonal where the data are seasonal. Data on total number of international tourist arrivals in Malaysia from January 2012 to June 2022 are used for the in-sample estimation. Fig. 2 depicts the decomposition of additive time series which is a seasonal time series decomposing by calculating the observed, trend, seasonal, and remainder components of total number international tourists who arrive in Malaysia. It obviously shows that the seasonal variation exists in December. According to the observed and trend components in Fig. 2, the series in June 2022 have an increasing pattern, indicating an increase in the number of international tourists arriving in Malaysia after the pandemic of COVID-19 in April 2022. It also shows that the pattern of the data after the pandemic of COVID-19 becomes similar to that which existed prior to the pandemic, even though the numbers are slightly lower than pre-pandemic levels in 2019 (Tourism Malaysia, 2023). Fig. 2 shows the components of tourists' arrival data that ultimately interact in an additive trend as time rises. The data are calculated using the additive assumption because the seasonal variations are roughly constant throughout the series. Following previous studies (Jere et al., 2019; Fauzi et al., 2020; Mohd Lip et al., 2020; Intarapak et al., 2022), this additive model has been estimated using auto generating in R software.

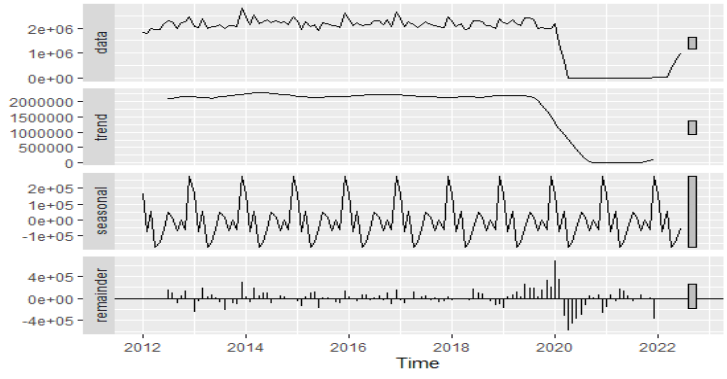

Fig. 2 Decomposition of Holt-Winters Additive Time Series for International Tourists Arrival in Malaysia

The results of the Holt-Winters additive model are presented with level, trend, and seasonality smoothing coefficients which would indicate the best parameters as shown in Table 1, while Table 2 shows the RMSE, MAPE, and MAE values for in-sample estimated values and out-sample evaluation for the best

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parameters values. Table 2 demonstrates that the MAPE value for forecast accuracy out-of-sample evaluation) is 37.142%, which indicates that the forecast is reasonable as highlighted by Moreno et al. (2013). Thus, even though the data revealed a structure break from MCO during the COVID-19 pandemic, the Holt-Winter model is still able to offer a good forecast of the number of international tourist arrivals in Malaysia. **Fig. 3** represents the filtered time series of Holt-Winters additive model of the total number of international tourist's arrival in Malaysia that are presented by the red line which is close to the original data.

Table 1. Smoothing parameters of Holt-Winters additive model

Smoothing Parameters		
α	β	γ
1.000	0.001	0.001

Table 2. Model performance

In-sample evaluation			Out-sample evaluation		
RMSE	**MAPE**	**MAE**	**RMSE**	**MAPE**	**MAE**
179905.626	253.918	122328.092	614472.924	37.142	554175.167

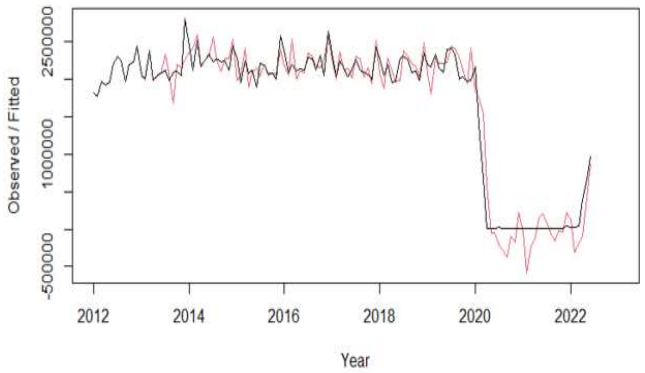

Fig. 3 Holt-Winters Additive Filtering for International Tourists Arrival in Malaysia

Fig. 4 presents the forecast values for international tourist arrivals in Malaysia which depict the actual trends of international tourist arrivals from January 2012 to June 2023, as well as the future trend for the next twelve months from July 2023 to June 2024 with the forecast values presented by the blue line. The pattern of the actual and forecast line series for both periods is quite comparable even though no tourist came to Malaysia during the MCO. The number of international tourist arrivals in Malaysia has been steadily increasing throughout the years. Furthermore, the forecast line indicates an increase year after year with a consistent pattern. Table 3 presents the monthly forecast value of international tourist arrivals in Malaysia from July 2023 to June 2024 which is generated based on the estimated models. The generated forecast values of international tourist arrivals in Malaysia from July 2023 to June 2024 demonstrating an increase and decrease values. The value in July 2023 was 1,779,940 number of international tourist arrivals while June 2024 has 1,780,856 number of international tourist arrivals which is closer in reaching Tourism Malaysia's aim of 27.3 million tourists by the end of 2024 (Tourism Malaysia, 2024). It can also be observed that the forecast values have a similar pattern trend for each month and year.

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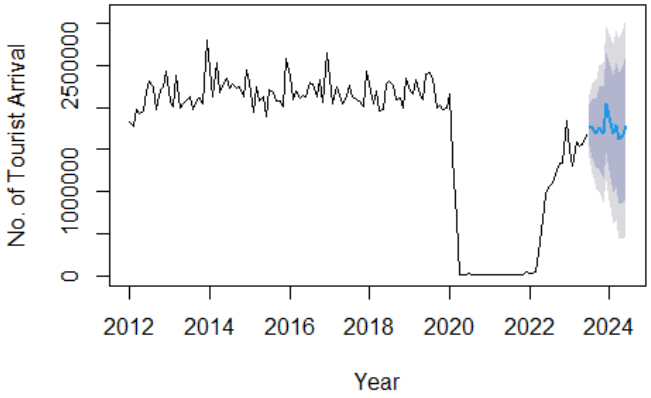

Fig. 4 Trend of Actual and Forecast Values for International Tourist Arrivals in Malaysia

Table 3. Forecast value for international tourist arrivals in Malaysia

Month/Year	Forecast values
July 2023	1,779,940
August 2023	1,749,958
September 2023	1,684,663
October 2023	1,748,783
November 2023	1,692,547
December 2023	2,049,210
January 2024	1,898,657
February 2024	1,681,433
March 2024	1,795,431
April 2024	1,628,010
May 2024	1,680,590
June 2024	1,780,856
Total	21,170,078

5. CONCLUSION

The intention of this study is to investigate the performance of Holt-Winters model in forecasting international tourist arrivals in Malaysia using inclusive data during and post COVID-19 pandemic. As a result of this study, based on the data which covered the 138-month (or twelve-year) period from January 2012 to June 2023, the number of Malaysia's tourist arrivals fluctuated significantly from one month to another since January 2012 to January 2020. Since then, the number of tourist arrivals progressively declined to its lowest level starting from April 2020 and remained constant till March 2022. The number of tourist arrivals then slowly increased in May 2022 until now. Based on the forecast accuracy of the Holt-Winter which covered the period of the pandemic, the model estimation performed as good as the original data. As it turned out, the forecast generated for the next 12 months is closer in reaching Tourism Malaysia's aim of 27.3 million tourists by the end of 2024. In addition, the result indicates that the number of international tourist arrivals in Malaysia will gradually rise even though it increases and decreases between July 2023 and June 2024 with consistent trend throughout months and years. Even though the Holt-Winters method applied in this study is able to produce a reasonable forecast, this method which relies on exponential smoothing tends to smooth out the shocks in the data rather than responding to them directly, leading to potential lags or inaccuracies in its forecasts. As a result, during periods of sudden change, the model may underestimate or overestimate future values, reducing its reliability for real-time decision-making in highly volatile conditions. Hence, future research may consider employing more robust forecasting techniques in handling sudden disruptions due to COVID-19 pandemic such SARIMA model with intervention or state space model which adapts more quickly to unexpected changes in data patterns. The sharp decline in international tourist arrivals during Malaysia's MCO period may

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introduce abrupt shifts and non-linear patterns in the data; hence, machine learning techniques may also be considered, as they are capable of capturing such complex relationships.

5.1 Suggestion for Future Research

Forecasting and comprehending international tourist arrivals necessitate a holistic strategy that considers a variety of elements impacting travel behaviour. All external factors such as economic situations, public health emergencies, and government regulations play important roles in driving travel trends. Future researchers may consider looking into these factors in their forecasting model. Although the Holt-Winters model can handle random shocks or data inaccuracies and provide reasonable forecasts, the accuracy and reliability of the forecast can be further improved by employing modern approaches such as machine learning, predictive analytics, and intervention analysis to address irregular patterns caused by sudden events due to COVID-19 pandemic. In addition, traditional statistical methods, when combined with advanced machine learning techniques, can provide a more detailed understanding of the data and yield more accurate and reliable forecasts.

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CONFLICT OF INTEREST STATEMENT

The authors confirmed that there is no conflict of interest in this article.

AUTHORS' CONTRIBUTION

Fauziah Ismail, Nur' Aina Sha'ari and Amla Ilyana Mohd Zuhair carried out the research. Wan Zakiyatussariroh Wan Husin designed the research, supervised research progress, anchored the review, revisions and approved the article submission. Wan Zakiyatussariroh Wan Husin and Nur Dalila Norshahidi wrote and revised the article.

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