Thai Environmental Engineering Journal Vol. 36 No. 2 (2022) : 45-53
www.eeat.or.th

Appropriate Forecasting Techniques Analysis for Number of Important Tourists Visiting Bangkok Forecasting Error Reduction After the COVID-19 Pandemic

Chatpon Mongkalig[*] and Nisakorn Nakornkao

Institute of Metropolitan Development, Navamindradhiraj University
Dusit District, Bangkok 10300, Thailand
[*]E-mail : chatpon@yahoo.com

Abstract

The objectives of this research are to analyze and conduct demand forecasting by using forecasting techniques in the Bangkok area. The study included conducting the experiments and determining the appropriate forecasting techniques for the number of tourists forecast in each of the top ten countries, which were the Thai tourists and tourists from the People's Republic of China, Japan, South Korea, India, UK, USA, Singapore, Malaysia, and Australia who come to travel and stay in Bangkok. The conducted demand forecasting included accommodation forecasting. In addition, medical and wellness tourism were additional study findings. Supply plan for tourist accommodation was proposed. Time series analysis methods including moving average, single exponential smoothing, double exponential smoothing, and Winters' method were used in the experiments for forecasting the number of tourists traveling and staying in Bangkok. According to the ANOVA, the forecasting method had a significant effect on MAPE and MAD. From the experimental results, it was found that the most suitable forecasting method was the Winters' method, with a seasonal length of 12 months. The focus group was conducted for the number of tourists forecasting verification and validation. For supply plan analysis, tourist accommodation optimistic demand (demand under normal situation) was higher than the tourist accommodation capacity by 47.86%. Additionally, tourist accommodation pessimistic demand (demand under new normal situation) was higher than the tourist accommodation capacity during the high season of December and January by 10.12%. For medical and wellness tourism, Thai government should formulate policies to drive the successful healthcare tourism. The promotion projects of medical and wellness tourism by increasing the supply of medical and wellness tourism, supporting the needs of various groups of tourists, and developing innovative medical research and new technologies should be conducted. These projects could increase the potential of Thailand medical and wellness tourism. Thailand's medical and wellness tourism yields high revenue at 1,200,000 million baht per year and is growing among the fastest in the world with an average growth of 13% per year. Moreover, the COVID-19 vaccination is an important strategy for the countries' main target group of tourists to minimize deaths, severe disease, curtail the health system impact, and fully resume socio-economic and tourism activity.

Keywords : Forecasting Techniques; Analysis of Variance; Forecasting Error Reduction; Time Series Analysis

Introduction

The 3R (Reduce-Reuse-Recycle) Concept is a sequence of steps on how to manage waste properly and prevent waste effects on environment. The top priority is Reduce, which is to reduce waste generation, then Reuse, and then Recycle. Demand forecasting and supply plan in excess will cause an increase in accommodation and food preparing for tourists, resulting in an increase in waste generation. Therefore, accurate forecasting the number of tourists in Bangkok is an important decision that affects waste reduction of tourism and decreases Thai tourism costs. According to the Thailand tourism statistics report of the Ministry of Tourism and Sports [1], the tourism business plays an important role in the Thai economic system. The income from tourism contributes to the economic value of the country. Tourism affects money circulation and income distribution for Bangkok. According to the report [1], it was found that income from tourism accounted for about 20% of the Gross Domestic Product, or GDP (the monetary value of the final goods or services produced within the country) [1]. The pandemic of coronavirus disease (COVID-19) resulted in a significant decrease in international tourists visiting Thailand during the year 2020 - 2021 when compared to the same period in 2019. Pareto chart of the target countries which had the highest ranking in terms of the number of tourists who visited and stayed in Bangkok was shown in Figure 1. Before the outbreak of COVID-19, the top ten countries which had the highest ranking in terms of the number of tourists who visited and stayed in Bangkok were Thailand, the People's Republic of China, Japan, South Korea, India, UK, USA, Singapore, Malaysia, and Australia, covering more than 80 percent of all tourists to Bangkok.

The objectives of this research are to analyze and conduct demand forecasting by using forecasting techniques in the Bangkok area; conduct the experiments; and determine the appropriate forecasting techniques for the forecasting of the number of tourists who visited Bangkok and came from the top ten countries, which were the Thai tourists and tourists from China, Japan, South Korea, India, UK, USA, Singapore, Malaysia, and Australia who come to travel and stay in Bangkok. The conducted demand forecasting included accommodation forecasting. In addition, medical and wellness tourism were additional study findings.

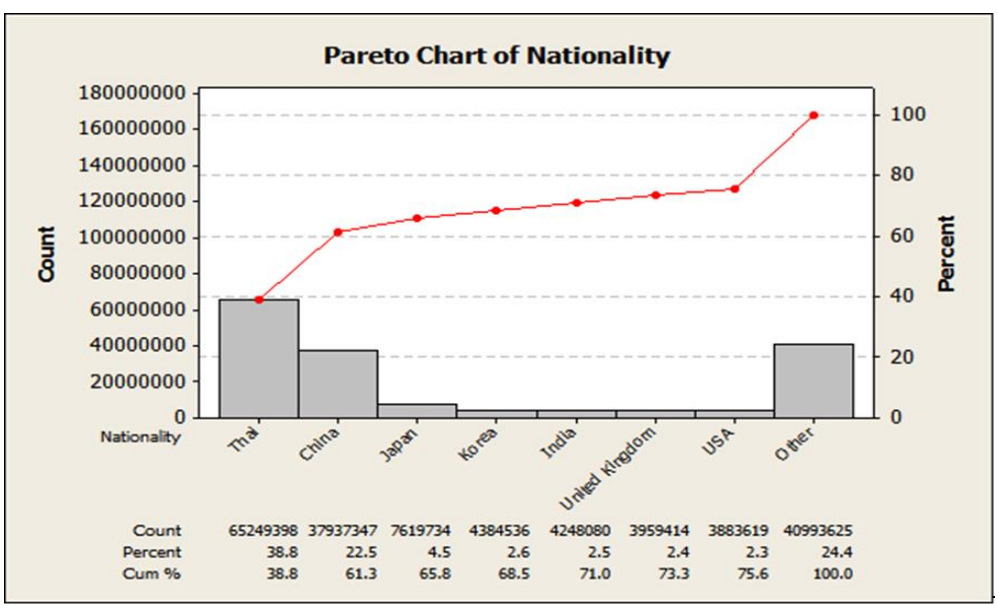

Figure 1 Pareto diagram of the number of tourists from the important countries

Methodology

Data from Thailand's tourism statistics report of the Ministry of Tourism and Sports [1] was collected prior due to the COVID-19 pandemic during the years 2015 - 2019. The data from the table named "Guest arrivals at accommodation establishments (monthly data)" [1] were used to forecast the number of target group tourists visited and stayed in Bangkok. The tool is to analyze and find the appropriate method for forecasting the number of target group tourists using the Time Series was the Analysis of Variance (ANOVA). The design of Experiment (DOE) [2] was used to analyze and find the most appropriate method that reduced the forecasting error between the fitted values and the actual numbers of the target group of tourists, which were the domestic tourists (Thai tourists), tourists from China, Japan, South Korea, India, UK, USA, Singapore, Malaysia, and Australia who travelled and stayed in Bangkok. The forecasting techniques include moving average, single exponential smoothing, double exponential smoothing, and Winters' method were applied [3]. The forecasting methods were analyzed as the factor for the demand forecasting error reduction [4]. Guidelines in planning to cope with the tourist demands (Supply Plan) [5], which were acquired from the suitable and effective forecasting method, are provided for tourism, hotels, and accommodation in Bangkok. The country is a blocking factor. The Randomized Complete Block Design (RCBD) was experimented. The response variables were the Mean Absolute Percentage Error (MAPE) and the Mean Absolute Deviation (MAD). The Analysis of Variance (ANOVA) was applied to determine the most appropriate forecasting method [6]. Prior to the Analysis of Variance (ANOVA), the ANOVA assumptions were checked in the Model Adequacy Checking [7] as follows:

The Mean Absolute Percentage Error (MAPE) was used in the Model Adequacy Checking.

According to the model adequacy checking, it was found that residuals were normally distributed in Figure 2. The independence assumption was checked in Figure 3. The variance of residuals was constant in Figure 4. Therefore, the ANOVA was suitable for the analysis of the forecasting method which had a significant effect on the Mean Absolute Percentage Error (MAPE) [8].

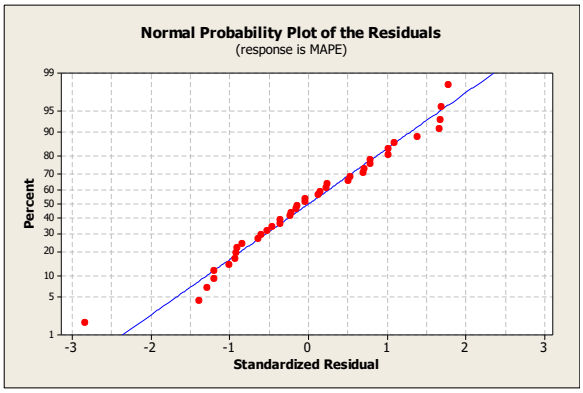

Figure 2 Normal probability plot of the residuals

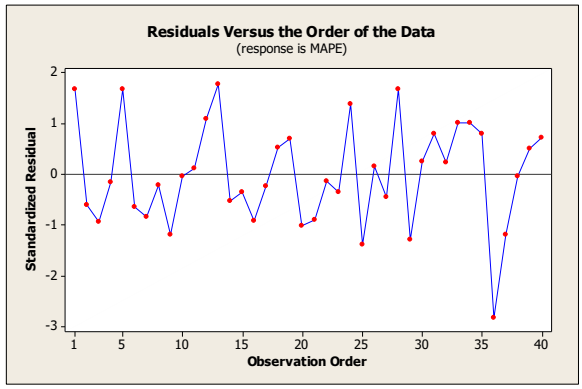

Figure 3 Independence assumption checking

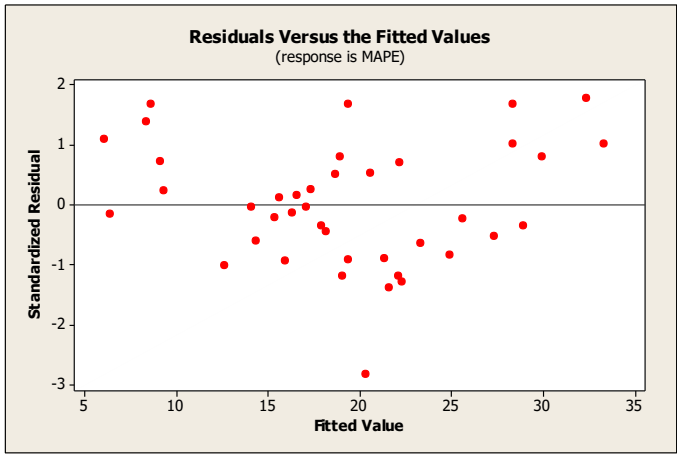

Figure 4 Constant variance assumption checking

Results and Discussion

Table 1 The ANOVA table for the experiment which MAPE was the response variable

General Linear Model: MAPE versus Forecasting Method, Country

Factor	Type	Levels	Values
Forecasting Method	fixed	4	Double Exponential Smoothing, Moving Average, Single Exponential Smoothing, Winters' Method
Country	fixed	10	Australia, China, India, Japan, Malaysia, Singapore, South Korea, Thailand, UK, USA

Analysis of Variance for MAPE, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Forecasting Method	3	1304.63	1304.63	434.88	33.69	0.000
Country	9	954.78	954.78	106.09	8.22	0.000
Error	27	348.54	348.54	12.91		
Total	39	2607.96				

S = 3.59292 R-Sq = 86.64% R-Sq (adj) = 80.70%

Table 2 The ANOVA table for the experiment which MAD was the response variable

General Linear Model: MAD versus Forecasting Method, Country

Factor	Type	Levels	Values
Forecasting Method	fixed	4	Double Exponential Smoothing, Moving Average, Single Exponential Smoothing, Winters' Method
Country	fixed	10	Australia, China, India, Japan, Malaysia, Singapore, South Korea, Thailand, UK, USA

Analysis of Variance for MAD, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Forecasting Method	3	5514109488	5514109488	1838036496	3.00	0.048
Country	9	1.05781E+11	1.05781E+11	11753497277	19.19	0.000
Error	27	16533643437	16533643437	612357164		
Total	39	1.27829E+11				

S = 24745.9 R-Sq = 87.07% R-Sq (adj) = 81.32%

From the analysis of variance (ANOVA) with Mean Absolute Percentage Error (MAPE) as a response variable in Table 1, it was found that forecasting method had a significant effect on the MAPE since the P-Value was less than the significance level of 0.05. Additionally, from the analysis of variance (ANOVA) with Mean Absolute Deviation (MAD) as a response variable in Table 2, the forecasting method had a significant effect on the MAD since the P-Value was less than the significance level of 0.05. According to the Randomized Complete Block Design (RCBD), the tourist nationality factor, which was classified by the nationality of tourists who visited and stayed in Bangkok, was a blocking factor [9]. It was not a factor to be analyzed in this research.

As shown in Figures 7 and Figure 8, the Main Effects Plots [10] for MAPE and MAD were used to analyze and determine the most appropriate forecasting technique to forecast the number of tourists for each target group, which were domestic tourists (Thai tourists), tourists from the People's Republic of China, Japan, South Korea, India, UK, USA, Singapore, Malaysia, and Australia who travelled and stayed in Bangkok.

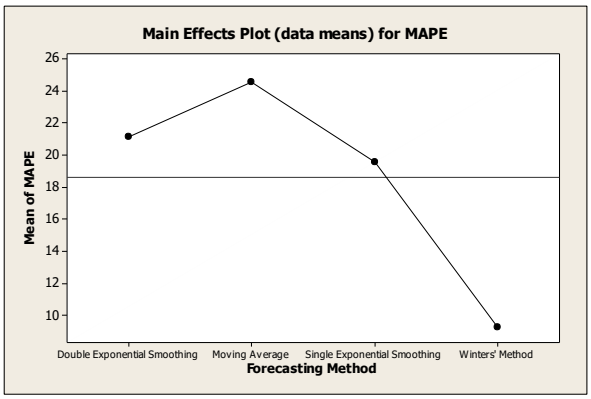

Figure 5 Main Effects Plot for MAPE

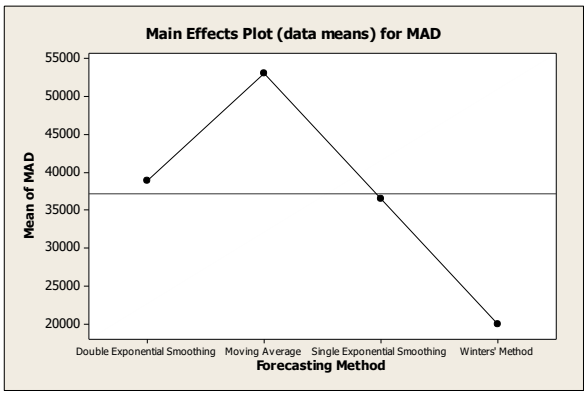

Figure 6 Main Effects Plot for MAD

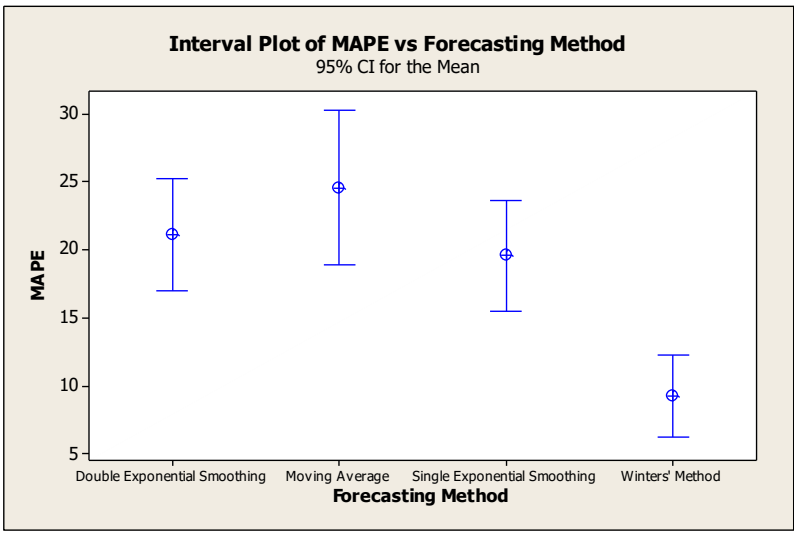

Figure 7 Interval Plot of MAPE for the most appropriate forecasting method analysis

From the Interval Plot graph to analyze the most suitable forecasting method in Figure 7, it was found that the 95% confidence interval of the Mean Absolute Percentage Error (MAPE) using the Winters' Method with a seasonal length of 12 months was the smallest value. In addition, the 95% confidence interval of the Mean Absolute Percentage Error (MAPE) using the Winters' Method and the 95% confidence interval of the Mean Absolute Percentage Error (MAPE) using other forecasting techniques were not overlapped. Therefore, the MAPE obtained from the Winters' Method forecasting with a seasonal length of 12 months was significantly lower than the MAPE obtained from other forecasting techniques. Due to the number of tourists in each target group, such as domestic tourists (Thai tourists), tourists from China, Japan, South Korea, India, UK, USA, Singapore, Malaysia, and Australia who visit and stay in Bangkok are cyclical or seasonal. Therefore, it can be concluded that the Winters' Method forecasting with a seasonal length of 12 months is the most appropriate forecasting method.

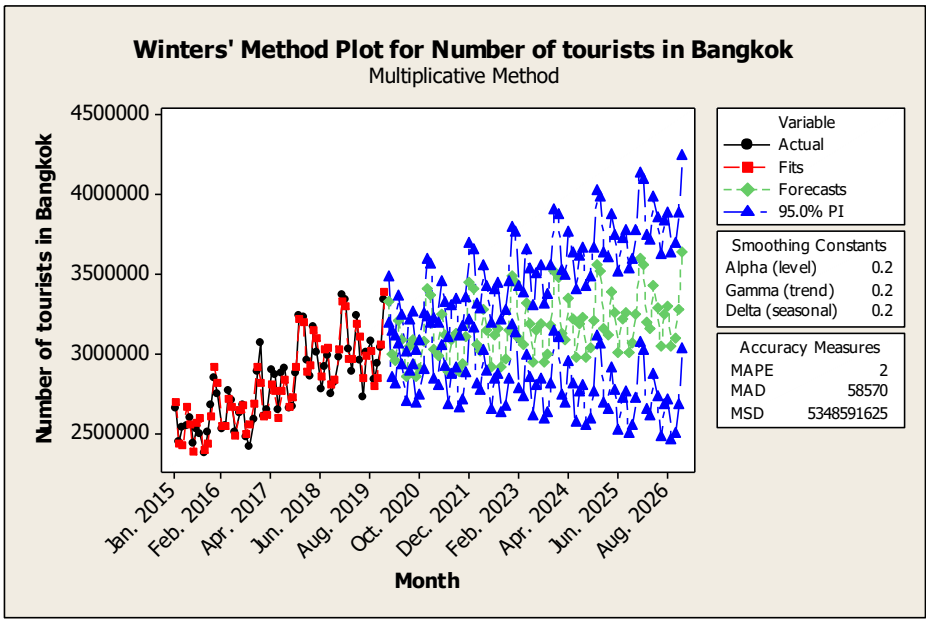

Figure 8 Winters' method plot for the number of tourists in Bangkok forecasting

According to Winters' method plot for the number of tourists in Bangkok forecast in Figure 8, in the forecasting of the number of Thai and foreign tourists visiting and staying in Bangkok in the next five years, 2022 – 2026 is highly accurate since the MAPE is 2% and the forecasting accuracy is 98%. The forecast of the number of Thai and foreign tourists in Bangkok in high season tourism in December 2026 was more than 3,600,000 travelers. The focus group was conducted for the number of tourists forecasting verification and validation. The comparative analysis of plan for providing accommodation (Supply Plan) was conducted by comparing the five-year forecasting values of accommodation supply to the accommodation demand of Thai and international tourists who visited and stayed in Bangkok. Data from the National Statistical Office's Accommodation Survey [11] were used prior to the COVID-19 pandemic during the years 2015 - 2019. The data included tourist demand for accommodation in Bangkok; length of stay; number of tourists per room; and accommodation supply. The forecasting values of pessimistic accommodation demand were attained by analyzing the length of stay during the COVID-19 outbreak as displayed in Figure 9. From Figure 9, the average accommodation demand of Thai and international tourists visiting and staying in Bangkok in situation where there is high demand (optimistic demand or demand under normal situation) is 8,222,720 man-days, while the supply capacity of all types of accommodation in Bangkok is 4,272,764 man-days. The optimistic demand is higher than the accommodation supply capacity at 3,949,956 man-days or 47.86%.

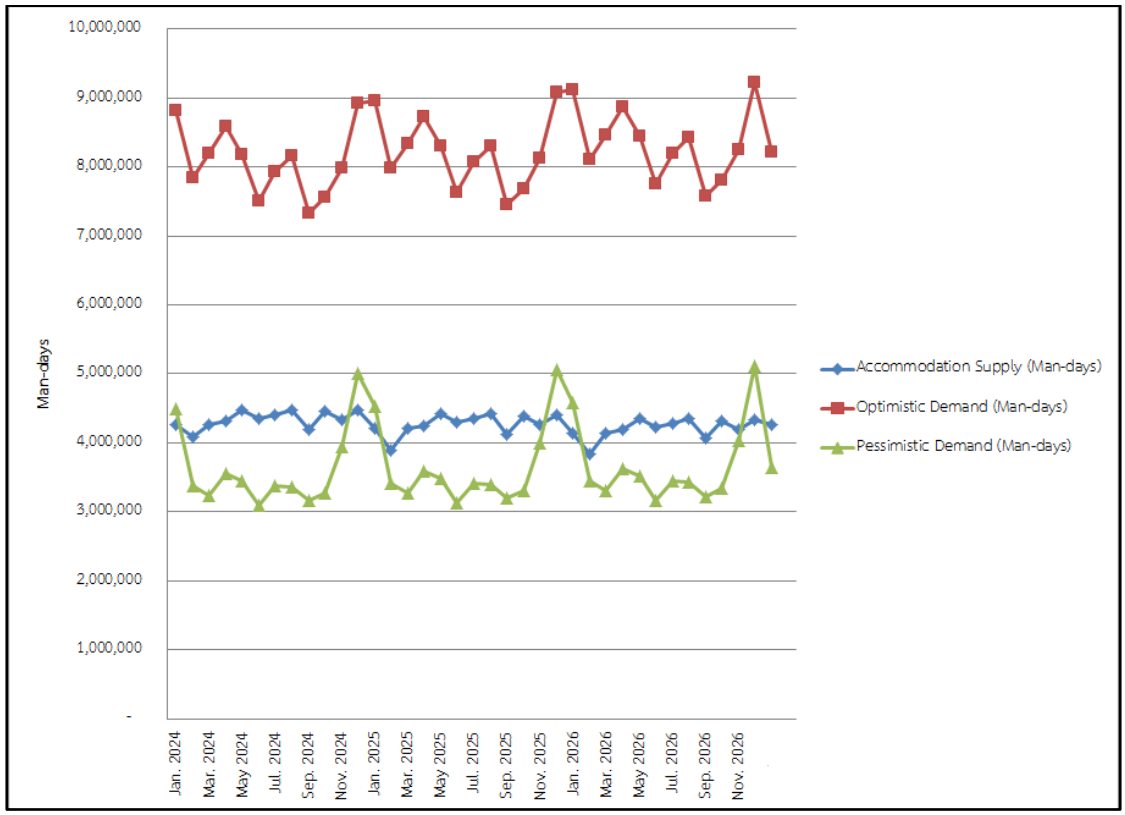

Figure 9 Comparative analysis of accommodation demand and supply forecasting (2024 – 2026) of Thai and International tourists in Bangkok

According to Figure 9, it can be found that the average accommodation demand of Thai and international tourists visiting and staying in Bangkok in situation where there is low demand (pessimistic demand or demand under COVID-19 situation which the DMHTT new normal action plan is necessary) is 3,649,048 man-days, while the supply capacity of all types of accommodation is 4,272,764 man-days. According to the announcement from Thailand Center for COVID-19 Situation Administration (CCSA) [12], DMHTT stands for D : Distancing, M : Mask Wearing, H : Hand Washing, T : Testing, and T : Thai Cha Na COVID-19 application. The pessimistic demand is higher than the accommodation supply capacity during the high season of the months of December and January at 10.12%. From the Figure 9, comparing between the optimistic demand/ the demand under the normal situation and the pessimistic demand/ the demand under COVID-19 situation (the new normal action plan is still implemented), the demand under the normal situation is higher than the demand under the COVID-19 situation with new normal action plan by 225%.

In between or after the COVID-19 situation, tourism is considered an important sector of Thai economy, with a total income of foreign tourists in 2019. In addition, tourists in Thailand spend more than 3,010 billion baht, so if Thai tourism can be promoted to improve the competitiveness, medical and wellness tourism will be a part of the wellness economy. The Thai tourism industry relies on it to attract high-paying tourists or high-end groups. The medical and wellness tourism that focuses on overall healthcare promotion as well as taking care of and preventing diseases will be an important opportunity to cope with the changes that will occur, and turn tourism back to being an important sector of the sustainable Thai economy again. This is in line with the country's policy to elevate Thailand towards quality tourism. It is of high value and attracts potential tourists, both Thais and foreigners.

The reasons why medical and wellness tourism is an important opportunity for Thailand are: (1) the overview of global medical and wellness tourism is of high quality and growing fast, with the medical and wellness tourism growth rate of 43% [13]. (2) Medical and wellness tourism can be a complementary activity to other types of tourism. Medical and wellness tourism accounts for 14% of the global tourism industry's value. (3) Medical and wellness tourism costs 61% more than general tourism. This group of tourists is a group with purchasing power and is willing to pay for new experiences. It also takes longer to travel for the medical and wellness tourism. (4) It is an extension of the potential of Thailand because Thailand has natural resources and a favorable culture, as well as strengths in service and tourism. In addition, Thailand's medical and wellness tourism is growing among the fastest in the world with an average growth of 13% per year.

Conclusions

In forecasting the number of tourists in each target group, which are domestic tourists (Thai tourists), tourists from China, Japan, South Korea, India, UK, USA, Singapore, Malaysia, and Australia who visited and stayed in Bangkok, it was found that the forecasting method had a statistically significant effect on the Mean Absolute Percentage Error (MAPE) and the Mean Absolute Deviation (MAD). The most appropriate forecasting technique with the smallest value of the MAPE and the MAD was the Winters' Method with a 12-month seasonal length. The comparative analysis of the accommodation supply plan was conducted by comparing the 2024 - 2026 forecasting values of accommodation supply to the accommodation demand of Thai and international tourists who visited and stayed in Bangkok. In a situation where there is high demand (optimistic demand or the demand under normal situation), the average accommodation demand of Thai and international tourists visiting and staying in Bangkok is higher than the supply capacity (optimistic demand over supply) at 3,949,956 man-days or 47.86%. In a situation where there is low demand (pessimistic demand or the demand under the COVID-19 new normal situation), the pessimistic demand is higher than the accommodation supply capacity (pessimistic demand over supply) during the high season of the months of December and January at 10.12%. Application of Thailand tourism and tourist accommodation promotion projects will increase the number of accommodation entrepreneurs and the number of rooms for tourists, and thus the accommodation demand and supply will be balanced efficiently. Therefore, the tourist hotel and guest house entrepreneurs should be promoted by tourist tax incentive projects, tourism promotion projects, Thailand tourism advertisement promotion, tax reduction, and soft loans for entrepreneurs to increase tourist accommodation capacity. In addition to medical and wellness tourism, Thai government should formulate policies to drive the successful healthcare tourism. Medical and wellness tourism is estimated to be around 10 million per year. The promotion projects of medical and wellness tourism by increasing the supply of medical and wellness tourism, supporting the needs of various groups of tourists and developing innovative medical research and new technologies should be conducted. These projects could increase the potential of Thailand medical and wellness tourism. Moreover, the COVID-19 vaccination is an important strategy for countries of main target group of tourists to minimize deaths, severe disease, curtail the health system impact, and fully resume socio-economic and tourism activity.

Acknowledgement

This research project was financially supported by Navamindradhiraj University Research Fund.

References

[1] Office of the Permanent Secretary, Ministry of Tourism and Sports. 2019. Thailand tourism statistics report for the year 2019. Ministry of Tourism and Sports, Bangkok.

[2] Montgomery, D.C. 2019. Design and Analysis of Experiments. John Wiley & Sons Inc., New York.

[3] Box, G.E.P., Jenkins, G.M., Reinsel, G.C. and Ljung, G.M. 2015. Time Series Analysis: Forecasting and Control.
[4] Makridakis, S.G., Wheelwright, S.C. and Hyndman, R.J. 1998. Forecasting: Methods and Applications. John Wiley & Sons Inc., New York.
[5] Pellerin, R. and Perrier, N. 2019. A review of methods, techniques and tools for project planning and control. International Journal of Production Research. 57: 2160–2178.
[6] Yu, P., Low, M.Y. and Zhou, W. 2018. Design of experiments and regression modelling in food flavour and sensory analysis: A review. Trends in Food Science & Technology. 71: 202-215.
[7] Dean, A., Voss, D. and Draguljic, D. 2017. Design and Analysis of Experiments. Springer, New York.
[8] Asilahijani, H., Steiner, S.H. and MacKay, R.J. 2010. Reducing variation in an existing process with robust parameter design. Quality Engineering. 22: 30–45.
[9] Montgomery, D.C. 2019. Introduction to Statistical Quality Control. John Wiley & Sons Inc., New York.
[10] Montgomery, D.C. and Runger, G.C. 2014. Applied Statistics and Probability for Engineers. John Wiley & Sons Inc., New York.
[11] National Statistical Office Thailand. 2020. The 2020 Accommodation Survey. National Statistical Office (NSO), Ministry of Digital Economy and Society, Bangkok.
[12] Center for COVID-19 Situation Administration (CCSA). 2020. Announcement from Center for COVID-19 Situation Administration (CCSA). Department of Disease Control, Ministry of Public Health, Bangkok.
[13] Global Wellness Institute. 2022. Global Wellness Trends Report: The Future of Wellness 2022. New York.