

## Application of The Exponential Smoothing Method in Predicting the Visit of Foreign Tourists to Indonesia

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ARTICLE INFO	ABSTRACT
<p><b>Article History</b>            Received : 03-10-2022            Revised : 23-10-2022            Accepted : 31-10-2022</p> <p><b>Keyword</b>            Exponential Smoothing;            International Tourists;            MAPE; Triple            Exponential Smoothing;</p>	<p>Indonesia is rich in natural beauty, diverse ethnic groups, cuisines, and languages, making it one of the most popular destinations for both domestic and international tourists. The purpose of this study is to forecast the number of foreign tourist visitors from 2020 to 2021. The government can improve facilities or infrastructure while also preserving the beauty and culture of Indonesia's various ethnic groups. This study will investigate 101 foreign countries that visited Indonesia using one of the Exponential Smoothing methods. In forecasting, the Triple Exponential Smoothing method has three smoothing times. Forecasting in 101 foreign tourists visiting Indonesia yields different parameter results because each result has a different smoothing value. Once the parameters ranging from 0.1 to 0.9 is close to forecasting results, there are close to the actual value. The search ends at one of these parameters because it already yields the expected results to calculate the error value using the MAPE method. There were 20 foreign tourists selected based on the average number of visits to Indonesia.</p>
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### 1. INTRODUCTION

Tourism is one of the industrial sectors that have the potential to be developed for the economy of a region. The development of the tourism sector in an area will attract other sectors to develop as well because its products are needed to support the tourism industry, such as the agricultural sector, livestock, plantations, folk crafts, increasing job opportunities and so on (Salma and Susilowati, 2004). Meanwhile, according to Koen Meyers (2009), tourism is a travel activity that is carried out temporarily from the original place of residence to the destination area for reasons not to settle or earn a living but only to fulfill curiosity, spend leisure time or holidays and other purposes. Based on the above opinion, it can be concluded that tourism is a trip taken by someone to fulfill curiosity and one of the sectors that stimulates the development of regional economic sectors.

The development of these tourism activities requires expertise in spatial allocation that is able to guarantee sustainable development in order to support the achievement of community welfare. In addition, the basic principles of spatial planning must be taken into account with the aim of increasing the utilization of natural resources and artificial resources that support efficient, effective and efficient use. Wahab (2003) states that tourism is one type of industry that is able to generate rapid economic growth in providing employment, improving living standards, and stimulating other productivity sectors. An area must also have a great potential for attraction so that tourists want to make the place a tourist destination. Tourism facilities are the spearhead to provide services to foreign tourists in an area, these facilities include: accommodation, souvenir supplies, culinary, and interesting tourist attractions (Desky, 1999; Kesrul, 2003; Pendit, 2002).

Indonesia is rich in natural beauty and various ethnic groups that exist in this country, diverse culinary and language so that Indonesia is one of the countries that are in demand by both local and foreign tourists, researchers choose to predict the large number of foreign

tourist visitors in 2020 to 2021. which one visits Indonesia more, so that the Government can improve facilities or infrastructure and also be able to maintain the beauty and culture of various ethnic groups in Indonesia.

Based on previous research by Emilia (2020) on the Double Exponential Smoothing Brown and Holt Method in Forecasting Exchange Rates and Foreign Exchange in Indonesia. The study predicts the rate of increase and decrease in the Dollar exchange rate each month, the method used is the double exponential smoothing method because the data shown in the form of fluctuating patterns and trends. The results in this study are the greater the number of alpha or parameters approaching the value of 1 used, the smaller the error value generated or the greater the accurate value obtained. Exponential Smoothing Method is a method used in forecasting or predicting foreign tourist visits. This research uses this method because it is relevant and in accordance with the data held. This method is divided into 3 namely Single Exponential Smoothing, Double Exponential Smoothing and Triple Exponential Smoothing, each of these methods has a difference in its use so that in this case the researcher chooses the Triple Exponential Smoothing method because the data in this study has a fluctuating pattern and also an upward trend.

## 2. METHOD

This research was conducted at the Dynamic Analysis and Optimization Laboratory (ADO) and UPT Syiah Kuala University Library. This research began in January 2021.

### 2.1. Data

The data that will be described by the researchers in this final project are data obtained from the Central Statistics Agency (BPS, 2021). The data is data on the number of visits by foreign tourists who come to Indonesia for 5 (five) years. Researchers chose several countries from 101 countries that visited Indonesia a lot in this study. Forecasting can predict or predict future events (Gaspersz, 1998), in this case the researcher aims to predict or predict the level of the number of visits to the country, which foreign tourists will visit Indonesia a lot in the future.

### 2.2. Research Methods and Stages

The procedure in this research is starting from a literature study, namely looking for all materials related to this research, then analyzing the case, then collecting data, then processing the data with methods according to the data pattern to obtain the expected results, then looking for the error value to get the results. appropriate, then the researcher concludes the results in the form of a report. The schema of the research procedure can be seen in Figure 1.

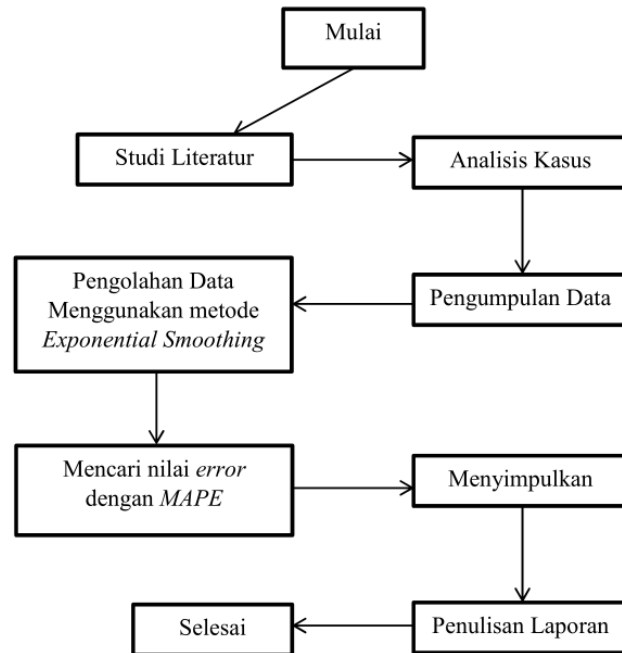
In this case, to predict the number of foreign tourists visits each month using the double exponential smoothing method. This method is more suitable for making forecasts if the data has a fluctuating pattern or experiences tidal waves. The procedure for making forecasts using the Triple exponential smoothing method is as follows (Winston, 1995):

$$\begin{aligned}
 S_t''' &= \alpha S_t'' + (1 - \alpha) S_{t-1}''' \\
 a_t &= 3S_t' - 3S_t'' + S_t''' \\
 b_t &= \frac{\alpha}{2(1 - \alpha)} ((6 - 5\alpha)S_t' - (10 - 8\alpha)S_t'' + (4 - 3\alpha)S_t''') \\
 c_t &= \frac{\alpha^2}{(1 - \alpha)^2} (S_t' - 2S_t'' + S_t''') \\
 F_{t+m} &= a_t + b_t m + \frac{1}{2} c_t m^2
 \end{aligned}$$

Where,

$S_t'''$  : the third exponential smoothing value,

- $t$  : period/time,
- $a_t$  : connecting constant in period,
- $b_t$  : connecting constant (trend/slope) in the period,
- $c_t$  : quadratic smoothing in period,
- $\alpha$  : smoothing parameters,  $0 < \alpha < 1$ , (Dielman, 2006)
- $F_{t+m}$  : forecast value for the next period,
- $m$  : number of future periods forecast.



**Gambar 1.** Research procedure

The initialization performed is

$$S'_{t-1} = S''_{t-1} = S'''_{t-1} = X_{t-1}$$

where  $X$  is actual data,  $S'_{t-1}$  is the value of the first smoothing period 1 month before  $X_t$ ,  $S''_{t-1}$  is the value of the second smoothing period 1 month before  $X_t$ , and  $S'''_{t-1}$  is the smoothing value of the third month period for the following year.

### 3. RESULT AND DISCUSSION

#### 3.1. Predicting the number of foreign tourist visits to Indonesia in 2022-2023

There are 101 countries to predict the number of foreign tourist arrivals to Indonesia in 2022-2023. An example is Malaysia as shown in Table 1.

Before searching for the results of the Triple Exponential Smoothing method for Malaysia, it is done first to look for the results of  $S'$  and  $S''$ . Because January 2017 did not get effective search results due to the absence of actual data values for January 2016 then the first-year search was started from January 2018. So, for the results of forecasting visits from Malaysia using the Triple Exponential Smoothing method with parameter  $\alpha = 0,1$  in January 2018 is the actual value in January 2017 of 149,488 visits.

**Table 1.** Actual data for Malaysia who visited Indonesia in 2017 to September 2021

Month	Malaysia				
	2017	2018	2019	2020	2021
JAN	149.488	207.123	242.352	207.523	45.764
FEB	142.045	205.944	275.115	164.043	37.437
MAR	172.097	252.966	278.828	114.453	40.359
APR	171.536	214.399	255.765	61.496	38.800
MEI	176.147	180.063	253.286	66.414	48.438
JUN	176.276	225.707	296.692	62.033	36.854
JUL	174.367	202.645	240.285	58.052	44.039
AGT	194.468	210.158	263.723	57.864	39.173
SEP	174.748	197.620	233.834	53.370	39.819
OKT	178.780	173.800	241.056	45.332	0
NOV	183.880	193.590	247.866	43.292	0
DES	228.056	239.329	239.783	46.246	0

Sumber: Data diolah (2021)

**Table 2.** Average forecasting results 2022 - 2023 in Malaysia using the triple exponential smoothing method

Alpha	Actual Data						
	2017	2018	2019	2020	2021	2022	2023
	176.824	208.612	255.715	81.677	41.187		
	Forecasting Results						
	2017	2018	2019	2020	2021	2022	2023
<b>0,1</b>	0	176.824	186.262	222.597	204.044	66.598	65.233
<b>0,2</b>	0	176.824	195.210	235.857	155.051	52.302	47.304
<b>0,3</b>	0	176.824	203.238	247.752	111.100	39.476	29.272
<b>0,4</b>	0	176.824	210.080	257.890	73.641	28.545	11.981
<b>0,5</b>	0	176.824	215.566	266.019	43.605	19.781	-4.025
<b>0,6</b>	0	176.824	219.623	272.032	21.389	13.298	-18.515
<b>0,7</b>	0	176.824	222.312	276.016	6.668	9.002	-31.677
<b>0,8</b>	0	176.824	223.819	278.250	-1.584	6.594	-44.111
<b>0,9</b>	0	176.824	224.415	279.133	-4.847	5.642	-56.680

Furthermore, for the January 2019 forecasting results, 166,594 visits, the same steps were carried out for the search in January 2020 to January 2022, while for the January 2023 results only changing the "m" constant from  $F_{t+m}$  or changing the value of the period sought from the last actual data. The prediction results based on the triple exponential smoothing method for January 2022 are 159,498 visits, while the prediction for January 2023 is 155,148 visits.

The results that have been obtained are then compared with finding the error value using the MAPE (Mean Absolute Percentage Error) method. The error value or error value of a forecast on the number of foreign tourists visiting Indonesia is seen in Table 3.

Table 3 is a lookup table for the error / error value for Malaysia with parameter 0.1 which has an error value of 152.58%. Below is a table of error/error values for 101 countries. In Table 4 it can be seen that the error value obtained in this study is >20% where the results are not in accordance with the results expected by the researcher. Due to Covid-19, the number of visits from various countries has decreased, resulting in a large error value.

**Table 3.** Finding the Value of Forecasting Errors / Forecasting Errors on the number of Malaysian tourists visiting Indonesia

Tahun	$X_t$	$\alpha (0,1)$		
		$F_t$	$X_t - F_t$	$\frac{X_t - F_t}{X_t}$
2018	208.612	176.824	31.788	0,1523786
2019	255.715	186.262	69.454	0,271606
2020	81.677	222.597	140.920	1,725346
2021	41.187	204.044	162.857	3,954097
<b>Jumlah</b>				6,1034276
<b>Rata-rata</b>				1,5258569
<b>%</b>				152,5857

**Table 4.** Prediction errors from 101 countries that visited Indonesia

Country	MAPE (%)								
	$\alpha$ (alpha)								
	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9
Brunei Darussalam	2.630	1.818	1.092	475	368	742	990	1.128	1.183
Malaysia	153	126	102	82	66	78	88	93	95
Philippines	590	442	312	201	140	214	262	289	300
Singapore	1.828	1.280	789	370	276	528	694	787	824
Thailand	730	536	363	214	196	288	349	384	397
Vietnam	889	653	441	261	116	217	292	334	351
Laos	11.884	8.293	5.072	2.326	125	1.745	2.827	3.433	3.672
Cambodia	1.219	877	570	308	217	386	497	560	584
Myanmar	306	248	197	153	117	127	152	166	171
Indonesia	1.603	1.164	771	439	176	242	374	447	477

With this large error value, the search using the triple exponential smoothing method cannot be carried out to predict 2022 to 2023, so that the actual data from 2020 to 2021 from 101 countries is only used as comparison data, namely the comparison between the actual data and the prediction results in from 2020 to 2021 using the Triple Exponential Smoothing method.

### 3.2. Predicting the number of foreign tourist visits to Indonesia in 2020-2021

Based on the previous search, to get the expected results, this study only uses actual data from 2017 to 2019 to predict 2020 to 2021. The search is carried out the same as the previous steps so as to produce prediction results from 101 countries in 2020 to 2021.

Based on Table 5, it can be seen that the average forecasting results decreased at parameter 0.1 and began to increase at parameter 0.4. From 101 countries, 20 countries have been selected that have a large number of tourists visiting Indonesia, from these countries have forecasting results with different parameters.

From Table 6 it can be seen that the countries that have the most visits to Indonesia are Malaysia, China, Singapore, Australia and Timor Leste, these countries have more than 100,000 visits to Indonesia in 2019, based on forecasting results in 2021 the number country visits have increased. This study selected these 5 countries for the final results. Next is to compare the forecasting results in 2020 to 2021 with actual data from 2020 to 2021 based on the selected alpha value with the smallest error value.

**Table 5.** Prediction results in Malaysia using the triple exponential smoothing method

$\alpha$ (alpha)	Actual Data					
	2017	2018	2019	2020	2021	
	176.824	208.612	255.715			
	Forecasting Results					
	2017	2018	2019	2020	2021	
	0,1	0	176.824	186.262	222.597	223.863
	0,2	0	176.824	195.210	235.857	240.492
	0,3	0	176.824	203.238	247.752	257.217
	0,4	0	176.824	210.080	257.890	273.254
	0,5	0	176.824	215.566	266.019	288.099
	0,6	0	176.824	219.623	272.032	301.538
	0,7	0	176.824	222.312	276.016	313.746
	0,8	0	176.824	223.819	278.250	325.278
0,9	0	176.824	224.415	279.133	336.936	

**Table 6.** Average Forecasting Results of the Number of Foreign Tourist Visits in 20 Countries Visiting Indonesia in 2017 to 2021

No.	Country	Average Forecasting Results		$\alpha$ (alpha)	MAPE (%)
		2020	2021		
1	Malaysia	278.242	314.425	0,9	13,74%
2	China	176.558	176.640	0,1	1,86%
3	Singapore	168.261	178.251	0,8	7,67%
4	Australia	119.100	124.923	0,8	4,11%
5	Timor Leste	133.506	133.077	0,1	2,31%
6	Japan	43.167	42.939	0,5	4,17%
7	India	57.316	61.376	0,8	7,55%
8	South Korea	31.273	31.370	0,2	9,29%
9	United Kingdom	32.676	32.676	0,4	1,86%
10	USA	40.835	45.415	0,8	10,94%
11	Philippines	20.265	20.305	0,2	2,19%
12	France	23.814	23.838	0,3	2,43%
13	Germany	23.387	23.680	0,8	1,41%
14	Taiwan	17.323	17.301	0,4	13,90%
15	Indonesia	58.100	57.821	0,4	3,50%
16	Netherlands	17.665	17.681	0,1	1,72%
17	Saudi Arabia	13.013	12.711	0,7	4,90%
18	Papua New Guinea	8.645	8.600	0,2	4,41%
19	Thailand	10.666	10.677	0,1	6,90%
20	Russia	14.488	16.695	0,8	12,47%

Based on Table 5, it can be seen that the resulting comparison is inefficient where the actual data is smaller than the forecast results so that the value is negative. Forecasting (see Table 6) has an increase and decrease in foreign tourist arrivals. The 4th and 5th years are forecasting data for 2020 and 2021. Several countries experienced an increase in the forecasting results of foreign tourist arrivals to Indonesia, namely Malaysia, Singapore, India, China, Timor Leste, France, Germany, United Kingdom, Russia, USA, Australia and New Zealand.

#### 4. CONCLUSION

Based on the results and discussions that have been studied, forecasting using the Triple Exponential Smoothing method cannot be done with actual data in 2020-2021 so that the data used is only 3 (three) years, namely 2017, 2018 and 2019. The reason why it cannot be continued using actual data from 2020 to 2021 is because the data for these 2 (two) years decreased very rapidly due to the influence of Covid-19. The results obtained when using 2020-2021 data are negative, while the search results without using 2020-2021 data are positive. Forecasting in 101 foreign tourists visiting Indonesia gets different parameter results because each result has a different smoothing value, if one of the parameters from 0.1 to 0.9 is close to forecasting results that are close to the actual value or get the value. If the error is small, the search stops at one of these parameters because it has obtained the expected results. From 101 countries, 20 countries were selected based on the results of the highest average number of visits to Indonesia

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