Forecasting the number of food and beverage industries using trend-adjusted exponential smoothing in Banyuwangi after pandemic covid-19

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ARTICLE INFO

ABSTRACT

The development of the tourism industry in Banyuwangi before the COVID-19 pandemic was quite rapid, including the food and beverage industries, but when the COVID-19 pandemic hit, it impacted the number of tourists in Banyuwangi decreasingly, and this had a significant impact on various economic sectors. However, interesting data showed that the number of food and beverage industries can be said to be stable during COVID-19, the trend indicated that there will be an increase in the number of the food and beverage industries after the pandemic subsides. In line with the Banyuwangi Rebound program, it is likely that the quantity of food and beverage industries will increase. Then, based on this phenomenon, the aim of this research was to forecast the number of food and beverage industries in Banyuwangi using the trend-adjusted exponential smoothing method. The accuracy and feasibility of forecasting results were measured based on the Mean Absolute Percentage Error (MAPE) and Tracking Signal (TS) values. The obtained forecasting model will be used to forecast the growth of the food and beverage industries in 2022, 2023, 2024, and 2025. The results of this research obtained that a forecasting model $F_{t+1} = 0.9D_t + 0.1F_t + 0.5(F_t - F_{t-1}) + (0.5)T_{t-1}$, with the results of forecasting the number of the food and beverage industries in Banyuwangi were 547 in 2022, 561 in 2023, 576 in 2024, and 589 in 2025. The average MAPE value for each forecasting result was 37.87% and the average TS value was 0.225, so it was included in the category of feasible to be used.

INTRODUCTION

COVID-19 is an infectious disease caused by the Corona Virus. This disease was discovered in early December 2019 in Wuhan, China which was later designated as a pandemic by the World Health Organization (WHO) on March 11, 2020 (Putri et al., 2021).

This virus spreads rapidly to 219 countries in the world, including Indonesia. The COVID-19 pandemic has made several countries take policies to

carry out physical distancing as an effort to break the chain of virus spread. This policy certainly greatly affects sectors related to people's daily mobility, including the tourism sector.

Before the COVID-19 pandemic era, Banyuwangi always tried to increase the number of tourists visiting Banyuwangi through the launching of the Calendar of Event Banyuwangi 2020 (CoE) as many as 123 events, there were additional events from the previous year, namely 99 events. Banyuwangi tourism is growing rapidly, so this is a great opportunity for economic growth towards a prosperous society from the multiplier of tourism sector development through other tourism events. Related to this, it is very necessary indeed to conduct an in-depth study related to the development and activities of tourism in Banyuwangi while still focusing on the development of sustainable tourism (Kanom & Darmawan, 2020).

Based on data from the Banyuwangi Culture and Tourism Office, in the 6 years before the COVID-19 pandemic was very high (Badan Pusat Statistik, 2022), it was described in Table 1.

Table 1. The Number of Tourists in Banyuwangi 2015-2021

Years	Domestic	Foreign
2015	1,926,179	46,214
2016	4,022,449	77,139
2017	4,832,999	98,970
2018	4,939,934	99,189
2019	5,476,496	109,089
2020	440,145	11,707
2021	430,906	1,772

(Source: Badan Pusat Satistik, 2022*)*

Based on the distribution of data in Table 1, a significant decrease was seen from 2019 to 2020 and 2021, which was around 92% for domestic tourists and 90% for foreign tourists. Whereas, before the COVID-19 pandemic one of the multipliers effects of the development tourism sector was a lot of food and beverage industries in Banyuwangi.

The food and beverage industry is a food and beverage supply service business equipped with equipment and supplies for the manufacturing process can be in the form of restaurants, cafes, food services, and bars/taverns (Undang-Undang Kepariwisataan, 2009).

Developing the number of food and beverage industries not only in the city center of Banyuwangi but also in some areas outside Banyuwangi. Food and beverage industries are developed and it can be said that this number quite a lot. Table 2 described the data distribution of the number of food and beverage industries in several areas in Banyuwangi (Badan Pusat Statistik, 2022).

Table 2. The Number of Food and Beverage Industries in Five Districts in Banyuwangi

District	2018	2019	2020	2021
Banyuwangi	98	137	168	149
Genteng	70	54	68	69
Gambiran	33	45	45	45
Kalipuro	26	28	39	36
Rogojampi	26	20	45	30

(Source: Badan Pusat Satistik, 2022*)*

Based on Table 2, it can be seen that the development of the food and beverage industry in Banyuwangi was growing quite rapidly, the data taken from a sample of the five largest districts in Banyuwangi with economic activities that can be said to be quite large.

The new normal policy requires the public to work from home (WFH), avoid crowds, and minimize mobility. That policy does not make some food and beverage industries drop drastically, this was because the availability of food delivery services like using go food application, makes the culinary industry, especially local culinary still survive in the pandemic era. One of the food and beverage industries that are famous for the local culinary in Banyuwangi is Srengenge Wetan which still survives during the pandemic.

Figure 1. Srengenge Wetan, Local Culinary Industry

(Source: https://srengenge-wetan.business.site, 2022)

Based on the COVID-19 vaccination data from the Ministry of Health of the Republic of Indonesia published on page https://vaksin.kemkes.go.id in June 2022, as many as 96.60% have been vaccinated with the dose I, 80.91% of vaccine dose II, and still 23.59% of vaccine dose III (booster). This is good news for economic recovery in the tourism sector including the food and beverage industry, considering the requirements for travel and access to public places can only be done with a minimum of vaccine dose II. Therefore, in early 2022 the Banyuwangi Regency Government launched a program called Banyuwangi Rebound.

Like the movement in basketball, jumping high to get bouncing balls that fail to enter the ring to be blown up again become points inspired the Banyuwangi to launch the program which focuses on three aspects, 1) deal with the pandemic; 2) restore the economy; and 3) knitting harmony. One of the regent's policy directions in restoring Banyuwangi's economy is the development of Micro, Small, and Medium Enterprises (MSMEs), which is included the food and beverage industry.

Based on the exposure and known data, the researcher was interested in forecasting to analyze the number of the food and beverage industries in Banyuwangi in 2022 and the next 3 years period. Forecasting models from this research were useful as the information

and material for the study development of The Cultural and Tourism Office and also The Cooperation, Micro Enterprise, and Trading Office in the success of the Banyuwangi Rebound program.

The forecasting method that is often used in the research was the time series method in the research by Oni & Akanle (2018), Karmaker (2017), and Sidqi & Sumitra (2019). These studies obtained fairly accurate forecasting results based on the parameter values of MAD (Median Absolute Deviation), MSE (Mean Square Error), and MAPE (Mean Absolute Percentage Error). In addition, for some of these studies, researchers also conducted studies with other approaches, such as in the research by Arceda et al. (2020), Maçaira et al. (2015), and Khamooshi & Abdi (2017) which used trend exponential smoothing.

By observing trends data in the field and analyzing the rate of change in the number of the food and beverage industries in Banyuwangi, then the time series method was considered more appropriate. Researchers used the Trend-Adjusted Exponential Smoothing with parameter values α and β which will later be combined. The Exponential Smoothing method was also applied in some research such as Kumar Paul (2011), Qiao et al. (2020), and Yang (2015).

METHOD

This research was included in applied research, carried out with regard to practical realities, application, and development of science produced by basic research in life, and also quantitative descriptive research with a statistical approach. Data analysis in this research used POM for Windows software; then the steps were described in Figure 2.
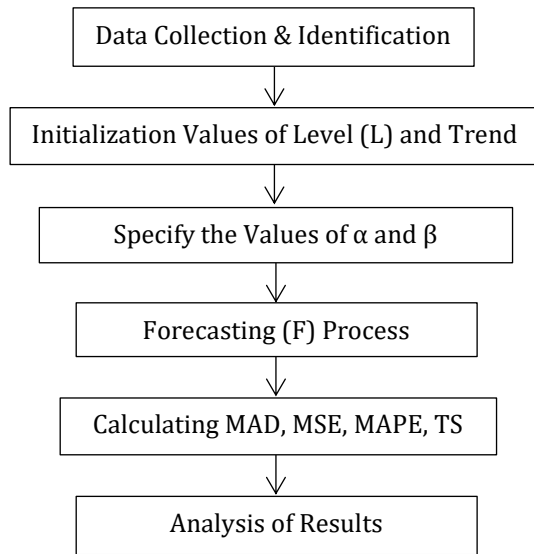
Figure 2. The Research Steps

Research Data

The data used in this research were secondary data about the number of food and beverage industries in Banyuwangi from the 2014-2021 period. The data was obtained from the Central Bureau of Statistics Banyuwangi which has been synchronized with the Department of Culture and Tourism.

Trend-Adjusted Exponential Smoothing

The Exponential Smoothing method, is suitable for long-term forecasting, generally for planning for more than 3 years. Besides that, data patterns that are unstable or the changes are large and turbulent generally use the exponential smoothing model more suitable for use while still paying attention to the trend of data fluctuations.

In this case, the time series exhibits a trend; in addition to the level component, the trend (slope) has to be estimated.

The forecast, including the trend for the upcoming period $t + 1$, was described as follows:

$$F_{t+1} = L_t + T_t \qquad (1)$$

Here, L_t is the estimate of the level made at the end of period t and given by

$$L_t = \alpha D_t + (1 - \alpha)F_t \qquad (2)$$

T_t is the estimate of the trend at the end of period t and is given by

$$T_t = \beta(F_t - F_{t-1}) + (1 - \beta)T_{t-1} \qquad (3)$$

β was also a smoothing constant between 0 and 1 and played a role very similar to that of α (Ravinder, 2016).

Calculating MAD, MSE, MAPE, Tracking Signal

The Mean Absolute Deviation (MAD) was used to measure the accuracy of the estimation value of the model expressed in average form absolute error, the formula is defined as:

$$MAD = \frac{\sum_{t=1}^{n}|X_t - F_t|}{n} \qquad (4)$$

where X_t is actual data, F_t is result data, n is amount of data (Wineka Nirmala et al., 2021).

The Mean Squared Error (MSE) is a method for evaluating forecasting methods. Each error or remainders squared, the formula is defined as:

$$MSE = \frac{\sum_{t=1}^{n}|X_t - F_t|^2}{n} \qquad (5)$$

where X_t is actual data, F_t is result data, and n is amount of data.

The Mean Absolute Percentage Error (MAPE) is calculated using absolute errors in each period divided by the actual observation values for that period. Then, the average is calculated using absolute percentage error. MAPE indicated how much error in forecasting was compared to the real value in the series. The formula is defined as:

$$MAPE = \frac{\sum_{t=1}^{n}\left|\frac{X_t - F_t}{X_t}\right|}{n} \times 100\% \qquad (6)$$

where X_t is actual data, F_t is result data, and n is amount of data (Wineka Nirmala et al., 2021).

Tracking Signal (TS) is calculated by dividing the most recent sum of forecast errors by the most recent estimate of MAD. Then, it was compared to the control limits; as long as the tracking signal was within these limits, the forecast was in control. One standard deviation was approximately equivalent to 1.25 MAD. Then, a common boundary of 3 standard deviations was used (or 3.75 MAD); consequently, Control limits of ±4 were used (Hemeimat et al., 2016).

RESULTS AND DISCUSSION

Based on data the number of food and beverage industries in Banyuwangi from the 2014-2021 period was described in Table 3. The value of parameters is $0 < (\alpha, \beta) < 1$ and which can be defined

a. Forecasting used $\alpha = 0.5$ and $\beta = 0.5$

independently, which reduces forecast error. The value of α and β which produces the smallest error rate is the one chosen in the forecast.

Table 3. The Number of the Food and Beverage Industries

Years	F&B Industry
2014	28
2015	37
2016	70
2017	123
2018	386
2019	788
2020	465
2021	533

Then using the value of parameters α=0.5;0.7;0.9 and β=0.5;0.7;0.9. The results of forecasting were described as follows.
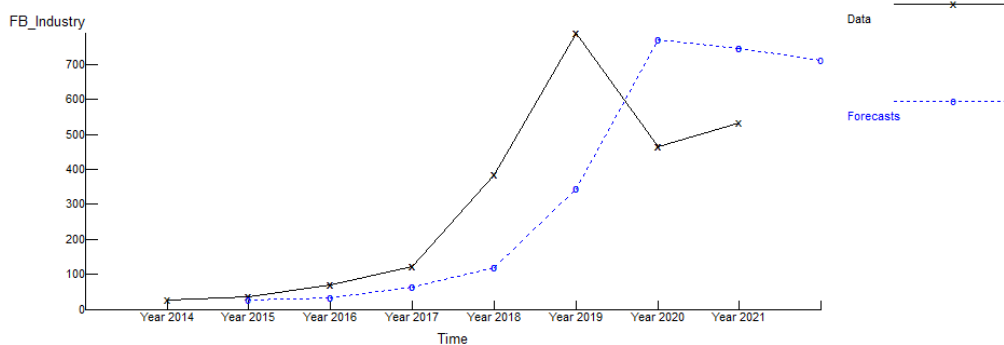

Figure 3. Forecasting results used $\alpha = 0.5$ and $\beta = 0.5$

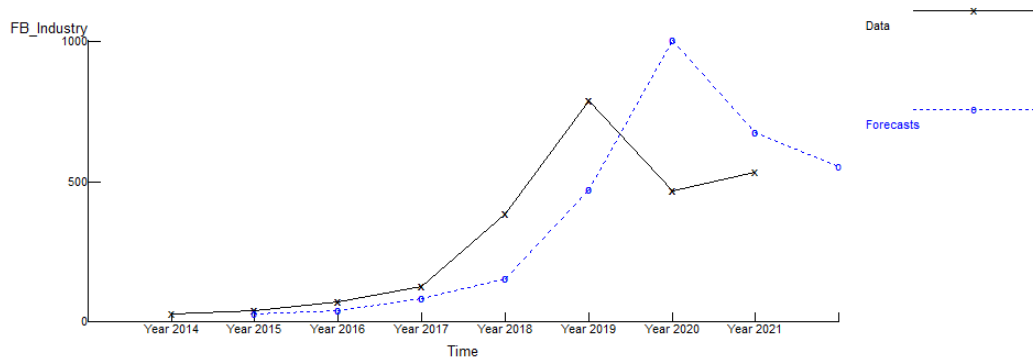b. Forecasting used $\alpha = 0.7$ and $\beta = 0.7$

Figure 4. Forecasting results used $\alpha = 0.7$ and $\beta = 0.7$

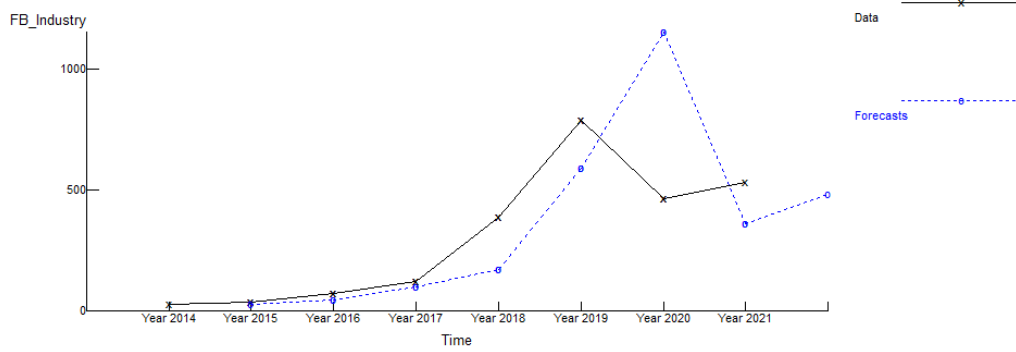c. Forecasting used $\alpha = 0.9$ and $\beta = 0.9$

Figure 5. Forecasting results used $\alpha = 0.9$ and $\beta = 0.9$

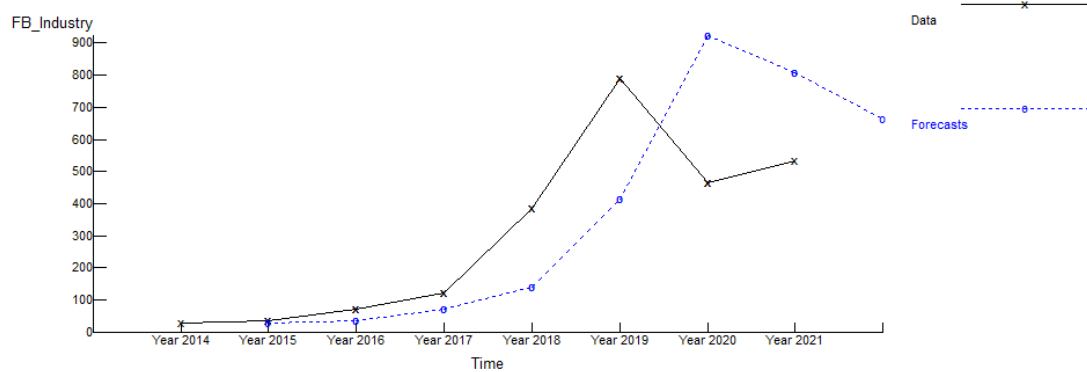d. Forecasting used $\alpha = 0.5$ and $\beta = 0.9$

Figure 6. Forecasting results used $\alpha = 0.5$ and $\beta = 0.9$
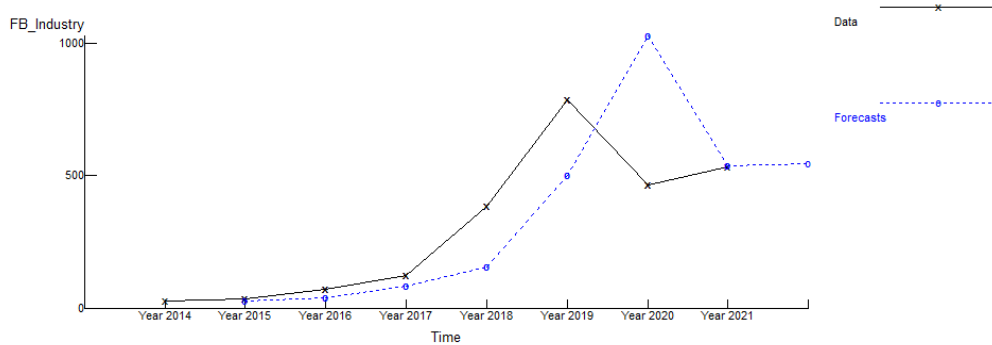
e. Forecasting used $\alpha = 0.9$ and $\beta = 0.5$

Figure 7. Forecasting results used $\alpha = 0.9$ and $\beta = 0.5$

Comparison the Results

After obtaining the forecasting results of 5 combinations of α and β parameter values, the next step was calculating MAD, MSE, and MAPE to know the accuracy of the forecasting model. A comparison of the results was described in Table 4.

Table 4. Comparison Forecasting Results Parameters

No	Parameters (α and β)	MAD	MSE	MAPE
1	0.5 and 0.5	190	58554.03	50.53%
2	0.7 and 0.7	187.78	66970.95	49.59%
3	0.9 and 0.9	190.93	84456.27	49.34%
4	0.5 and 0.9	206.33	69705.94	53.47%
5	0.9 and 0.5	165.83	64899.01	45.17%

$$L_t = 0.9D_t + 0.1F_t \qquad (7)$$

$$T_t = 0.5(F_t - F_{t-1}) + (0.5)T_{t-1} \qquad (8)$$

$$F_{t+1} = 0.9D_t + 0.1F_t + 0.5(F_t - F_{t-1}) + (0.5)T_{t-1} \qquad (9)$$

Parameter value in formula (7) uses $\alpha = 0.9$ and $\beta = 0.5$ in formula (8) because it produces the smallest MAD, MSE, and MAPE value.

Based on the values in Table 4, the combined value of parameters α and β are chosen, and forecasting effectiveness is determined by the value of prediction accuracy, 3 indicators that are often used are MAD, MSE, and MAPE. Forecasting accuracy will be higher if the values of MAD, MAPE, and MSE are getting smaller. If the MAPE value is in the range of 20% - 50%, then the ability of the forecasting model is feasible, and If the MAPE value is in the range of more than 50%, then the ability of the forecasting model is poor. So, $\alpha = 0.9$ and $\beta = 0.5$ were chosen to be used as forecasting models.

The next step using the forecasting model on formula (9), got the result that was presented in Table 5.

Table 5. Forecasting Results for 4 Years

Years	F&B Industry	MAD	MSE	MAPE	TS
2022	547	165.83	64899.01	45.17%	0.18
2023	561	145.13	56786.64	39.53%	0.21
2024	575	129.05	50477.04	35.15%	0.24
2025	589	116.17	45429.34	31.64%	0.27

The forecasting results in Table 5 showed that the number of the Food and Beverage Industries in Banyuwangi was increasing slowly from 2022 to 2025 period, with an average of 568 each year. MAPE value also shrunk by an average of 37.87 % this indicated that the forecasting model in equation (9) was said to be feasible to use for forecasting in subsequent years.

In addition, the results of the tracking signal value become a reference that the forecasting model used is appropriate or not to calculate the existing data. If the tracking signal value exceeds the existing control limit, which is the range of $-4 < TS < 4$, the forecasting results cannot be used to predict future outcomes. The results in Table 5 showed that all TS values do not exceed the control limit. Therefore, the results and forecasting models can be used as material for study and consideration to formulate policies by the Cultural and Tourism Office and also Cooperation, Micro Enterprise, and Trading Office in the development of the food and beverage industries after the COVID-19 pandemic era and also to make the Banyuwangi Rebound program become a success.

CONCLUSIONS AND SUGGESTIONS

Based on the results of this research, forecasting using trend-adjusted exponential smoothing obtained a model forecasting time-series $F_{t+1} = 0.9D_t + 0.1F_t + 0.5(F_t - F_{t-1}) + (0.5)T_{t-1}$, which the results of forecasting the number of food and beverage industries in Banyuwangi were 547 in 2022, 561 in 2023, 576 in 2024, and 589 in 2025. The MAPE value in each forecasting result was an average of 37.87% included in the feasible category for use, then the TS value in each forecasting result was an average of 0.225 within the control limit so that the obtained forecasting model can be used as a study material for the Banyuwangi district government in the development of food and beverage industries in order to make the Banyuwangi Rebound program become a success.

For further research, it is highly recommended to do the same research

using three smoothing parameters such as triple exponential smoothing. The artificial neural network can also be used as an alternative method, to produce the best forecast.

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