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Prediction of the Number of Visitors to Tourism Objects in the Ujung Genteng Coastal Area of Sukabumi Using the Holt-Winter Method

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Abstract:

Ujung Genteng Sukabumi Beach is one of the tourism destinations in Sukabumi Regency, West Java. Forecasting tourist arrivals is a very important factor for tourist destination policies and contributes to the regional economy and the surrounding community. The purpose of this study is to predict the number of tourists who come to Ujung Genteng Beach, Sukabumi. The method used is the Holt-Winter approach exponential smoothing. The Holt-Winter method is used for data that is not stationary, has both trend and seasonal elements. The Holt-Winters method has two models, namely the Additive model and the Multiplicative model. The data used is visitor data in January 2017 - February 2020, the results of the analysis show that the prediction of the number of visitors to Ujung Genteng beach in March 2020 from the additive model is 300 people with a MAPE value of 85.48% and an MSE value of 31230672.68 and a prediction of the number of beach visitors. Ujung Genteng in March 2020 from a multiplicative model of 740 people, with MAPE and MSE values obtained were 86.34% and 27754873.34.

Keywords: Tourism, Prediction, Holt-Winter, Additive, Multiplicative

1. Introduction

Ujung Genteng Beach is a natural tourist area located on the southwest peninsula of the island of Java and is directly adjacent to the Indian Ocean. Ujung Genteng Beach area is located in Sukabumi Regency, West Java. In this area there are various natural attractions, namely beaches and waterfalls. One of the most popular tourist attractions in this area is Pangumbahan Beach. Pangumbahan beach tourism object has beautiful sea views, this place is also a place for turtle cultivation, where there is a turtle breeding conservation area managed by the West Java Provincial Tourism Office. Attractions in the Ujung Genteng beach area are indeed many interesting places to be visited by domestic and foreign tourists. (Pertiwi and Lathifah, 2019; Nurfitria and Arumsari, 2018)

The development of tourist objects can make a very large contribution to the economic growth of the community, because tourist attractions are able to provide job opportunities, income, standard of living and welfare and can also be a source of income for local governments if they are taken seriously, not only local governments who are involved. feel, but also the people who live in it. Thus the development of tourism objects can create community welfare. (Deswita and Yaneri, 2021; Leonita et al., 2019)

The development of the tourism sector is increasing every year, with various kinds of diversity and beauty of natural wealth in various regions of Indonesia. The arrival of tourists to the Ujung Genteng beach attraction, Sukabumi, can increase regional income from the retribution at the entrance to the area.

Predicting tourist visits can be done by various methods, one of which is the Holt-Winter exponential smoothing method. The Holt-Winter method is used for data containing seasonal and trend elements simultaneously. There are two models in the Hol-Winter method, namely addictive and multiplicative models. (Elmunim et al., 2017; Nurhamidah et al., 2020; Bazerra and Santos, 2020)

In this study, the application of the Holt-Winter forecasting method was carried out to determine the number of tourists who would come to the tourist attraction of the Ujung Genteng beach area of Sukabumi in the future using monthly visit data.

2. Research Methods

2.1. Material

The material for predicting the number of visitors to the Ujung Genteng Beach area of Sukabumi uses the Holt-Winter method in the form of field data from a recap of the number of tourist visitors at the entrance to the Ujung Genteng beach attraction every month from January 2017 - February 2020. Data analysis was carried out with the help of Ms. software. Excel and R software.

2.2. Methods

Prediction of the number of visitors to the Ujung Genteng beach area, Sukabumi, was carried out using the Holt Winter method, an additive model and a multiplicative model. Furthermore, the prediction results are analyzed for statistical measure values, namely Mean Squared Error (MSE) and Mean Absolute Percentage Error (MAPE). In this analysis, (Sungkawa and Megasari, 2011; Alfarisi, 2017; Robial, 2018) the results show whether the model method applied is good or not on the data.

3. Results And Discussion

3.1. Descriptive Statistics

Referring to the discussion of materials in section 2.1, that the data analyzed is data on the number of tourist attraction visitors from January 2017 to February 2020.

Table 1. Data on the Number of Visitors

Month	Number of visitors (person)	Month	Number of visitors (person)
Jan-17	5066	Agu-18	5807
Feb-17	2808	Sep-18	2218
Mar-17	1419	Okt-18	1244
Apr-17	5043	Nov-18	9702
Mei-17	2817	Des-18	4774
Jun-17	22790	Jan-19	459
Jul-17	33072	Feb-19	888
Agu-17	2151	Mar-19	807
Sep-17	1069	Apr-19	3057
Okt-17	1373	Mei-19	1564
Nov-17	506	Jun-19	23112
Des-17	3255	Jul-19	5427
Jan-18	2030	Agu-19	5289
Feb-18	1518	Sep-19	4312
Mar-18	1866	Okt-19	1750
Apr-18	3532	Nov-19	1644
Mei-18	2557	Des-19	5933
Jun-18	14200	Jan-20	3181
Jul-18	25842	Feb-20	1524

Furthermore, visitor data is predicted using the Holt Winter method of additive and multiplicative models every month. The calculation of the data on the number of visits was carried out with the help of the R software. The results of the descriptive statistical calculations of the data are given in Table 2.

Table 2. Descriptive Statistics of the Number of Visitors

Descriptive			
Mean	5673.842105	Skewness	2.364934871
Standard Error	1253.664041	Range	32613
Median	2812.5	Minimum	459
Standard Deviation	7728.104168	Maximum	33072
Sample Variance	59723594.03	Sum	215606
Kurtosis	4.933129888	Count	38

Based on Table 2. it is known that the average monthly visitors to Ujung Genteng beach from January 2017 to February 2020 are 5673.84 people per month, the maximum number of visitors is 33072 people, and the minimum visitors are 459 people, for the standard deviation of the data is 7728.104168.

3.2. Assumption Test

a. Stationary Test

In this study, the test used to test the stationary of the data was the Augmented Dickey Fuller (ADF) test. This test was conducted to determine whether the research data used was stationary or not, using of 0.05 and the help of software R, the results were obtained as follows.

Table 3 ADF Uji Test Results

Dickey Fuller	p-value
-1.4949	0.7707

Based on Table 3, it is known that the p-value obtained is 0.7707. P-value > α, then H_0 is accepted or the visitor data of Ujung Genteng Beach is not stationary.

b. Seasonal Pattern (Seasonal)

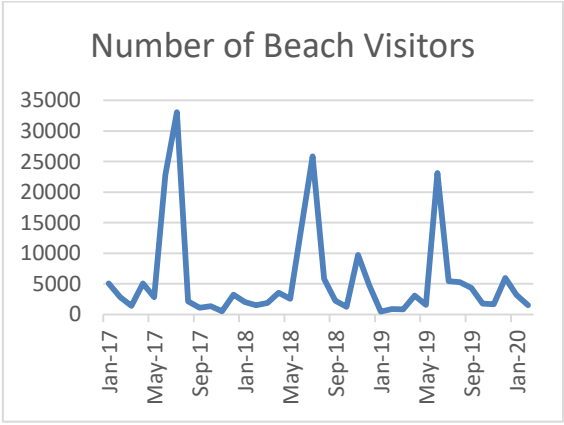

Figure 1. Plot Graph of Visitor Data

Based on Figure 1, it is known that the data has a seasonal pattern. The data pattern experienced a significant increase in July each year and continued with a declining pattern until September. To further confirm the existence of seasonal patterns, an autocorrelation function (ACF) plot will be used.

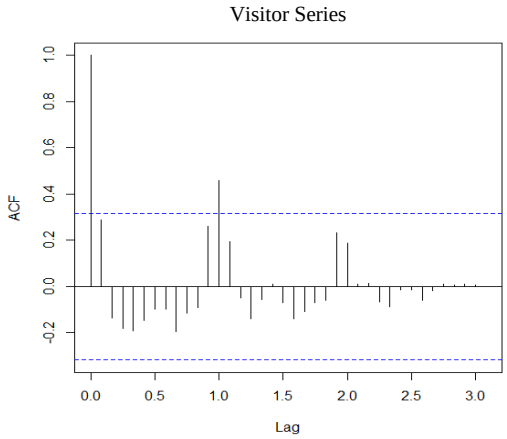

Figure 2. Plot of ACF Data from visitor data

Based on Figure 2 the ACF plot above, it is known that lag 1 is significant, then continued with an insignificant lag until lag 12, and at lag 13 it is significant again. There is a difference of 12 lags between the lags which is significant. In this study, this indicates that there is a seasonal pattern per 12 periods or per 1 year when looking at the data used is monthly data.

c. Trend Pattern

The picture below is a plot of visitor data along with the trendline of the data. Based on the graph, it was found that there was a downward trend for data on visitors to the Ujung Gede beach from year to year.

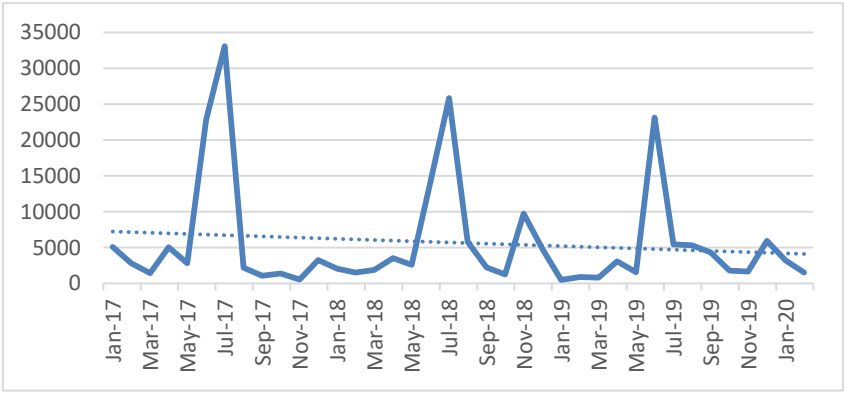

Figure 3. Plot Graph of Trend Pattern Visitor Data

To further confirm the existence of trend patterns from the data, a trend plot from the decomposition of the time-series data will be displayed using R software.

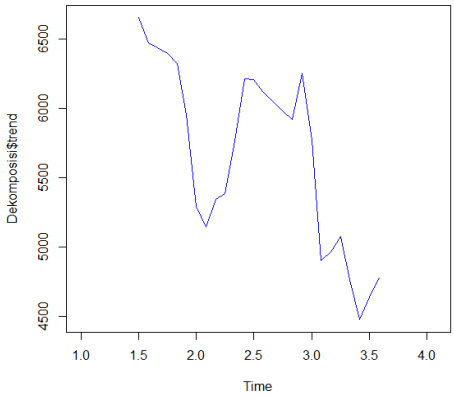

Figure 4. Trend Pattern Data Plot

From Figure 4, it can be seen that the visitors to Ujung Genteng Sukabumi beach are experiencing a downward trend, this can be seen from the graph of the trend component which tends to decrease.

3.3. Holt Winter method

a) Initial smoothing value
Level smoothing starting value

$$S_l = \frac{1}{l}(y_1 + y_2 + \cdots + y_l)$$
$$S_{12} = \frac{1}{12}(5066 + 2808 + \cdots + 3255)$$
$$S_{12} = 6870{,}75$$

Then the initial value of smoothing level is obtained $S_{12} = 6870{,}75$

The initial value of smoothing the trend pattern

$$b_l = \frac{1}{l}\left(\frac{y_{l+1} - y_1}{l} + \frac{y_{l+2} - y_2}{l} + \cdots + \frac{y_{l+l} - y_1}{l}\right)$$
$$b_{12} = \frac{1}{12}\left(\frac{y_{13} - y_1}{12} + \frac{y_{14} - y_2}{12} + \cdots + \frac{y_{24} - y_{12}}{12}\right)$$
$$b_{12} = \frac{1}{12}\left(\frac{2030 - 5066}{12} + \frac{1518 - 2808}{12} + \cdots + \frac{4774 - 3255}{12}\right)$$
$$b_{12} = -42.2153$$

Then the calculation of the initial value of smoothing the trend pattern is obtained $b_{12} = -42.2153$

Initial value of seasonal smoothing
Calculation of the initial value of seasonal smoothing for the additive model

$$I_k = (y_k - S_l)$$

I_1	-1714.75	I_7	26291.25
I_2	-3972.75	I_8	-4629.75
I_3	-5361.75	I_9	-5711.75
I_4	-1737.75	I_{10}	-5407.75
I_5	-3963.75	I_{11}	-6274.75
I_6	16009.25	I_{12}	-3525.75

Calculation of the initial value of seasonal smoothing for multiplicative models

$$I_k = \frac{y_k}{S_l}$$

I_1	0.747115	I_7	4.877337
I_2	0.414113	I_8	0.317222
I_3	0.209269	I_9	0.157652
I_4	0.743723	I_{10}	0.202485
I_5	0.415441	I_{11}	0.074623
I_6	3.360985	I_{12}	0.480035

b) Determination of optimal parameter values α, β and γ,
By using the solver function in Microsoft Excel software. Based on excel, it was found that the optimal values for the parameters α, β and γ, are as follows.

Table 3. Parameter Value

	Multiplicative	Additive
Alpha	0	0
Beta	0.12370988	0
Gamma	1	1
MSE	27754873.34	31230672.68

c) Holt Winter Additive
Level smoothing value for additive model

$$S_t = \alpha(y_t - I_{t-l}) + (1-\alpha)(S_{t-1} + b_{t-1})$$
$$S_{38} = \alpha(y_{38} - I_{24}) + (1-\alpha)(S_{37} + b_{37})$$
$$S_{38} = 5683.153$$

Trend smoothing values for additive models

$$b_t = \beta(S_t - S_{t-1}) + (1-\beta)b_{t-1}$$
$$b_{38} = \beta(S_{38} - S_{37}) + (1-\beta)b_{37}$$
$$b_{38} = -42.21528$$

Seasonal smoothing values for additive models

$$I_t = \gamma(y_t - S_t) + (1-\gamma)I_{t-l}$$
$$I_{38} = \gamma(y_{38} - S_{38}) + (1-\gamma)I_{26}$$
$$I_{38} = -4159.153$$

Then the predictive value of the additive model for $t = 38$ and $m = 1$ is as follows:

$$F_{t+m} = S_t + mb_t + I_{t-l+m}$$
$$F_{39} = S_{38} + mb_{38} + I_{27}$$
$$F_{39} = 300.4167$$

Then the predictive value for the number of visitors to the Ujung Genteng beach in Sukabumi in March 2020 using the Holt Winter additive model is 300 people.

d) Multiplicative Holt Winter
Level smoothing value for multiplicative models

$$S_t = \alpha\frac{y_t}{I_{t-s}} + (1-\alpha)(S_{t-1} + b_{t-1})$$
$$S_{38} = \alpha\frac{y_{38}}{I_{26}} + (1-\alpha)(S_{37} + b_{37})$$
$$S_{38} = 5683.153$$

Trend smoothing values for multiplicative models

$$b_t = \beta(S_t - S_{t-1}) + (1-\beta)b_{t-1}$$
$$b_{38} = \beta(S_{38} - S_{37}) + (1-\beta)b_{37}$$
$$b_{38} = -42.21528$$

Seasonal smoothing values for multiplicative models

$$I_t = \gamma \frac{y_t}{S_t} + (1 - \gamma)$$

$$I_{t-l} I_{38} = \gamma \frac{y_{38}}{S_{38}} + (1 - \gamma) I_{26}$$

$$I_{38} = 0.268161$$

Then the prediction value of the multiplicative model for $t = 38$ and $m = 1$ is obtained as follows:

$$F_{t+m} = (S_t + mb_t) I_{t-l+m}$$

$$F_{39} = (S_{38} + mb_{38}) I_{26}$$

$$F_{39} = 740.4996$$

Then the predictive value for the number of visitors to the Ujung Genteng beach in Sukabumi in March 2020 using the Holt Winter multipkative model is 740 people.

The calculation of the accuracy of the model using MAPE in the data period January 2017 – February 2020. The results of the evaluation are shown in the following table.

Table 4. MAPE . Value

	Multiplikatif	Additif
MAPE	86,34%	85,48%

4. Conclussion

This paper discusses the prediction of the number of visits to Ujung Genteng beach tourism objects using the addictive and multiplicative Holt-Winter model. From the results of the prediction analysis of the number of visitors to the Ujung Genteng beach, Sukabumi which in March 2020 was 300 people using the Holt Winter Additive method with an MSE value of 31230672.68 and a MAPE value of 85.48%, and the prediction of the number of visitors in March 2020 using the Holt Winter Multiplicative method of 740 people with MSE value 27754873.34 and MAPE 86.34%. From the results of the MAPE value, the Holt Winter method is not good for use in the data on the number of visitors to the Ujung Genteng beach.

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