

TRIPLE EXPONENTIAL SMOOTHING ANALYSIS IN PREDICTING NUMBERS REQUEST FOR DELIVERY OF LOGISTICS CV. LOTUS MAS EXPRESS

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Abstract

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CV. Teratai Mas Express is a company engaged in services, namely transportation services or commonly called expeditions. But this company specializes in transportation logistics. The problem that is often faced by this company is that it often suffers losses due to being unstructured in terms of stock transportation inventory to the number of delivery requests. Especially in certain seasons and usually the corn harvest season. Demand rose, but companies often made mistakes in providing their freight. Sometimes advantages and sometimes disadvantages. Excess or shortage of these supplies in a high level. Suppose the company provides 14 transportations but only 8 is used or vice versa, resulting in a large loss. For this reason, a precise prediction calculation is needed so that the number of logistics delivery requests can be predicted efficiently in order to reduce large losses. The prediction method that I use is Triple Exponential Smoothing. This method is suitable for use in this case because the number of logistics delivery requests increases in certain seasons and this method can analyze it.

Keywords: prediction, quantity, demand, delivery, logistics

1. INTRODUCTION

Logistics activities in Indonesia play an important role in trade and business processes where the distribution process is to distribute goods/products from sellers to the public. Problems in distribution or distribution are quite easy to get products anytime and anywhere quickly and at the right cost. In logistics activities, goods owners tend to practice outsourcing (out source) to other parties who provide logistics services (logistics service providers) to handle the core company's logistics affairs such as warehousing, delivery of raw materials / products, and packaging [1]. To meet the needs of delivery of goods, currently many courier service companies are born that continue to grow and compete to seize the market.

The biggest challenge for courier service providers is how to compete with other companies that offer the same type of service, and service users are increasingly demanding the security and reliability of freight forwarder services. Seasonal delivery on CV. Lotus Mas Express on corn logistics is very unpredictable. During the corn season, flour products produced by corn are in great demand so that the company is overwhelmed by customer demand for corn shipments. The company will hire additional transportation from other companies to meet customer demands. However, the problem that arises is that the company is often not right in providing transportation stock from other

companies so that it has an impact on the company's losses. For example CV. Teratai Mas Express has rented 3 transport trucks as logistics delivery stock but only 2 are used, even 1 can be detrimental to the company. For this reason, a forecasting system for the number of logistics delivery requests is needed so that the company can minimize losses due to the irregular supply of transportation stock.

Exponential Smoothing is a method that continuously improves prediction results by smoothing the past value of a time series data in a descending manner. The Exponential Smoothing method has 3 kinds, namely Single Exponential Smoothing, Double Exponential Smoothing, and Triple Exponential Smoothing. The difference between these three methods is that the Single Exponential Smoothing method explains that the data is unstable around a stable average value. While the Double Exponential Smoothing method is often used for data that shows a trend. While the Triple Exponential Smoothing method is often used for data that shows trends and seasonality [3].

The first research was applied by Irma Fitria in 2017 which aims to predict stock prices. In this study using the Double Exponential Smoothing and Autoregressive Integrated Moving Average (ARIMA) methods. The error value in this study uses MAPE. The conclusion in this study is that the Double Exponential Smoothing method has the smallest MAPE value than the ARIMA method [4]. The second research was applied by Eucharistia Yacoba Nugraha in 2017 which aims to predict the best demand for Oxygan PT. Samator Gresik. This study discusses the Double Exponential Smoothing method, Weighted Moving Average, Moving Average, Time Series, and projections of the trend. Error calculation in this study using MAE, MAPE, and MSE. The conclusion in this study is that the Double Exponential Smoothing method is considered better because it has the smallest MSE, MAE, and MAPE values compared to the other two methods with MSE values of 968877.92, MAPE of 1.3%, and MAE of 14372.35. 5]. In this case, the Exponential Smoothing method is included in the very good criteria.

2. Method

The research method used can be seen in Figure 1. It is explained that the use of the exponential smoothing method in this study was carried out in several stages, namely:

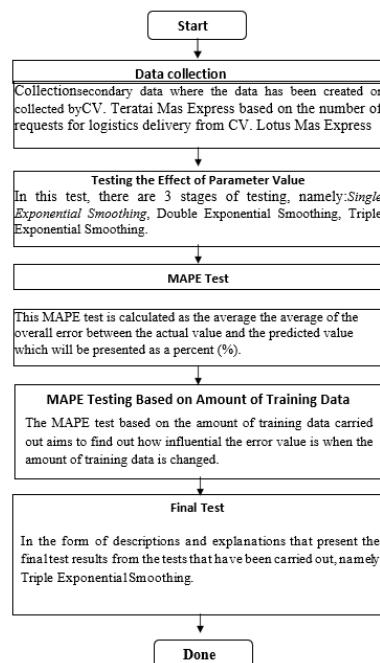


Figure 1. Research methods

3.RESULTS AND DISCUSSION

Problem analysis

Problem analysis aims to identify and evaluate the problems that occur in CV. Lotus Mas Express. The problem found in conducting this research is the difficulty of the company in predicting the magnitude of the demand for logistics shipments in the coming period. This forecasting aims to minimize the problem of lack of transportation stock in logistics delivery to an area. This problem is because the company has not used a computerized system to forecast delivery demand so it is difficult to know how much transportation is needed in the next period so as to minimize losses due to very excess stock or very short stock..Based on these problems, the authors are interested in providing solutions with designing and building a system application that can predict the number of logistics delivery requests in the future.

Solution Analysis

With the problems that often occur in CV. Teratai Mas Express, the solution to this problem is to create a system that can predict the number of logistics requests that are integrated with the database so that it can speed up and make it easier for companies to make reports on logistics delivery requests. The process of forecasting the number of requests for logistics delivery using smoothing method, namely triple exponential smoothing. Where the use of this method is due to the surge in demand for logistics delivery based on certain seasons. Usually the logistics in the form of corn flour at the time of the corn harvest start to increase in demand. The problem is that even though there is a large demand, the exact number of delivery requests is so that the availability of transportation stock often experiences errors. Over stock or even short stock due to predictions so far not based on valid calculations.

Prediction System for Total Logistics Delivery Request CV. Lotus Mas Express

Prediction system for the number of requests for logistics delivery CV. Teratai Mas Express uses the Triple Exponential Smoothing method. This method must be guided by input data from CV. Lotus Mas Express in this case is data on the number of existing logistics requests from the previous 1 (one) year. That is from 2020 and 2021.

Table 1.Number of Requests for Logistics Delivery During 2020

No	Month	Number of Requests (Unit of Trucks)	
1	January	12	Unit
2	February	8	Unit
3	March	3	Unit
4	April	0	Unit
5	May	0	Unit
6	June	0	Unit
7	July	0	Unit
8	August	0	Unit
9	September	1	Unit
10	October	1	Unit
11	November	3	Unit
12	December	4	Unit

Table 2.Number of Requests for Logistics Delivery During 2021

Amount		32	Unit
No	Month	Number of Requests (Unit of Trucks)	
1	January	4	Unit
2	February	4	Unit
3	March	5	Unit
4	April	3	Unit
5	May	6	Unit
6	June	5	Unit
7	July	0	Unit
8	August	0	Unit
9	September	3	Unit
10	October	3	Unit
11	November	8	Unit
12	December	8	Unit
Amount		45	Unit

During the Covid-19 pandemic, this was a very bad condition for the Company. And for the Business World too. So that the number of requests for logistics delivery is very mired from 2020 to 2021. Thank God the company CV. Lotus Mas Express was able to survive in the midst of the Covid 19 pandemic.

The Triple Exponential Smoothing model is used to forecast data with seasonal patterns.

The factors that influence the seasonal pattern of forecasting are as follows:

1. Forecasting Horizon

There are two aspects of the time horizon associated with each forecasting method:

- The scope of future time differences from the forecasting method used should be adjusted.
- Number of periods for which the forecast is desired
Some forecasting techniques and methods can only forecast for forecasting one or two periods in advance, other techniques and methods can predict some time in advance.

2. Accuracy Level

The level of accuracy required is closely related to the level of detail required in a forecast.

- The availability of data for the method used is very useful. If from past data it is known that there is a seasonal pattern, then for forecasting one year ahead, the seasonal variation method should be used. Meanwhile, if it is known that the relationship between variables influence each other, it is necessary to use a causal or correlation method.
- The main form of the basic data pattern for the forecasting method is the assumption that the predicted data pattern will be sustainable. For example, some series show

seasonal patterns, or trends. Other forecasting methods may be simpler, consisting of a single mean, with inherent random fluctuations.

5. There are generally four types of costs in the forecasting process, namely:
 - a. Development costs.
 - b. Storage costs.
 - c. operating costs.
 - d. The opportunity cost of using forecasting techniques.
6. This type of model in addition needs to be considered as some basic assumptions that are important in reality. Many forecasting methods have considered the existence of several models of the predicted state.
7. It's easy to use and apply. One general principle in using the scientific method from forecasting to management and analysis is understandable and easy-to-apply methods that will be used in decision making and analysis.

Unlike the Holt Double Exponential Smoothing model, the Triple Exponential Smoothing model uses three parameters to achieve the value forecasting is a , and u . The steps for forecasting consist of 3 parts, namely the process smoothing (A_t), trend estimation process (T_t), period t estimation process (S_t), and seasonal estimation process (Y_{t+p}). Formula Y_{t+p} used to calculate smoothing are as follows:

$$A_t = a + (1-a)A_{t-1} \dots (1) \frac{Y_t}{S_{t-L}} \alpha A_{t-1} T_{t-1}$$

$$T_t = (1-\beta)T_{t-1} + \beta(A_t - A_{t-1}) \dots (2) \beta(A_t - A_{t-1}) \beta T_{t-1}$$

$$S_t = (1-\mu)S_{t-1} + \mu \frac{Y_t}{A_t} \dots (3) \mu \frac{Y_t}{A_t} \mu S_{t-1-L}$$

Similar to the Holt Double Exponential Smoothing model, the value of A_1 can be assumed to be the same as the value of the first actual data, namely Y_1 . While the value of T_1 can be assumed to be 0 (because the trend value obtained from the previous period does not exist). And the initial seasonal estimate value (S_1) is assumed to be 1 (removing the seasonal effect on the actual data) The formula to determine the forecast value is as follows:

$$Y_{t+p} = A_t + pT_t + S_{t-L+p} \dots (4) A_t T_{t+p} S_{t-L+p}$$

Under the condition:

- α = smoothing constant ($0 < \alpha < 1$)
- β = smoothing constant for trend forecast ($0 < \beta < 1$)
- A_t = actual data at time t
- T_t = trend forecast
- Y_{t+p} = seasonal forecast
- L = Length of season. [4]

Results

The data used in this study is data on logistics delivery requests for 2 years, namely from 2020 and 2021. Forecasting data to be sought is data for the next year, namely data in 2022. In studies with constant values = 0.4 and = 0.1, value = 0.3 : $\alpha\beta u$

Table 3 The determination of the values of α and β and μ used

No	α	β	μ
1	0.1	0.1	0.1
2	0.2	0.2	0.2
3	0.3	0.3	0.3
4	0.4	0.4	0.4
5	0.5	0.5	0.5
6	0.6	0.6	0.6
7	0.7	0.7	0.7
8	0.8	0.8	0.8
9	0.9	0.9	0.9

Score β

Score μ

Score α

This provision is a provision used in the triple exponential smoothing method.

1. The initial value calculated is the value in 2020 and 2021 which have 12 months each. The results of the calculation of the initial value are:

$$\begin{aligned}
 L_{12} &= \frac{1}{12} (y_1 + y_2 + y_3 + y_4 + y_5 + y_6 + y_7 + y_8 + y_9 + y_{10} + y_{11} + y_{12}) \\
 &= \frac{1}{12} ((12 + 4) + (8 + 4) + (3 + 5) + (0 + 3) + (0 + 6) + (0 + 5) + (0 + 0) \\
 &\quad + (0 + 0) + (1 + 3) + (1 + 3) + (3 + 8) + (4 + 8)) \\
 &= \frac{1}{12} (81) \\
 L_{12} &= 6.75
 \end{aligned}$$

2. The second step is to find the initial value of Trend smoothing.

$$\begin{aligned}
 b_{12} &= \frac{1}{12} (y_{12+1} - y_1 + y_{12+2} - y_2 + y_{12+3} - y_3 + y_{12+4} - y_4 + y_{12+5} - y_5 + y_{12+6} \\
 &\quad - y_6 + y_{12+7} - y_7 + y_{12+8} - y_8 + y_{12+9} - y_9 + y_{12+10} - y_{10} + y_{12+11} \\
 &\quad - y_{11} + y_{12+12} - y_{12}) \\
 b_{12} &= \frac{1}{12} ((13 - 16) + (14 - 12) + (15 - 8) + (16 - 3) + (17 - 6) + (18 - 5) \\
 &\quad + (19 - 0) + (20 - 0) + (21 - 4) + (22 - 4) + (23 - 11) + (24 \\
 &\quad - 12) / 12) \\
 &= \frac{1}{12} ((-3) + 2 + 7 + 13 + 11 + 13 + 19 + 20 + 17 + 18 + 12 + 12 / 12) \\
 &= \frac{1}{12} (141 / 12) \\
 &= \frac{1}{12} (11.75) \\
 L_{12} &= 0.979
 \end{aligned}$$

3. The next step is to calculate the value of seasonal smoothing the results of the calculation of the initial seasonal writing value are:

Formula :

$$S_1 = (y_1 - L_s, S_2 = y_2 - L_s, \dots, S_s = y_s - y_s)$$

$$S_1 = (16 - 0,979 = 15.021)$$

$$S_2 = (12 - 0,979 = 11.021)$$

$$S_3 = (8 - 0,979 = 7.021)$$

$$S_4 = (3 - 0,979 = 2.021)$$

$$S_5 = (6 - 0,979 = 5.021)$$

$$S_6 = (5 - 0,979 = 4.021)$$

$$S_7 = (0 - 0,979 = -0.979)$$

$$S_8 = (0 - 0,979 = -0.979)$$

$$S_9 = (4 - 0,979 = 3.021)$$

$$S_{10} = (4 - 0,979 = 3.021)$$

$$S_{11} = (11 - 0,979 = 10.021)$$

$$S_{12} = (12 - 0,979 = 11.021)$$

4. The next step is to calculate the error smoothing value in this manual calculation example using the values $a = 0.4$ and $b = 0.1$, $= 0.3u$

Table 4 data on overall and seasonal smoothing results for 2022.

Month	Period	Overall Smoothing (Lt)	Trends Overall (Tt)	Seasonal Overall (St)
January	15,021	6.0084	1.5021	4.5063
February	11.021	4.4084	1.1021	3.3063

5. The next step after calculating the smoothing value is to calculate the error value.

Table 5 forecasting error values in 2022

Month	Year	Actual Data (xt)	Forecast Data (ft)	$\left \frac{Xt - Ft}{Xt} \right $
January	2022	9	$(6.0084 + 1.5021 + 4.5063) = 12.0168 \Rightarrow 12$	-0.3333
February	2022	10	$(4.4084 + 1.1021 + 3.3063) = 8.8168 \Rightarrow 9$	0.1
Total MAPE				-0.2333

$$\begin{aligned} \text{MAPE Percentage} &= \frac{\text{Total MAPE}}{n} \times 100 \\ &= \frac{-0.2333}{12} \times 100 = 1.9442 \% \end{aligned}$$

The conclusion from the MAPE (Mean Absolute Percentage Error) calculation above is that the ability is very good with a MAPE value of 1.9%. This means that the prediction method can still be applied because it has a small error rate.

4. CONCLUSIONS

Based on the analysis and calculations that have been carried out in the previous chapter, the authors put forward the conclusions, namely Analysis of the calculation of the Triple Exponential Smoothing method can predict the number of logistics delivery requests on CV. Lotus Mas Express so

as to minimize losses due to overstock truck transport. There is an error value from the calculation is a natural thing because the prediction system must have a level of uncertainty. However, the calculation shows that the error rate is minimal, so this method can be used.

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