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Demand Forecasting Analysis of Clay Mask Production Using Time Series Method at PT. Molhar

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ABSTRACT

Forecasting is an attempt to predict future conditions through past data. In life, everything is uncertain, it is difficult to predict precisely. In this case PT. MOLHAR wants to analyze the demand forecasting for CLAY MASK products using the time series method. The purpose of this practicum is to be able to analyze the demand for CLAY MASK using the time series method, namely Moving Average 3, Weighted Moving Average 3, and Single Exponential Smoothing and by calculating errors, namely Mean Square Error (MSE), Standard Error Estimation (SEE), Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) which will then choose the most appropriate method and ensure that the method used is good to use. demand for sales of CLAY MASK in the following month is 762 units.

Keywords: Forecasting, moving average, weighted moving average, single exponential smooothing

Introduction

According to Tannady et al. (2021), forecasting is a process for estimating how many future needs include quantity, quality, time, and location needed to meet the demand for goods or services. Time-series methods are divided into many kinds. One of them is the smoothing method. The smoothing method is used to organize past data according to the seasonality of the data that occurs by averaging a series of data to have a distance and amount of data that tends to be almost balanced (Biri et al., 2013). The next method is a simple moving average, which uses the average of several (n) recent data to forecast future periods. In the moving average method, the time series of the original data is converted into a moving average data series that is smoother and less dependent on oscillations making it more likely to show underlying trends or cycles in data patterns over time. Other kinds of time series methods are weighted moving average and single exponential smoothing. The weighted moving average has the same calculation as a simple moving average, only given the weighting coefficients. This technique is more responsive to changes because the closer period gets heavier weight (Hayuningtyas, 2017).

The choice of weight is uncertain because there is no formula to determine it (Wu & Gonzales, 1999). The magnitude of the weighting coefficient can be determined arbitrarily. Still, in general, the magnitude of the weighting coefficient for the last period from historical data is twice the weighting coefficient for the previous period. Otherwise, Single Exponential Smoothing is used for short-distance approximations. The model assumes that the data fluctuates around a fairly stable average (Yapar, 2016). This method is a forecasting technique using an exponential weighting of the data in the past. Weighting is done on the data so that the most recent data has a greater weight in the moving average. A common problem faced when using the exponential smoothing model is to

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choose a smoothing constant (α) that is estimated to be appropriate. The constant smoothing value is selected between 0 and 1 because it applies 0 < < 1. If the historical pattern of the actual demand data is volatile over time, the chosen value is close to 1. The historical pattern of the actual demand data does not fluctuate or is relatively stable over time. The selected is the one whose value is close to zero. Some formulas can be used to count the forecast manually :

1. Moving Average
   $\overline{M_t}$= Y_{t+1} = $\frac{yt-1+yt-2+\cdots\ldots+yt-n}{n}$ .....1)
   Formula desc :
   M_t = Moving average in period t
   Yt+1 = The forecast value for the next period
   Yt = amount of data on moving average

2. Weighted Moving Average
   $Y'_t = W_1A_{t-1} + W_2\ A_{t-2} + \ldots + W_nA_{t-n}$ ……..2)
   Formula desc :
   A = Actual demand in period t
   W1 = Weight (0 Wt 1) given in period t-1
   n = Number of periods

3. Single Exponential Smoothing
   $Y'_{t+1} = \alpha\ T_t + (1-\alpha)\ Y'_t$……3)
   Formula desc :
   Tt = Demand data in period t
   α = smoothing factor/ constant
   Y't+1 = Forecasting for period t.

Material and Methods

This research was conducted at PT. MOLHAR, East Java in January 2021. In general, the data needed is primary data. That is in the form of order data and CLAY MASK production data.

1. Data Collection Stage: Data are collected by the following method:
   a. Literature study, to find theories relevant to research carried out through relevant references, which can be in the form of journals, books, articles, and previous research;
   b. Interviews were conducted directly with the sales department of PT. MOLHAR, East Java to obtain data on weighting numbers and smoothing number values.
   c. Observation, carried out directly on the production department to obtain data on sales of CLAY MASK in the past for 12 months.

The data used are primary and secondary. Primary data is data obtained directly by researchers at PT. MOLHAR, East Java. While secondary data is data received or collected by people researching existing sources. The data needed in this study are as follows:

   1) Past sales data of CLAY MASK for 12 months
   2) Weighting figures
   3) Smoothing rate2.

2. Data Processing Stage: The method used in this research is the forecasting method. The definition of forecasting is an estimate of the occurrence of an event in the future based on data that has existed in the past. More specifically, the methods used are the Moving Average, Weighted Moving Average, and Single Exponential Smoothing methods.
   The flow chart used in this study is as shown in figure 1.

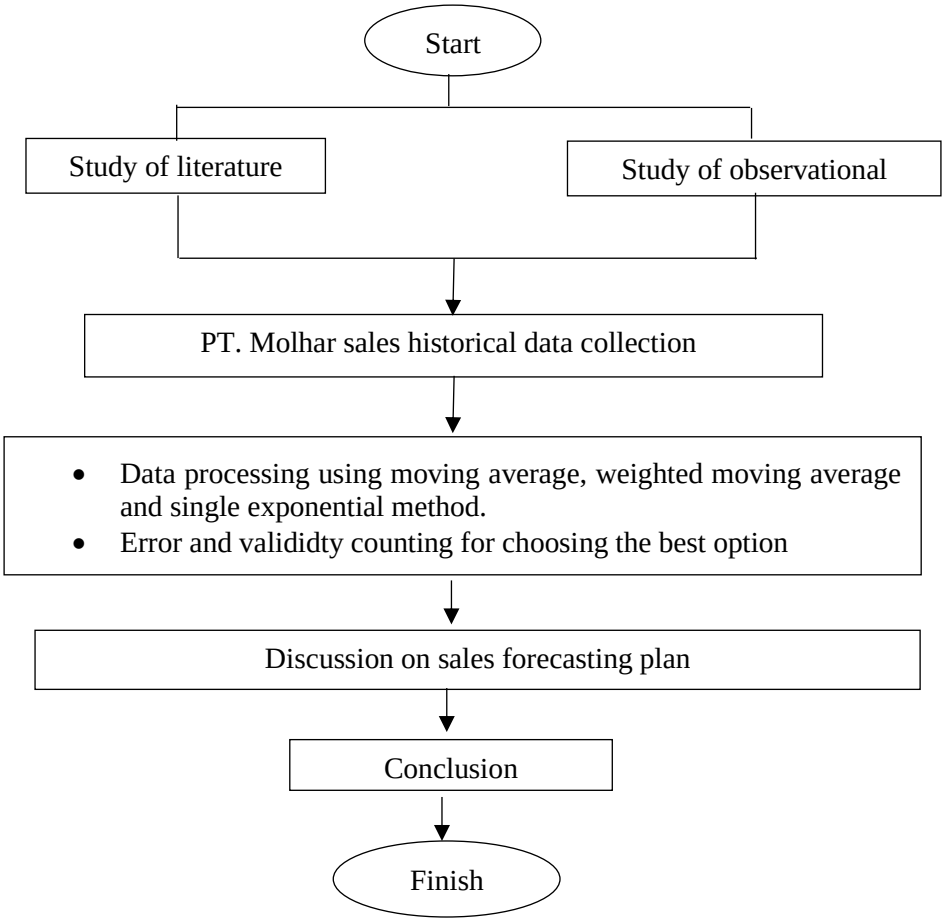

Figure 1. Research flowchart

Results and Discussion

Data input of demand and production

Table 1. Demand and production of clay mask

No	Month	Year	Order (Units)	Production (Units)
1	January	2020	920	932
2	February	2020	870	891
3	Maret	2020	841	853
4	April	2020	694	703
5	May	2020	731	749
6	June	2020	745	757
7	July	2020	953	964
8	August	2020	747	751
9	September	2020	721	730
10	October	2020	851	863
11	November	2020	702	711
12	December	2020	732	740

We can see the comparison between the amount of CLAY MASK production and the number of orders from January 2020 to December 2020, not too far away. The production level of CLAY MASK and the level of sales that have the biggest difference can be seen in May 2020. The production resulted in 749 products but the level of sales was only 731 products. The difference between production and product orders is 18. If this happens often, the company must increase product marketing so that there is no accumulation of products in the warehouse. In controlling problems where production levels are high and product sales are low, product demand forecasting is carried out to overcome existing problems, so that product accumulation does not occur**.**

Result of Demand Forecast

The data of results moving average forecasting, weighting moving average, and single exponential smoothing are shown in Table 2, Table 3, and table 4, respectively

1. Moving average 3

Table 2. Result of moving average forecasting

Month	Year	*Demand*	Production (Units)
January	2020	920	
February	2020	879	
Maret	2020	841	
April	2020	694	880
May	2020	731	804,6667
June	2020	745	755,3333
July	2020	953	723,3333
August	2020	747	809,6667
September	2020	721	815
October	2020	851	807
November	2020	702	773
December	2020	732	758
January	2021		761.6667

2. Weighted moving average

Table 3. Result of moving average forecasting

Month	Year	*Demand*	Production (Units)
January	2020	920	
February	2020	879	
Maret	2020	841	
April	2020	694	868,2
May	2020	731	775,1
June	2020	745	741,9
July	2020	953	730,6
August	2020	747	846,2
September	2020	721	808,4
October	2020	851	775,2
November	2020	702	791,2
December	2020	732	750,5
January	2021		746,8

3. Single exponential smoothing

Table 4. Result of single exponential smoothing

Month	Year	*Demand*	*Forecasting* (α=0.9)
January	2020	920	0
February	2020	879	920
Maret	2020	841	915,9
April	2020	694	908,41
May	2020	731	886,969
June	2020	745	871,3721
July	2020	953	858,7349
August	2020	747	868,1614
September	2020	721	856,0453
October	2020	851	842,5407
November	2020	702	843,3867
December	2020	732	829,248
January	2021		819,5232

Error size calculation

Error calculation data are shown in table 5.

Table 5. Size of error of each forecasting method

Method	Error Size Value			
	MAD	MSE	SEE	MAPE
Moving Average 3	88,57	12.588	113,88	11,4%
Weighted Moving Average 3	90,43	12.587	116,27	11,6%
Single Exponential Smoothing	110,01	14.909	134,467	14,72%

From the table of error sizes for each forecasting method, the method that has the smallest error is obtained, namely the Moving Average 3 method.

Verification of forecasting methods

Following are the results of the mapping for the Moving Average 3 method

Table 6. Size of error of each forecasting method

Period	Order Data (Dt)	Forecast (D't)	Dt-D't	MR	|MR|
January	920	0	0		
February	879	0	0		
Maret	841	0	0		
April	694	880	-186	112,3333	165,666
May	731	804,66666667	-73,6667	63,33333	165,666
June	745	755,33333333	-10,3333	240	165,666
July	953	723,33333333	2229,6667	-292,333	165,666
August	747	809,66666667	-62,6667	-31,3333	165,666
September	721	815	-94	138	165,666
October	851	807	44	-115	165,666
November	702	773	-71	45	165,666
December	732	758	-26	-224	165,666
				2112	

$\overline{MR} = \frac{\sum_{t=1}^{n} MR}{n-1} = \frac{2112}{9} = 165{,}6$

BKA = +2.66 $\overline{MR}$ = +2.66 (165,6) = 440,67

BKB = -2.66 $\overline{MR}$ = -2.66 (165,6) = -440,67

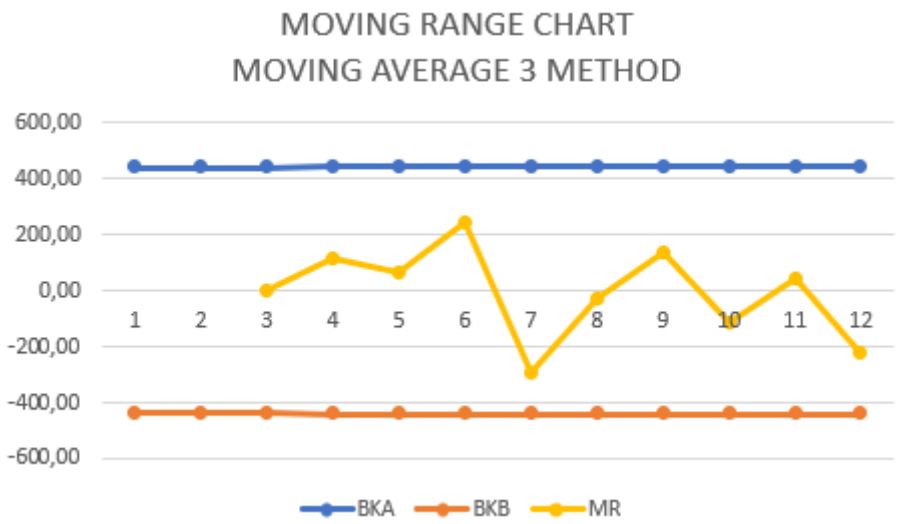

Figure 2. Moving range chart moving average 3 method

The verification data is processed to form a Moving Range Chart (MRC), as shown at the movement data graphic. Based on the MRC graph, there are no extreme data that move past the upper control limit. And for forecasting for the next month, namely January 2021, as many as 762 units.

Conclusion

The verification data above has been processed to form a Moving Range Chart (MRC), which shows the movement of the data graphic. Demand for sales of CLAY MASK in the following month is 762 units.

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