Implementation of the Moving Average Method for Forecasting Inventory in Cv. Tre Jaya Perkasa

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ABSTRACT

The supply chain is an organization's place to distribute production goods and services to customers. This chain is a network of various organizations that are interrelated and have the aim of carrying out the procurement or supply of goods. Inventory is storing goods in the form of raw materials, semi-finished goods or finished goods that will be used in the production or distribution process. CV. Tre Jaya Perkasa is a company engaged in the distribution of goods such as snacks, drinks and daily necessities. CV. Tre Jaya Perkasa is located in Solok, West Sumatra, Indonesia. From January 2020 to June 2021, CV. Tre Jaya Perkasa has made more than 10 thousand transactions. Based on the sales data, each period (month) of sales transactions can increase and decrease, and the company must plan product sales in the coming period. To maximize profits and minimize losses, a strategy is needed to maintain the availability of goods that are often purchased by customers. From historical transaction data, the company can predict how much stock should be provided for transactions in the coming period. The method used is the moving average method, to measure the error rate of forecasting, MAD, MSE and MAPE are used. Based on the research that has been done, then carried out on the product TRICK POTATO BISCUIT BBQ 24 BOX X 10X18 forecasting comparison between using 3 periods and 5 periods, using 5 product data that are most often purchased by buyers, it was found that the average value of MAD, MSE and MAPE closer to 0 is to use 3-period forecasting.

1. Introduction

The supply chain is an organization's place to distribute production goods and services to customers. This chain is a network of various organizations that are interrelated and have the same goal, namely to organize the procurement or supply of goods. Entities that play a role in the supply chain are suppliers, manufacturers, distributors, retail outlets, and customers. [1] [2]

Inventory is storing goods in the form of raw materials, semi-finished goods or finished goods that will be used in the production or distribution process [3]. Inventory is useful to facilitate the company's operational processes that are carried out successively for business processes. Inventory of goods is very important for the company's operations, if it is not done properly it will create a risk of disrupting the buying and selling process, which can result in losses to the company [4]. For

example, the case of the NIKE company, which recently experienced problems in the supply chain due to production and distribution delays, resulting in increased sales and administrative costs [5].

Forecasting is an attempt to predict future conditions by studying data sets from the past [6] [7]. The use of forecasting in trading companies can help companies to find out the number of requests that will come, so that companies can consider whether to add inventory or not [8].

CV. Tre Jaya Perkasa is a company engaged in the distribution of goods. CV. Tre Jaya Perkasa already has more than 1000 customers who pick up goods for resale. The number of sales transactions will affect the inventory of goods in the warehouse. Because many transactions are carried out, inventory control is needed. Inventory control is very important for distributor companies. This is useful for minimizing storage costs that must be borne by the company, and meeting customer demands [9]. However, because demand is difficult to know with certainty, stock reserves become an alternative to meet more changes in demand. Market or customer demand that cannot be fulfilled will result in out of stock on certain products. With this problem, we need a system that can predict the number of items that must be ordered from suppliers, so that there will be no shortage or excess stock of goods in the warehouse.

One method in forecasting that can be used is the Moving Average method. The Moving Average method uses time as the basis for forecasting. Past historical data is the basic material used to be described in forecasting. Furthermore, to calculate the level of forecasting error is calculated by MAD (Mean Absolute Deviation), MSE (Mean Squared Error), and MAPE (Mean Present Error) [3] [10].

Similar research has been carried out by Hayuningtyas, in this study combining the weighted moving average method and the double exponential smoothing method, the data used for this research is sales data for one year 2016. In this study, the comparison of forecasting results using both methods is described. inventory for the next period 52 with Weighted Moving Average and 60 with Double Exponential Smoothing. Both of these methods have a Mean Square Error value. Where the Weighted Moving Average error value is 0.114 and the Mean Square Error error value is 6.12, the smallest error value [9].

While the research conducted by Rizal Rahman, in this study compared 2 forecasting methods, namely the moving average method and the Exponential Smoothing method, the data used is consumer demand data in 2017. In this study, a comparison between the two methods is described, the results of demand forecasting for January 2018 using the moving average method is 76.999.67 pcs, while the exponential smoothing method = 0.9 is 78.146 pcs. Between the two methods, the method that has a smaller forecast error value is the exponential smoothing method =0.9. [11]

2.   Research Method

The primary data collection methods used in this research are:

- Observation In this method the researchers made a direct visit to CV. Tre Jaya Perkasa and conducted data collection from existing processes in the field to obtain the data needed in this research.
- Interview In this method, a question and answer process is carried out with several sources, to obtain the data used in this study.
- Study of literature Studying and understanding books, journals and others related to this research.

The secondary data from this research is the transaction history data collection of Cv. Tre Jaya Perkasa from April 2020 to June 2021. For this study, the data used is sales data for the TRICK POTATO BISCUIT BBQ 24 BOX X 10X18 product. Sales data from these products will be tested for the 3 period and 5 period moving average method. Sales data of the TRICK POTATO BISCUIT BBQ 24 BOX X 10X18, can be seen in Table 1.

Table 1. Histori Transaksi Produk Trick Potato Biscuit BBQ 24 BOX X 10X18

No	Period	Sold
1	April 2020	1,415
2	May 2020	1,700
3	June 2020	2,873
4	July 2020	1,959
5	August 2020	4,185
6	September 2020	2,718
7	October 2020	3,465
8	November 2020	2,956
9	December 2020	2,768
10	January 2021	3,451
11	February 2021	2,996
12	March 2021	1,320
13	April 2021	2,497
14	May 2021	1,635
15	June 2021	1,401

The method used to predict the amount of stock using the type of quantitative forecasting, namely the moving average method

A. Forecasting Approach

This study uses a quantitative approach, namely research that emphasizes analysis on numerical data that is processed by statistical methods to be able to predict future conditions or trends. Quantitative research allows for generalization to the results, which are calculated by statistical analysis [12] [13].

The quantitative approach can be separated into 2 criteria, namely the Time Series approach, which is a design stage that makes a process to obtain accurate planning results as a unit that cannot be found and no further process is needed to find it. Then the second is the causal explanatory technique, which is a method in which it considers the forecasting results to have a causal relationship by utilizing system inputs [14].

B. Determining the Forecasting Model

To determine the forecasting model to be used, it is necessary to conduct data analysis. The historical data used is stationary or non-stationary data. Stationary data is historical data that has an average and has a tendency to move towards the average. Stationary data occurs when there is no sharp increase or decrease in the data [15]. Non-stationary data is historical data that has a trend, tends to move up or down.

In Figure 1, you can see a graph of sales of the TRICK POTATO BISCUIT BBQ 24 BOX X 10X18, on the graph you can see how the data pattern is to determine the forecasting model that can be used.
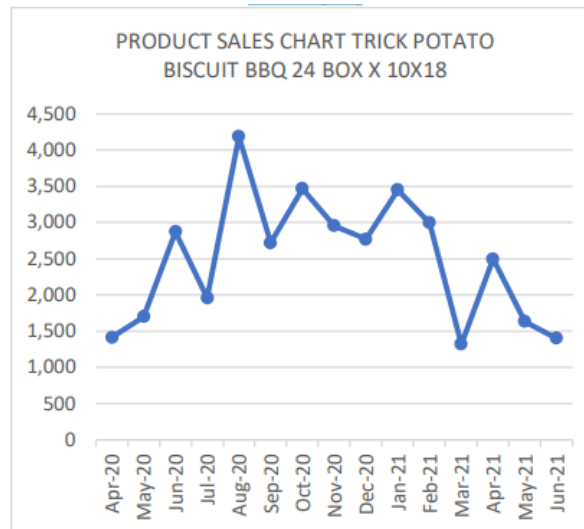
Figure 1. Product Sales Chart Trick Potato Biscuit Bbq 24 Box X 10x18

It can be seen in Figure I that the data does not experience a significant trend, sales data tends to move towards the average. Because the data is not trend data, so for the forecasting process it can be used using the moving average method.

C. Moving Average

Moving Average is a forecasting method that is carried out by using a group of data that has a value, then looking for the average of that group of values for forecasts in the future period [3]. Forecasting with this moving average method assumes that all values in historical data have the same weight value in calculating the forecast value in the next period. Forecasting using the moving average method is the simplest forecasting, because it does not use weighting in forecasting calculations. Although simple, this method is quite effective for knowing market trends [16]

The characteristics of the Moving Average Method are as follows:
- Historical data over a certain period of time is needed to determine forecasts for the future period. For example with a 3 month moving average, to forecast the 4th month.
- The longer the moving average time, the better the moving average will be.

The mathematical equation of the Moving Average method is:

$$M_t = F_{t+1} \tag{1}$$

$$M_t = \frac{Y_t + Y_{t-1} + Y_{t-2} + \cdots + Y_{t-n}}{n} \tag{2}$$

Description:
M_t : Moving Average for period t
F_{t+1} : Forecast for period t+1
Y_t : Real value period t
n : the number of limits in the moving average

D. Measuring Forecasting Error

The measure of the accuracy of the forecasting results is a measure of the degree of difference between the forecasting results and the actual value. This measure of forecasting accuracy can be measured by [17]:

1) MAD (Mean Absolute Deviation)

Mean Absolute Deviation is used to measure the accuracy of the forecast by averaging the magnitude of the forecast error where each forecasting has an absolute value for each error [18]. The formula for calculating MAD is as follows:

$$MAD = \frac{\Sigma |A - F|}{n} \tag{3}$$

Description:

A   : actual value
F   : forecast value
2) MSE (Mean Square Error)

MSE is the second way to measure forecasting error. MSE is the average of the squared differences between the actual values and the forecast values [19].
The formula for calculating MSE is as follows:

$$MSE = \frac{\Sigma|A-F|^2}{n} \tag{4}$$

3) MAPE (Mean Absolute Percent Error)

MAPE is the average of the absolute difference (absolute) between the forecast and actual values, then displayed as a percentage of the actual values [20].
The formula for calculating MAPE is:

$$MAPE = \frac{\Sigma\left(\frac{|A-F|}{A}\right)*100}{n} \tag{5}$$

3. Results and Discussion

To forecast the inventory of goods in the future period, namely the period of July 2021, the data used is sales data from April 2020 to June 2021 from the products most frequently purchased by customers, namely TRICK BISKUIT KENTANG BBQ 24 BOX X 10X18 products. Forecasting will be done using the 3 period and 5 period moving average method.

1) Forecasting with 3 period

The results of sales forecasting for the July 2021 period will be a reference for determining the amount of inventory that must be provided by the company for transaction processing in July 2021. The sales forecasting process in July can be seen in Table 2.

Table 2. Forecasting Results Using 3 Periods

No	Period	Sold		MA (3)
1	April 2020	1,415		0
2	May 2020	1,700		0
3	June 2020	2,873		0
4	July 2020	1,959	(1415+1700+2873)/3	1,996
5	August 2020	4,185	(1700+2873+1959)/3	2,177
6	September 2020	2,718	(2873+1959+4185)/3	3,006
7	October 2020	3,465	(1959+4185+2718)/3	2,954
8	November 2020	2,956	(4185+2718+3465)/3	3,456
9	December 2020	2,768	(2718+3465+2956)/3	3,046
10	January 2021	3,451	(3465+2956+2768)/3	3,063
11	February 2021	2,996	(2956+2768+3451)/3	3,058
12	March 2021	1,320	(2768+3451+2996)/3	3,072
13	April 2021	2,497	(3451+2996+1320)/3	2,589
14	May 2021	1,635	(2996+1320+2497)/3	2,271

No	Period	Sold		MA (3)
15	June 2021	1,401	(1320+2497+1635)/3	1,817
16	**July 2021**			**1,844**

From the table above, it is known that the forecasting results in July with 3 periods are 1.844. After doing the forecasting, the next step is to calculate MAD, MSE and MAPE.

Table 3. Calculation Results of Mad, Mse, And Mape

Period	A	F	Dev	MAD	MSE	MAPE
Jul 2020	1,959	1,996	-37	37	1,369	1.89
Aug 2020	4,185	2,177	2,008	2,008	4,030,725	47.97
Sep 2020	2,718	3,006	-288	288	82,752	10.58
Oct 2020	3,465	2,954	511	511	261,121	14.75
Nov 2020	2,956	3,456	-500	500	250,000	16.91
Dec 2020	2,768	3,046	-278	278	77,469	10.06
Jan 2021	3,451	3,063	388	388	150,544	11.24
Feb 2021	2,996	3,058	-62	62	3,885	2.08
Mar 2021	1,320	3,072	-1,752	1,752	3,068,336	132.70
Apr 2021	2,497	2,589	-92	92	8,464	3.68
May 2021	1,635	2,271	-636	636	404,496	38.90
Jun 2021	1,401	1,817	-416	416	173,333	29.72
			Total	6,968	8,512,496	320
		MAD | MSE | MAPE		580.67	709,374.67	26.71 %

Based on the calculation results of MAD, MSE and MAPE in Table II, the MAD value is 580.67, MSE is 709,374.67, and MAPE is 26.71%

2) Forecasting with 5 period

The results of forecasting sales of TRICK BISKUIT KENTANG BBQ 24 BOX X 10X18 products in July 2021 using a 5-period moving average, can be seen in Table 3.

Table 4. Forecasting Results Using 5 Periods

No	Period	Sold	MA (5)
1	Apr 2020	1,415	0
2	May 2020	1,700	0
3	Jun 2020	2,873	0
4	Jul 2020	1,959	0
5	Aug 2020	4,185	0

No	Period	Sold		MA (5)
6	Sep 2020	2,718	(1415+1700+2873+1959+4185)/5	2,426
7	Oct 2020	3,465	(1700+2873+1959+4185+2718)/5	2,687
8	Nov 2020	2,956	(2873+1959+4185+2718+2465)/5	3,040
9	Dec 2020	2,768	(1959+4185+2718+2465+2956)/5	3,057
10	Jan 2021	3,451	(4185+2718+2465+2956+2768)/5	3,218
11	Feb 2021	2,996	(2718+2465+2956+2768+3451)/5	3,072
12	Mar 2021	1,320	(2465+2956+2768+3451+2996)/5	3,127
13	Apr 2021	2,497	(2956+2768+3451+2996+1320)/5	2,698
14	May 2021	1,635	(2768+3451+2996+1320+2497)/5	2,606
15	Jun 2021	1,401	(3451+2996+1320+2497+1636)/5	2,380
16	**July 2021**			**1,970**

From the table above, it is known that the forecasting results in July with 5 periods are 1.970. After doing the forecasting, the next step is to calculate MAD, MSE and MAPE.

Table 5. Calculation Results of MAD, MSE, and MAPE

Period	A	F	Dev	MAD	MSE	MAPE
Sep 2020	2,718	2,426	292	292	85,031	10.73
Oct 2020	3,465	2,687	778	778	605,284	22.45
Nov 2020	2,956	3,040	-84	84	7,056	2.84
Dec 2020	2,768	3,057	-289	289	83,290	10.43
Jan 2021	3,451	3,218	233	233	54,103	6.74
Feb 2021	2,996	3,072	-76	76	5,715	2.52
Mar 2021	1,320	3,127	-1,807	1,807	3,265,972	136.91
Apr 2021	2,497	2,698	-201	201	40,481	8.06
May 2021	1,635	2,606	-971	971	943,618	59.41
June 2021	1,401	2,380	-979	979	958,049	69.86
			Total	5,709	6,048,599	330

Period	A	F	Dev	MAD	MSE	MAPE
			MAD | MSE | MAPE	570.90	604,859.93	33.00 %

Based on the calculation results of MAD, MSE and MAPE in Table II, the MAD value is 570.90, MSE is 604,859.93, and MAPE is 33.00 %

4.　Conclusion

Based on the results of the study, it can be concluded that the existence of an inventory forecasting system can help facilitate the process of providing goods for the future. Then, from the comparison between the moving average using 3 periods and 5 periods, the results show that for TRICK BISKUIT KENTANG BBQ 24 BOX X 10X18 seen from the MAD, MSE and MAPE results, the 5 period moving average is better than the 3 period moving average, because the value MAD, and MSE 5 periods are less than 3 periods.

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