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PLANNING OF RAW MATERIAL INVENTORY TO MAKE TOFU METHOD WITH MATERIAL REQUIRETMENS PLANNING (MRP)

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ABSTRACT

UD. Ai Kampung Bilah Tofu Factory, Labuhan Batu Regency is an industry that is engaged in the processing of Tofu. The purpose of this study is to determine the amount of tofu production from forecasting the number of requests for the previous period. Problem with UD. The aim of the Kampung Bilah Tofu Factory is that it has not implemented rules in controlling the supply of raw materials. In the production process, there are often obstacles, namely the use of raw materials and orders that are not appropriate. Optimum plannin and inventory of material requirements is carried out using the Material Requirement Planning method. MRP is a method of planning and scheduling better inventory on a product that is produced. In this study the Material Requirement Planning method, the lot sizing technique used is Lot For Lot, Economic Order Quantity, Priode Order Quantity. Based on the calculation results, Material Requirement Planning using the lot sizing technique, namely Lot For Lot, produces a total cost of Rp. 2,640,000 minimum orders for raw materials.

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1. INTRODUCTION

In the development of the industrial world, every company competes with each other to add and retain consumers to increase the company's income. In addition, companies are also required to be able to satisfy consumers by completing requests from consumers in a timely manner. (Supriyanto, S. 2018).

By planning product orders before the production process, what will be done is to provide raw materials that have been adjusted to production capacity in order to meet demand. Some companies that are still developing carry out planning and control not according to existing methods, but only based on experience and previous product requests. Therefore, in the production of raw materials, it becomes an important problem so that proper ordering activities must be used in order to avoid delays in the arrival of raw materials. (Rahayu, CY 2017).

Indonesia is a country with a lot of diversity in the food sector . Many businesses are engaged in the field of food grown very rapidly in Indonesi a .One of the most popular food is out. Tofu is known to the public as a daily food which is generally very popular and has high digestibility and is often found in stalls to restaurants with very large commodity developments and more economical prices, so tofu is very

popular with people in Indonesia. UD. Ai Kampung Bilah Tofu Factory is an industrial business engaged in the production of making raw tofu which is located in Kampung Bila, Bilah downstream District, Labuhan Batu. This company has been running for more than 6 years with the processed tofu which is quite well known in the Bilah Hilir area. The main raw material for making tofu is soybeans and other supporting materials. The problem in the tofu factory that will be investigated by the author is about planning the supply of raw materials for tofu products. Based on interviews conducted with the owner of UD. Ai Kampung Bilah Tofu Factory while monitoring the course of production activities, it is known that in applying production techniques to UD. Ai Kampung Bar's Tofu Factory found a problem regarding the supply of raw materials. One of the obstacles in the production system is ordering raw materials suddenly because they do not anticipate increasing demand.

2. RESEARCH METHOD

a. Data collection
   Researchers record all data objectively and as it is in accordance with the results of observations, interviews and documents (schedule) from the field.
b. Calculate the forecast demand for raw materials for the next 1 year by comparing 3 forecasting methods, namely:
   1. Average (Simple Average)
      The average method simply calculates the mean of the available data.
   2. Single Exponential Smoothing
      The exponential smoothing equation is calculated based on the forecasting results plus the forecast for the previous period.
   3. Moving Average method for a period of 3 months
   4. Linear Regression
c. Calculating order size (lot size)
d. The results of the demand forecasting will then be used as a Master Production Schedule at the stage of calculating the Material Requirement Planning, which is then in the final stage of this research a Material Requirement Planning Table will be made.

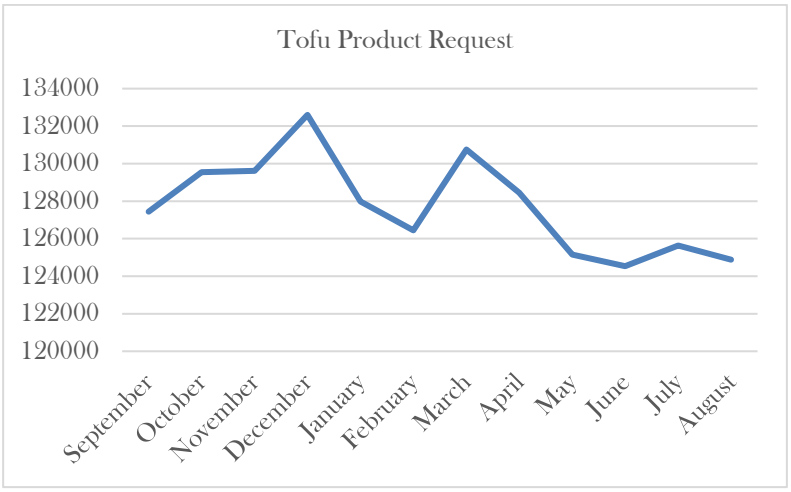
3. RESULT AND ANALYSIS

The collection of data taken in this study was obtained by interviewing and recording the results based on the documentation of the UD Ai trading business the tofu factory, the tofu processing village later to support data processing based on the results of past requests from customers or consumers.

Table 1. Demand for Tofu Raw Materials

Period	Month	Request
1	September	127444
2	October	129541
3	November	129611
4	December	132601
5	January	127988
6	February	126452
7	March	130752
8	April	128451
9	May	125148
10	June	124535
11	July	125632
12	August	124876
Total		1533031

Data is used as the basis for forecasting demand for soybean raw materials for the period September 2020-August 2021. The demand data above comes from reports on the use of soybean raw material supplies at the UD.Ai Tahu Kampung Bilah Factory.



Picture 1. Graph of Tofu Raw Material Demand Data

Based on Picture 1 above, the tofu demand data at the UD.Ai Kampung Bilah tofu factory is from September 2019 to August 2020. Based on the data above, it can be seen that in 1 year the lowest demand for tofu was in June 2020, which was 124,535 tofu, and the number of requests for tofu The highest tofu occurred in December 2019 with a total of 132,601 years.

3.1 Forecasting

The forecasting method is carried out here for 1 year using the minitab 14.1 software and Microsoft excel. Based on the plot of past demand data obtained from the trading business (UD) the village tofu factory uses three forecasting methods, namely the Simple Average, Moving Average, Single Exponential Smoothing and Linear Regression methods.

a. Simple Average and Moving Range (MR) Forecasting Results

Moving range maps are used to test the stability of the data system due to the effects that affect demand.

Table 2. Moving Range Calculation Results

Month	Request	Forecasting	Xi	MR
September	127444			
October	129541	128493	-1048	302
November	129611	128865	-746	2056
December	132601	129799	-2802	4251
January	127988	129437	1449	1039
February	126452	128940	2488	4042
March	130752	129198	-1554	2208
April	128451	129105	654	2863
May	125148	128665	3517	200
June	124535	128252	3717	1335
July	125632	128014	2382	495
August	124876	127753	2877	8057
Total	1533031	1416521	10934	26848

Source: primary data processed

$$MSE = \sum \frac{e_1^2}{n} = \sum \frac{(X_i - F_i)^2}{n}$$
$$= \frac{(1533031 - 141652)^2}{12}$$

$$= \frac{116510^2}{12}$$
$$= \frac{13574580100}{12}$$
$$= 1.131.215.008$$
$$MR = \sum \frac{MR}{n-1}$$
$$= \frac{26848}{12-1}$$
$$= 2.441$$
$$BKA = 2{,}66\ x\ MR$$
$$BKB = -2{,}66\ x\ MR$$

From the calculation results in Table 4.9 of the moving range above, it can be seen that the error value does not exceed the upper control limit (BKA) and lower control limit (BKB). Means the system is still within the control limits and does not affect the request.

b. Moving Average and Moving Range (MR) Forecasting Results

Moving range maps are used to test the stability of causal system data affecting demand.

Table 3. Moving Range Results

Month	Request	Forecasting	Xi	MR
September'19	127444			
October'19	129541			
November'19	129611			
December;19	132601	128865	-3736	
January'20	127988	130584	2596	6332
February'20	126452	130067	3615	1019
March'20	130752	129014	-1738	5353
April'20	128451	128397	-54	1684
May'20	125148	128552	3404	3458
June'20	124535	128117	3582	178
July'20	125632	126045	413	3169
August'20	124876	125105	229	184
Total	1533031	1154746	8311	21377

Source : Processed Primary Data

$$MSE = \sum \frac{e_1^2}{n} = \sum \frac{(X_i - F_i)^2}{n}$$
$$= \frac{(1533031 - 1154746)^2}{12}$$
$$= \frac{378285^2}{12}$$
$$= \frac{143097271524}{12}$$
$$= 11.924.772{,}627$$
$$MR = \sum \frac{MR}{n-1}$$

$$= \frac{21377}{12-1}$$
$$= 1.943$$
$$BKA = 2{,}66\ x\ MR = 2{,}66\ x\ 1.943 = 5.168{,}38$$
$$BKB = -2{,}66\ x\ MR = -2{,}66\ x\ 1.943 = -5.168{,}38$$

From the results of the calculation of the moving range table above, it can be seen that the error value does not exceed the upper control limit (BKA) and lower control limit (BKB). Means the system is still within the control limits and does not affect the request.

c. Single Exponetial Smoothing and Moving Range (MR) forecasting results In Table 4 the moving range map is used for testing the stability of the causal system data that affects demand.

Table 4. Single Exponetial Smoothing Moving Range Table

Month	Request	Forecast	Xi	MR
September'19	127444	127444	0	
October'19	129541	127444	- 2,097	2,097
November'19	129611	127863,4	-1,748	349
December;19	132601	128212.92	- 4.388	2.640
January'20	127988	129090,536	1.103	5.491
February'20	126452	128870.0288	2.418	1.315
March'20	130752	128386.423	- 2,366	4.784
April'20	128451	128859,5384	409	2,774
May'20	125148	128777,8307	3,630	3.221
June'20	124535	128051.8646	3,517	113
July'20	125632	127348,4917	1,716	1,800
August'20	124876	127005,1933	2,129	413
Total	1533031	1537354,227	4.323	24,998

Source : Processed Primary Data

$$MSE = \sum \frac{e_1^2}{n} = \sum \frac{(X_i - F_i)^2}{n}$$
$$= \frac{(1533031 - 157354{,}227)^2}{12}$$
$$= \frac{4323^2}{12}$$
$$= \frac{18.690.287}{12}$$
$$= 1.557.524$$
$$MR = \sum \frac{MR}{n-1}$$
$$= \frac{24998}{12-1}$$
$$= 2273$$
$$BKA = 2{,}66\ x\ MR = 2{,}66\ x\ 2273 = 6.046{,}18$$
$$BKB = -2{,}66\ x\ MR = -2{,}66\ x\ 2273 = -6.046{,}18$$

From the calculation results of the moving range table above, it can be seen that the error value does not exceed the upper control limit (BKA) and lower control limit (BKB). Means the system is still within the control limits and does not affect the request

d. Linear Regression and Moving Range forecasting results

Based on forecasting from linear regression on historical data, it can be estimated that the forecasting results from each demand data on existing historical data, and for the next stage is to test using a moving range.

Table 5. Linear Regression Forecasting and Moving Range Table

Month	Request	Forecasting	Xi	MR
September	127444		127444	
October	129541	128493	-1048	128492
November	129611	128865	-746	302
December	132601	129799	-2802	2056
January	127988	129437	1449	4251
February	126452	128940	2488	1039
March	130752	129198	-1554	4042
April	128451	129105	654	2208
May	125148	128665	3517	2863
June	124535	128252	3717	200
July	125632	128014	2382	1335
August	124876	127753	2877	495
Total	1533031	1416521	138378	147283

Source : Processed Primary Data

$$MSE = \sum \frac{e_1^2}{n} = \sum \frac{(X_i - F_i)^2}{n}$$
$$= \frac{(1533031 - 1416521)^2}{12}$$
$$= \frac{116510^2}{12}$$
$$= \frac{13574580100}{12}$$
$$= 1.131.215.008$$
$$MR = \sum \frac{MR}{n-1}$$
$$= \frac{147283}{12-1}$$
$$= 13.389$$
$$BKA = 2{,}66\ x\ MR = 2{,}66\ x\ 13389 = 35.614{,}74$$
$$BKB = -2{,}66\ x\ MR = -2{,}66\ x\ 13389 = -35.614{,}74$$

3.2 Smallest Error Value Comparison Results

Based on the results of the comparison of the smallest MSE error value, MSE identifies a deviation from the accuracy of the forecasted demand data with the actual demand data. To see the results of forecasting the error value, see Appendix D. The following is a comparison of the error calculations of the three forecasting methods, which can be seen in Table 6

Table 6. Results of the Smallest Error Value Comparison

	Forecasting Method			
	Simple Average	Moving Average	Single Exponential Smoothing	Linear Regression
MAD	2.112	1,500	2.127	1,430
MSE	5,524,985	3,507,949	6,046.324	3,466,999
MAPE	0.016627178	0.011740201	0.016644197	0.011113277

Based on the results from the table seen, the method chosen is linear regression because it has the smallest MSE value compared to the simple average, moving average, and single exponential smoothing, it can also be seen that the smallest MAPE value is the value of the linear regression method.

3.3 Calculation of Material Requirements planning (MRP)

The best lot sizing method is a method that meets the criteria by having a minimum total cost in planning raw material inventory. Lot size calculation is a technique that determines the optimal number of orders and determines when is the right time to place an order with a minimum total cost of ordering and storing. The results of the lot sizing calculation on the MRP can be seen in the table 7.

Table 7. Comparison of Ordering Costs and Savings Costs

	The Cost of The Message	Storage Cost	Total
Lot For Lot (Lfl)	2,640,000	0	2,640,000
Economic Order Priority (EOQ)	31,680,000	1.262.069	32,942,069
Period Order Quantity (POQ)	2,200,000	2,499,088	4,699,088
Total	36.520.000	3,761,157	

Based on the results of processing the overall costs obtained from the three lot size techniques above, it can be seen that Lot For Lot (LFL) produces a total cost of Rp. 2,640,000 with a minimum ordering cost of raw materials and is used as a solution for controlling raw material inventory at UD.Ai Tofu Factory kampung bilah.

4. CONCLUSION

The conclusion is based on the analysis that has been done, the author can draw the conclusion that the ups and downs of sales occur due to demand from consumers. From the results of the calculation of planning data processing for the supply of raw materials for making tofu, it can be concluded that the best forecasting method used to forecast demand for the next 12 months is to use the linear regression method.

To be able to optimize the inventory function, the company must make a plan in the procurement of raw materials from the optimal method based on the total costs incurred in each lotting method, the lot sizing technique used is Lot For Lot by producing the lowest and optimal costs By using the MRP calculation with the lot sizing technique, namely Lot For Lot (LFL) produces a total cost of Rp.2.640.000.

Based on the research that has been done using this, it can be seen from the comparison of the smallest values of the MSE, MAD, and MAPE error values from linear regression forecasting calculations. It is concluded that the raw material inventory using the selected forecasting method namely linear regression will be 127753 products in 2021.

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