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Forecasting Methods Determination of Raw Material Needs for Sheep Cabretta And Batting Leather at PT Adi Satria Abadi

Grita Supriyanto Dewi[1], Khairun Nadiyah[2]
[1]Industrial Engineering Departement, Faculty of Engineering and Information Technology, Universitas Jenderal Achmad Yani Yogyakarta
[2]Agro-Industry Engineering Department, Polytechnic ATI Padang
Email: grita1202@gmail.com

Abstract

The high level of fluctuating demand for products that consumers want, makes companies need to have a demand estimation or forecasting tool. PT. Satria Abadi is a manufacturing company engaged in the leather tanning process. Leather processed by PT. Adi Satria Abadi consists of two types of leather, namely goat leather (Goat Cabretta and Goat Batting) and sheep leather (Sheep Cabretta and Sheep Batting). In the tanning process, PT. Adi Satria Abadi sometimes encounters several obstacles, one of which is insufficient raw materials. This is because there has not been an estimate of the need for raw materials for the production process to fulfil demand. To deal with these obstacles, it is necessary to estimate the need for raw materials for the type of Sheep Cabretta Leather and Sheep Batting Leather so that there is no shortage of raw materials that can hinder the leather tanning production process. Based on the pattern of demand for raw materials, Sheep Cabretta Leather and Sheep Batting Leather are included in a random or fluctuating demand pattern. Therefore, the method used to predict the need for raw materials is Single Exponential Smoothing with 0.1 to 0.9. From the results of the calculation of forecasting accuracy, it was found that the smallest MSE value lies in the results of forecasting with the Single Exponential Smoothing method with an alpha value of 0.7 of 44560919259, while in sheep Batting Leather, it also lies in the Single Exponential Smoothing forecasting with an alpha of 0.7 with an MSE value amounting to 31462955201. Therefore, the need for raw materials for the type of Sheep Caretta Leather for June based on forecasting calculations using the Single Exponential Smoothing method with an alpha value of 0.7 is 964,878.62 SF, while for the need for raw materials for the type of Sheep Batting Leather is 989,018.39 SF.

Keywords: leather tanning, forecasting, raw materials, single exponential smoothing

INTRODUCTION

Business activity has a close relationship with the demand for the number of products. The number of product requests that consumers want is constantly changing according to changing developments and trends of the times. To meet product demand from consumers, an estimate or demand forecast is needed. This will help the company to meet consumer demand accurately and quickly. In addition, the company will also be able to produce raw materials appropriately so as to minimize waste and increase profits. To predict the amount of raw material needs in the future, companies can refer to past data.

PT. Satria Abadi is a manufacturing company engaged in the leather tanning process. The main raw material needed in the process of tanning leather is leather from animals, namely goats and sheep that have been depilated and have been preserved by an acidification process. Leather processed by PT. Adi Satria Abadi consists of two types of leather, namely goat leather (Goat Cabretta and Goat Batting) and sheep leather (Sheep Cabretta and Sheep Batting) (Kusuma & Ayuliya, 2016). In the tanning process, PT. Adi Satria Abadi sometimes encounters a number of obstacles, one of which is insufficient raw materials. This is because there has not been an estimate of the need for raw materials for the production process to fulfill demand. To deal with these obstacles, it is necessary to

estimate or forecast the need for raw materials for the types of Sheep Cabretta Leather and Sheep Batting Leather so that there is no shortage of raw materials that can hinder the production process of leather tanning.

LITERATURE REVIEW

1. Forecasting Definition

In making a forecasting, it takes past data or past experience to project how the future of the company will be. Usually, the technique or method used is forecasting (Yamit, 2011). Forecasting is the art and science of predicting future events. This can be done by involving taking historical data and projecting it into the future with a form of mathematical model (Heizer et al, 2001). Forecasting has three main roles in several parts of the organization (Wirabuana, 2006), namely:

1. Determine the required resource requirements. All organizations must determine what resources are needed in the long term. These decisions depend on market opportunities, environmental, financial, labor, product and technological resources.
2. Additional resources. The cycle time (lead time) of purchasing raw materials, recruiting labor or purchasing machinery and equipment can vary from 20 days to a year. Forecasting is needed to determine future resource requirements.
3. Scheduling of existing resources. Resource usage requires scheduling. Forecasting product, material, labor, financial or service needs is an input for scheduling.

Forecasting techniques provide an effective impact for the long and short term on the planning of a company. One of the forecasting techniques is time series analysis. Time series analysis is a future prediction based on the past value of a variable and/or past errors (Heizer, 2001). This is based on the fact that human behavior is heavily influenced by previous conditions or time, so in this case the time factor plays a very important role In using the time series method, the data pattern must be considered because it serves to determine the type of forecasting method that is most appropriate to use (Wiley, 1983). Data patterns are divided into four types, namely:

a. Horizontal Pattern (H)
   The horizontal pattern occurs when the data value fluctuates around the average value. A product whose sales have neither increased nor decreased over a period of time.

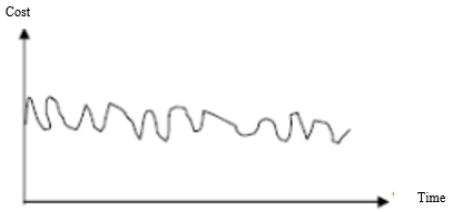

Figure 1. Horizontal Pattern
Source: John Wiley & Sons Inc (1983)

b. Seasonal Pattern (S)
   A seasonal pattern occurs when a series is influenced by seasonal factors, such as yearly, monthly, or on certain days. Seasonal patterns are useful in forecasting short-term sales.

Figure 2. Seasonal Pattern
Source: John Wiley & Sons Inc (1983)

c. Cyclic Pattern (C)
   A cyclical pattern occurs when the data obtained is influenced by long-term economic fluctuations such as those associated with the business cycle. Sales of products such as cars, steel and others.

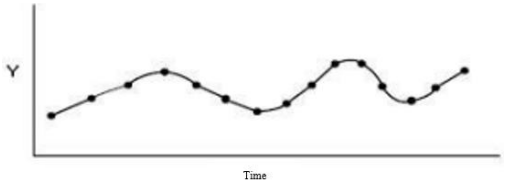

Figure 3. Cyclic Pattern
Source: John Wiley & Sons Inc (1983)

d. Trend Pattern (T)
A trend pattern occurs when there is a long-term secular increase or decrease in the data. The effect of long-term trends shows the company's development in sales. This development can be positive (growth) or negative development (decline).

Figure 4. Trend Pattern
Source: John Wiley & Sons Inc (1983)

2. Forecasting Method

a. Linier Regression
Forecasting technique using linear regression is a statistical procedure that is most widely used as a forecasting method. In this method the pattern of the relationship between a variable that affects it is expressed by a straight line (Purnomo, 2004).

$$Y = a + bx \tag{1}$$

$$a = \frac{\Sigma y - b\Sigma x}{N} \tag{2}$$

$$b = \frac{\mathrm{N}\Sigma \mathrm{x}y - \Sigma x\Sigma \mathrm{y}}{N\Sigma x^2 - (x)^2} \tag{3}$$

Information:
Y = the amount of the predicted value
a = trend value in the base period
b = the level of development of the predicted value
x = unit years calculated from the base period

b. Single Moving Average
Single moving average method is a forecasting method used to eliminate randomness in time series. This method separates the cyclical trend element from the data by calculating a moving average whose sum of elements is equal to the seasonal length. The new average value can be calculated by removing the new observation values. The moving average then becomes a forecast for the future period (Nasution, 2008).

$$F_{t+1} = \frac{X_{t-N+1} + \cdots + X_{t-1} + X_t}{N} \tag{4}$$

Information:
X_t = demand in period t
X_{t-1} = demand in period t-1
X_{t-N+1} = demand in period t-N+1
N = the number of time series used
F_{t+1} = forecasting result for period t+1

c. Single Exponential Smoothing
Data patterns that are unstable or have large and volatile changes generally use exponential smoothing models (Exponential Smoothing Models). The Single Exponential Smoothing method is more suitable for predicting things whose fluctuations are random (irregular).

$$F_{t+1} = \alpha(x_t) + (1 - \alpha)F_t \tag{5}$$

Information:
X_t = latest actual value
F_t = last forecast
F_{t+1} = forecasting result for period t+1
α = smoothing constant

3. Forecasting Accuracy Measurement

To measure the level of accuracy of a forecasting method, several calculation techniques can be used, namely (S.Russell & III, 2011):

a. Mean Absolute Deviation (MAD)

MAD is the average absolute error over a certain period regardless of whether the forecast results are greater or less than the reality.

$$MAD = \frac{\sum|D_t - F_t|}{n} \quad (6)$$

Information:
D_t = actual data in period t
F_t = forecasting result in period t
n = number of periods

b. Mean Square Error (MSE)

MSE is a method for evaluating forecasts, from each error squared. The result of the square will be divided by the number of observations (Wiley,1983)

$$MSE = \frac{\sum|D_t - F_t|^2}{n} \quad (7)$$

Information:
D_t = actual data in period t
F_t = forecasting result in period t
n = number of periods

c. Mean Absolute Percentage Error (MAPE)

Calculation using the absolute error in each period divided by the actual observed value for that period. MAPE indicates how big the forecast error is compared to the real value in the series. MAPE can also be used to compare the precision of the same or different techniques in two very different series and measure the accuracy of values with the model expressed in terms of the mean absolute percentage of error.

$$MAPE = \frac{\sum \frac{|D_t - F_t|}{D_t} x\ 100}{n} \quad (8)$$

Information:
D_t = actual data in period t
F_t = forecasting result in period t
n = number of periods

METHODS

The data used to forecast the need for raw materials for sheep cabretta leather and sheep batting leather are historical data for the last 15 months, namely March 2014-May 2015. The details of the raw material requirements are as follows:

Table 1. Raw material requirements

No	Month	Year	Needs SF(Square Feet)	
			Sheep Cabreta Leather	Sheep Batting Leather
1	March	2014	779000,25	895653
2	April	2014	853900,5	996985
3	Mey	2014	957966	1125896,25
4	June	2014	857990	956897
5	July	2014	987697,5	894789
6	August	2014	479000	600052
7	September	2014	507890,75	562395,75
8	October	2014	700072	798754
9	November	2014	409605	636997
10	December	2014	400091	598970,5
11	January	2015	899654,25	500156
12	February	2015	1000020	985987,25
13	March	2015	987542	886897,5
14	April	2015	859997	1000125,5
15	Mey	2015	995459,75	1000201

Source :PT Adi Satria Abadi, 2015

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The data obtained above is then poured into the form of a graph. From the graph pattern formed, the type of forecasting method that is most suitable to be used will be determined.

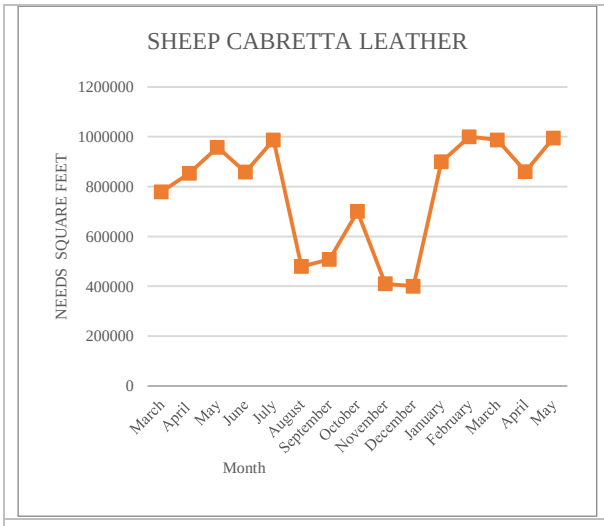

Figure 5. Graph of Raw Material Needs for Sheep Cabretta Leather

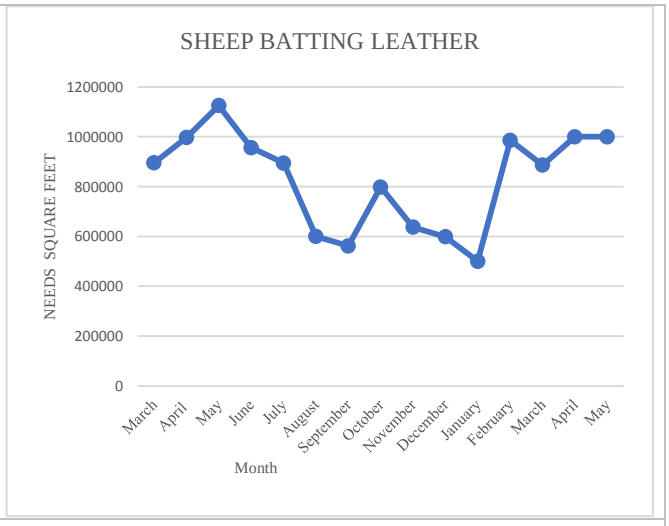

Figure 6. Graph of Raw Material Needs for Sheep Batting Leather

From Figures 1 and 2, it can be seen that the raw material of the Sheep Cabretta Leather type during the last 15 months from the period of March 2014-May 2015 has a random tendency where the need for raw materials fluctuates. Likewise, it can be seen from the graph that the demand of raw materials for the type of Sheep Batting Leather is unstable. Due to the low level of stability and random data, forecasting will be carried out using the exponential smoothing technique using the value of α 0.1; 0.2; 0.3; 0.4; 0.5; 0.6; 0.7; 0.8; and 0.9. Mean Square Error (MSE) is used to find the error value in forecasting. The smallest MSE results will be used to predict the usage needs of raw materials in the next period.

RESULT AND DISCUSSION

The results of forecasting using the Exponential Smoothing method α 0.1; 0.2; 0.3; 0.4; 0.5; 0.6; 0.7; 0.8; and 0.9 are as follows:

Table 2. Sheep Cabretta Leather Forecasting Results

No	Month	Year	Actual Data Sheep Cabreta Leather	Forcasting Result with Alfa								
				0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9
1	March	2014	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25
2	April	2014	853900,5	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25	779000,25
3	Mey	2014	957966	786490,28	793980,30	801470,33	808960,35	816450,38	823940,4	831430,43	838920,45	846410,475
4	June	2014	857990	803637,85	826777,44	848419,03	868562,61	887208,19	904355,76	920005,33	934156,89	946810,448
5	July	2014	987697,5	809073,06	833019,95	851290,32	864333,57	872599,09	876536,304	876594,60	873223,38	866872,045
6	August	2014	479000	826935,51	863955,46	892212,47	913679,14	930148,30	943233,022	954366,63	964802,68	975614,954
7	September	2014	507890,75	792141,96	786964,37	768248,73	739807,48	704574,15	664693,209	621609,99	576160,54	528661,495
8	October	2014	700072	763716,84	731149,65	690141,34	647040,79	606232,45	570611,733	542006,52	521544,71	509967,825
9	November	2014	409605	757352,35	724934,12	693120,54	668253,27	653152,22	648287,893	652652,36	664366,54	681061,582
10	December	2014	400091	722577,62	661868,29	608065,88	564793,96	531378,61	505078,157	482519,21	460557,31	436750,658
11	January	2015	899654,25	690328,95	609512,83	545673,41	498912,78	465734,81	442085,863	424819,46	412184,26	403756,966
12	February	2015	1000020	711261,48	667541,12	651867,66	659209,37	682694,53	716626,895	757203,81	802160,25	850064,522
13	March	2015	987542	740137,34	734036,89	756313,36	795533,62	841357,26	886662,758	927175,14	960448,05	985024,452
14	April	2015	859997	764877,80	784737,92	825681,96	872336,97	914449,63	947190,303	969431,94	982123,21	987290,245
15	Mey	2015	995459,75	774389,72	782751,90	821587,55	867671,47	910238,37	943916,24	967207,78	980854,08	872726,325
16	June	2015		796496,72	781915,69	817703,99	863063,08	905981,68	940548,45	964878,62	979489,45	983186,407

Table 3. Sheep Batting Leather Forecasting Results

no	Month	Year	Actual Data sheep Batting Leather	Forcasting Result with Alfa								
				0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9
1	March	2014	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00
2	April	2014	996985,00	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00	895653,00
3	Mey	2014	1125896,25	905786,20	915919,40	926052,60	936185,80	946319,00	956452,20	966585,40	976718,60	986851,80
4	June	2014	956897,00	927797,21	957914,77	986005,70	1012069,98	1036107,63	1058118,63	1078103,00	1096060,72	1111991,81
5	July	2014	894789,00	930707,18	957711,22	977273,09	990000,79	996502,31	997385,65	993258,80	984729,74	972406,48
6	August	2014	600052,00	927115,37	945126,77	952527,86	951916,07	945645,66	935827,66	924329,94	912777,15	902550,75
7	September	2014	562395,75	894409,03	876111,82	846785,10	811170,44	772848,83	734362,26	697335,38	662597,03	630301,87
8	October	2014	798754,00	861207,70	813368,60	761468,30	711660,57	667622,29	631182,36	602877,64	582436,01	569186,36
9	November	2014	636997,00	854962,33	810445,68	772654,01	746497,94	733188,14	731725,34	739991,09	755490,40	775797,24
10	December	2014	598970,50	833165,80	775755,95	731956,91	702697,56	685092,57	674888,34	667895,23	660695,68	650877,02
11	January	2015	500156,00	809746,27	740398,86	692060,98	661206,74	642031,54	629337,63	619647,92	611315,54	604161,15
12	February	2015	985987,25	778787,24	692350,29	634489,49	596786,44	571093,77	551828,65	536003,58	522387,91	510556,52
13	March	2015	886897,50	799507,24	751077,68	739938,82	752466,77	778540,51	812323,81	850992,15	893267,38	938444,18
14	April	2015	1000125,50	808246,27	778241,64	784026,42	806239,06	832719,00	857068,02	876125,89	888171,48	892052,17
15	Mey	2015	1000201,00	827434,19	822618,41	848856,15	883793,64	916422,25	942902,51	962925,62	977734,70	989318,17
16	june	2015		844710,87	858134,93	894259,60	930356,58	958311,63	977281,60	989018,39	995707,74	999112,72

From the forecasting calculations in Tables 2 and 3, the error value for each forecast was calculated; then the MSE value will be compared on each type of sheep leather by the calculation of exponential smoothing forecasting with an alpha value of 0.1-0.9. The comparison of MSE values is as follows:

Table 4. Comparison of MSE Values in Both Leather Types

No	alfa	MSE	
		Sheep Cabreta Leather	Sheep Bitting Leather
1	0,1	49802428817	39826307895
2	0,2	50819785657	38701235443
3	0,3	49496783122	36802046458
4	0,4	47520516941	34735241878
5	0,5	45859603236	33051810030
6	0,6	44869807267	31958515696
7	0,7	44560919259	31462955201
8	0,8	44828127545	31521286956
9	0,9	46563116684	32117668587

From the comparison table of MSE values on Sheep Cabretta Leather, it was found that the smallest MSE value lies on the results of forecasting with the Single Exponential Smoothing method with an alpha value of 0.7, which is 44560919259, while in sheep Batting Leather, it also lies on the Single Exponential Smoothing forecasting with alpha 0.7 with an MSE value of 31462955201. Therefore, the need for raw materials for the type of Sheep Cabretta Leather for June is based on forecasting calculations using the Single Exponential Smoothing method with an alpha value of 0.7 of 964,878.62 SF, while for the need for raw materials the type of Sheep Batting Leather is 989,018.39 SF.

CONCLUSIONS

From the research conducted, it can be concluded that:

1. The forecasting method used to determine the type of Sheep Cabretta Leather and Sheep Batting Leather is the Single Exponential Smoothing method with an alpha of 0.7.
2. Forecasting results for Sheep Cabretta Leather for June is 964878.62 SF and for Sheep Batting Leather is 989018.39 SF
3. Researchers' recommendation for the company is that company can immediately utilize forecasting method, therefore, the company can maximize its effectiveness and efficiency in manufacturing the products.

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