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FORECASTING OF TOTAL STOCK RAW MATERIALS OF DOUBLE EXPONENTIAL SMOOTHING METHOD (STUDY: PT. CHAROEN POKPHAND INDONESIA)

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ABSTRACT

Inventory control at a company is very important in determining the efficiency of warehouse functions. Uncertain information about the availability of goods in the warehouse affects the decision to be taken in determining the amount of ordering goods. So that it has difficulty in predicting stock in the next month. The negative effect in the future if one predicts the stock will experience excessive stock build up. This study aims to create an application that can help facilitate and maximize the performance of warehouse administration employees in predicting the number of goods that must be ordered for the next period. Forecasting method used is the double exponential smoothing method. This method requires data information in previous years so that in this study took data 4 years earlier. With this forecasting method the forecasting results are obtained close to the actual data. From the results of testing the system imposed on 3 data obtained a system accuracy of 60%.

Keywords: *Forecasting, Smoothing method, Warehouse stock.*

1. INTRODUCTION

PT. CHAROEN POKPHAND INDONESIA (CPI) is a company engaged in the animal feed industry, ranging from processing or production, and packaging. But in the current era of globalization, the need for a data is very important as capital in increasingly fierce competition to meet the market in this increasingly advanced era. Such as warehouse inventory data needed by the company. There are many types of animal feed in PT. Charoen Pokphand Indonesia including feed laying hens, broilers, fighting chickens, and so on. PT. CPI takes raw materials to producers, for the process of taking (reorder) the owner of PT. CPI must predict in advance what should be taken to be stocked in a warehouse at PT. CPI.

To predict stock using forecasting methods such as the double exponential smoothing method. So that the owner of PT. CPI did not experience difficulties in predicting stock in the next month. The negative effect in the future if one predicts the stock will experience excessive stock buildup. The methods that can provide solutions to the problems outlined above, such as the double exponential smoothing forecasting method, why use the double exponential smoothing method because of the trend pattern of sales data. With the double exponential smoothing method is expected to help PT. Charoen Pokphand Indonesia in determining stock in the following month.

Given the importance of a system to help the above problems, so in order to help the company in the process of running its business to be better, then built **"Forecasting Number of Stocks of Animal Feed Raw Materials Using Double Exponential Smoothing Method (Case Study: PT. CHAROEN POKPHAND INDONESIA)"** which can help the monitoring process at PT. Charoen Pokphand Indonesia. Before the development of the system is implemented, it is necessary to identify the needs of the system user. From the results of the identification then the system can be built and then documented. The document serves to facilitate the work on development projects and system development.

2. THEORETICAL BASIS

PT. CHAROEN POKPHAND INDONESIA (CPI) is a company engaged in the animal feed industry, ranging from processing or production, and packaging. But in the current era of globalization, the need for a data is very important as capital in increasingly fierce competition to meet the market in this increasingly advanced era. As warehouse inventory data needed by the company. There are many types of animal feed in PT. Charoen Pokphand Indonesia including feed laying hens, broilers, fighting chickens, and so on. PT. Charoen Pokphand Indonesia takes raw materials to producers, for the reorder process of the owner of PT. Charoen Pokphand Indonesia must predict in advance what should be taken to be stocked in a warehouse at PT. Charoen Pokphand Indonesia.

2.1 Forecasting Stock of Raw Materials Using the Double Exponential Smoothing Method

A. Forecasting Method

Forecasting method is a way to estimate or estimate quantitatively and qualitatively what will happen in the future, based on relevant data in the past. The purpose of forecasting methods is to estimate systematically and pragmatically on the basis of relevant data in the past. Thus forecasting is expected to provide greater objectivity. Forecasting methods provide a sequence and solution to the problem approach in forecasting, so that if the same approach to the problem is used, then the rationale and solution of the same arguments will be obtained.

B. Concept of the Double Exponential Smoothing Method

This method is a linear model proposed by Brown. In the Double Exponential Soothing method, the smoothing process is carried out twice, as follows:

a) Determine the first smoothing.
(S't) S't = α Xt + (1-α) S't (3.7)

b) Determine the second smoothing.
(S"t) S"t = α S't + (1-α) S"t-1 (3.8)

c) Determine the magnitude of the constant.
(αt) αt= S't + (S't - S"t) (3.9)
= 2S't – S"t

d) Determine the size of the slope (bt).
bt= α 1–α (S't – S"t) (3.10)

e) Determine the size of the forecast (Ft + m).
St+m = αt+ btm (3.11)

Information :

m: number of periods to be predicted.

S ': Smoothing period value to t

Xt: actual data from period to t

S "t: Double Smoothing value

αt: constant value α

bt: constant value b

Ft + m: Looking for forecasting in the next period.

A. Mean Squared Error (MSE)
Mean Squared Error (MSE) is another method for evaluating forecasting methods. Each error or remainder is squared. Then add up and add the number of observations. Mean Squared Error is the average of forecast errors squared, or if written in the form of a formula is:

$$MSE = \frac{\Sigma \mid Xt - Ft \mid 2}{n} \quad (3.12)$$

B. Mean Absolute Percentage Error (MAPE)
Mean Absolute Percentage Error is the mean absolute percentage error of a forecast.

$$MAPE = \frac{\sum \frac{|e_t|}{X_t} \times 100\%}{n} = \frac{\sum \frac{|X_t - F_t|}{X_t} \times 100\%}{n} \quad \text{..... (3.13)}$$

3. SYSTEM DESIGN

A. DESIGN FLOWCHART

The whole system flow chart is a description of the processes related to the running of the system. At this stage it is depicted as shown in the following flow chart:

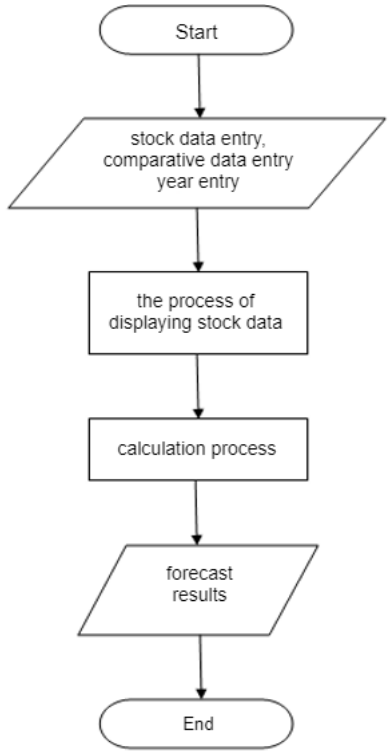

Figure 1 Forecasting system design

B. MANUAL CALCULATION

From the upper diagram, this section has a forecasting calculation that includes a Double Exponential Smoothing calculation. The following calculations:

Table 1: Raw Material Data for Soya Bean Meal Th. 2016 – 2019

Month	SOYA BEAN MEAL			
	Th. 2016	Th. 2017	Th. 2018	Th. 2019
January	370.000	490.000	375.000	430.000
February	400.000	410.000	475.000	410.000

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March	415.000	480.000	440.000	425.000
April	511.500	476.500	476.500	541.500
May	415.000	420.000	455.000	455.000
June	520.000	540.000	540.000	-
July	640.000	640.000	605.000	-
August	510.000	610.000	580.000	-
September	450.000	450.000	480.000	-
October	431.500	431.500	385.000	-
November	440.000	480.000	470.000	-
December	445.000	390.000	325.000	-

1) The training data to be calculated can be seen in Table 1:
2) From the data above, the first thing to do is calculate the single exponential smoothing. Calculations for finding the first smoothing are as follows:
3) Determine the first Smoothing (S'_t) by formula $(S'_t = \alpha X_t + (1-\alpha) S'_{t-1})$

S'2 = 0,4. 375.000+ (1-0,4) . 375.000 = 375.000

S'3 = 0,4. 475.000+ (1-0,4) . 375.000 = 415.000

S'4 = 0,4. 440.000+ (1-0,4) . 415.000 = 425.000

S'5 = 0,4. 476.500+ (1-0,4) . 425.000 = 445.600

S'6 = 0,4. 455.000+ (1-0,4) . 445.600 = 449.360

S'7 = 0,4. 540.000+ (1-0,4) . 449.360 = 485.616

S'8 = 0,4. 605.000+ (1-0,4) . 485.616 = 533.369,6

S'9 = 0,4. 580.000+ (1-0,4) . 533.369,6 = 552.021,76

S'10 = 0,4. 480.000+ (1-0,4) . 552.021,76 = 523.213,06

S'11 = 0,4. 385.000+ (1-0,4) . 523.213,06 = 467.927,83

S'12 = 0,4. 470.000+ (1-0,4) . 467.927,83 = 468.756,7

S'13 = 0,4. 325.000+ (1-0,4) . 468.756,7 = 411.254,02

4) Determine the second smoothing by formula $(S''_t = \alpha S'_t + (1- \alpha) S''_{t-1})$

S"2 = 0,4 . 375.000 + (1-0,4) . 375.000 = 375.000

S"3= 0,4 . 415.000 + (1-0,4) . 375.000 = 391.000

S"4 = 0,4 . 425.000 + (1-0,4) . 391.000 = 404.600

S"5 = 0,4 . 445.600 + (1-0,4) . 404.600 = 421.000

S"6 = 0,4 . 449.360 + (1-0,4) . 421.000 = 432.344

S"7 = 0,4 . 485.616 + (1-0,4) . 432.344 = 453.652,80

S"8 = 0,4 . 533.369,60 + (1-0,4) . 453.652,80 = 485.539,52

S"9 = 0,4 . 552.021,76 + (1-0,4) . 485.539,52 = 512.132,42

S"10 = 0,4 . 523.213,06 + (1-0,4) . 512.132,42 = 516.564,67

S"11 = 0,4 . 467.927,83 + (1-0,4) . 516.564,67 = 497.109,94

S"12 = 0,4 . 468.756,70 + (1-0,4) . 497.109,94 = 485.768,64

S"13 = 0,4 . 411.254,02 + (1-0,4) . 485.768,64 = 455.962,79

5) Calculate the value of α with the formula $\alpha_t = S'_t + (S'_t - S''_t) = 2S'_t - S''_t$

α1= 4(375.000) – 375.000 = 375.000

α2= 4(375.000) - 375.000 = 375.000

α3= 4(415.000) – 391.000 = 439.000

α4= 4(425.000) – 404.600 = 445.400

α5= 4(445.600) – 421.000 = 470.200

α6= 4(449.360) – 432.344 = 466.376

α7= 4(485.616) – 453.652,80 = 517.579,20

α8= 4(533.369,60) – 485.539,52 = 581.199,68

α9= 4(552.021,76) – 512.132,42 = 591.911,10

α10= 4(523.213,06) – 516.564,67 = 529.861,44

α11= 4(467.927,83) – 497.109,94 = 438.745,73

α12= 4(468.756,70) – 485.768,64 = 451.744,76

α13= 4(411.254,02) – 455.962,79 = 366. 545,25

6) Calculate the value of b with the formula $b_t = \frac{}{1-} (S'_t - S''_t)$

b1 = $\frac{0,4}{1-0,4}$ 375.000–375.000 = 0

b2 = $\frac{0,4}{1-0,4}$ 375.000 – 375.000 = 0

b3= $\frac{0,4}{1-0,4}$ 415.000 – 391.000 = 16.000

b4= $\frac{0,4}{1-0,4}$ 425.000 – 404.600 = 13.600

b5= $\frac{0,4}{1-0,4}$ 445.600 – 421.000 = 16.400

b6= $\frac{0,4}{1-0,4}$ 449.360 – 432.344 = 11.344

b7= $\frac{0,4}{1-0,4}$ 485.616 – 453.652,80 = 21.308,80

b8= $\frac{0,4}{1-0,4}$ 533.369,60 – 485.539,52 = 31.886,72

b9= $\frac{0,4}{1-0,4}$ 552.021,76 – 512.132,42 = 26.592,90

b10= $\frac{0,4}{1-0,4}$ 523.213,06 – 516.564,67 = 4.432,26

b11= $\frac{0,4}{1-0,4}$ 467.927,83– 497.109,94 = -19.454,74

b12= $\frac{0,4}{1-0,4}$ 468.756,70 – 485.768,64 = -11.341,29

b13= $\frac{0,4}{1-0,4}$ 411.254,02 – 455.962,79 = -29.805,85

7) Look for the value of Ft with the equation Ft+m = αt + btm

F2 = 375.000 + 375.000 .1 = 0

F3= 415.000 + 391.000 .1 = 455.000

F4= 425.000 + 404.600 .1 = 459.000

F5= 445.600 + 421.000 .1 = 486.600

F6= 449.360 + 432.344 .1 = 477.720

F7= 485.616 + 453.652,80 .1 = 538.888

F8= 533.369,60 + 485.539,52 .1 = 613.086

F9= 552.021,76 + 512.132,42 .1 = 618. 504

F10= 523.213,06 + 516.564,67 .1 = 534.293,70

F11= 467.927,83 + 497.109,94 .1 = 419.291

F12= 468.756,70 + 485.768,64 .1 = 440.403,46

F13= 411.254,02 + 455.962,79 .1 = 336.739,40

8) Look for MSE calculations $\frac{\sum|X_t-F_t|2}{n|}$

$MSE2 = \frac{475.000-455.000}{6} = 184.900.000$

$MSE3 = \frac{440.000-459.000}{6} = 16.000.000$

$MSE4 = \frac{4701-6421,64}{6} = 29.160.000$

$MSE5 = \frac{5484-6160,118}{6} = 476.112.400$

$MSE6 = \frac{4360-6090,294}{} = 566.440.000$

So to find the F_{13} forecast value by:

S'14 = 0,4 . 336.739 + (1-0,4) . 411.254 = 381.448,17

S"14 = 0,4 . 381.448,17 + (1-0,4) . 455.155,42 = 426.156,94

a14 = 4 . (381.448,17) – 426.156,94 = 336.739,40

$b14 = \frac{0,4}{1-0,4}$ 381.448,17 – 426.156,94 = -29.805,85

F14= 336.739,40 + (-29.805,85) . 1 = 306.933, 55

So for forecasting the amount of raw material stock in January 2019 with alpha 0.4 is **306.933.55**

4. RESULTS AND DISCUSSION

In the results of this experiment will be forecasting the stock of animal feed raw materials. The experiment was conducted 2 times in 2019 with soy bean meal & soybean data using an alpha value of 0.4. with the actual data for 2018, you can compare later. Before the data is processed, the actual data is displayed first and then the forecasting process is done for 2019.

A. Trial

Initial display on the forecast data import menu, this import aims to enter the actual data into the program shown in Figure 2.

Figure 2 Data import menu.

➢ **Results of Soya Bean Meal Trial in 2019 Month 1**

Testing is done by giving an alpha amount of 0.4, the process is done 1 time. In 2019. And here are the results of the experiment. Results of forecasting data in 2019.

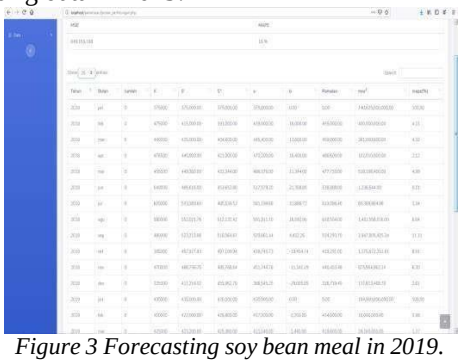

Figure 3 Forecasting soy bean meal in 2019.

So for forecasting the stock of raw materials in January 2019 with alpha 0.4 is 306,933.55

➢ **Soybean Trial Results in 2019 Month 1**

Testing is done by giving an alpha amount of 0.4, the process is done 1 time. In 2019. And here are the results of the experiment. Results of forecasting data in 2019.

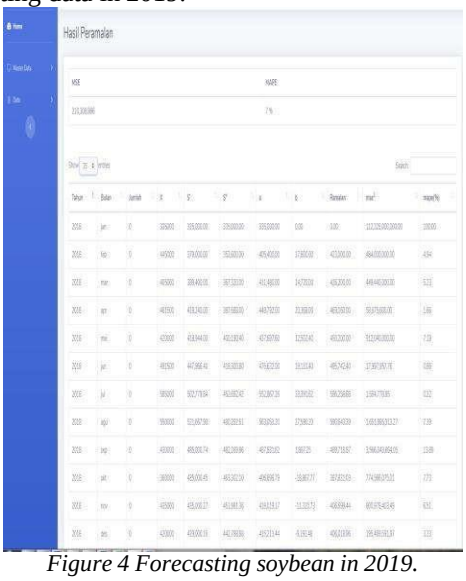

Figure 4 Forecasting soybean in 2019.

So for forecasting the stock of raw materials in January 2019 with alpha 0.4 is 406,128.55.

➢ **System Testing**

After conducting experiments in running the raw material stock forecasting system using the Double Exponential Smoothing method. And it is considered to be good in providing the results of forecasting by the warehouse user admin and certainly helps the performance of officers.

Table 2: Comparison of Actual Data 2019 with the Results of 2019 Soya bean meal forecasting.

Month	Actual Data	Forecast Results	MAPE Value
January	430..000	306.933,55	3.61
February	410.000	414.000	0.98
March	425.000	419.600	1.27
April	521.500	499.600	4.18
May	455.000	478.800	5.23
June	80.000	167.475	109.34
Average Difference in Forecasting Results			16%

The value of error in forecasting every month on average under 0.4% can be obtained from the calculation of actual data minus the forecasting results, then this application has an accuracy of 0.6%.

With an alpha value of 0.4, it indicates that forecasting in warehouse stock yields a MAPE value between forecasting and original data is 16%.

5. CONCLUSION

The conclusions that can be drawn after several stages in completing the forecasting system for the amount of raw material stock are:

1) The application is only for predicting the stock of animal feed raw materials at PT. Charoen Pokphand Indonesia.
2) Based on the calculation of forecasting in Chapter VI with an alpha value of 0.4, it shows that forecasting in the warehouse stock yields the MAPE value between forecasting and original data is 16%. The method used for forecasting stock of animal feed raw materials at PT. Charoen Pokphan Indonesia is a double exponential smoothing method.

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