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Forecasting Analysis of Cement Selling (Non-Bulk) Using The Method of Triple Exponential Smoothing (*Case study: PT. Lafarge Holcim Cement Indonesia*)

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ABSTRACT

PT. Lafarge Holcim Cement Indonesia is one of the cement companies focusing on construction. The aim of this study is to analyze the sales forecasting applied to know the next period using Triple Exponential Smoothing. The results showed that the values of MAD, MSE and MAPE for PCC's bag are 3980, 20925291 and 13%, respectively. Meanwhuile, the values for OPC's bag are 105, 19497 and 14%, respectively. Furthermore, the forcasting result of the next period of cement selling for PCC's and OPC's bag are 32498 and 792, respectively. Triple exponential smoothing method is a suitable method to forecast the case that has small bias, such as the case in PT. Lafarge Holcim Cement Indonesia.

Keyword: *Triple Exponential Smoothing; forecasting; selling.*

ABSTRAK

PT. Lafarge Holcim Cement Indonesia merupakan perusahaan yang berfokus pada bahan baku untuk kontruksi bangunan. Penelitian ini bertujuan untuk menganalisa peramalan yang akan diterapkan dan untuk mengetahui besarnya penjualan semen pada periode selanjutnya menggunakan metode triple exponential smoothing. Hasil yang diperoleh menggunakan metode peramalan triple exponential smoothing ini, untuk PCC bag, MAD sebesar 3980, MSE sebesar 20925291, dan MAPE sebesar 13 %. Sedangkan untuk OPC bag, MAD sebesar 105, MSE sebesar 19497, MAPE sebesar 14%. Sedangkan jumlah penjualan semen untuk periode selanjutnya dengan menggunakan metode peramalan triple exponential smoothing masing-masing yaitu PCC bag sebesar 32498, OPC bag sebesar 792. Metode peramalan Triple Exponential Smoothing dapat dipakai untuk meramalkan hal-hal yang fluktuatif dan memiliki bias yang kecil, seperti yang terjadi pada

Kata kunci: *Triple Exponential Smoothing; Peramalan; Penjualan.*

INTRODUCTION

Cement is the primary raw material in building construction. To date, nothing has replaced the function of cement itself. Moreover, with the development of increasingly advanced technology, public facilities, infrastructure and housing increases in the number and in population. This has made the demand for cement also increase. The competition of cement business is also experiencing rapid development. Thus, the companies must have their respective strategies to maintain their company's continuity and success. PT. Lafarge Holcim Cement Indonesia (PT. LHCI), One of the cement companies in Aceh , produces two types of cement products, which are OPC (Ordinary Portland Cement) and PCC (Portland Composit Cement). Both have differences in the composition of raw materials based on the SNI standards.

Currently PT. LHCI still has difficulty in predicting future sales for increasing company profits. This is due to the company has not implemented an appropriate method of sales forecasting

. If the company takes the wrong action in predicting sales, the company might suffer losses. if the sales forecasting of the company is too high, the company might suffer losses due to the enormous production costs. Otherwise, if company management determines the sales forecasting too low. The company might also experience losses due to the inventory out of stock which not fulfilling consumer demand. Therefore, companies need to forecast their next selling using specific methods. This study aims to forecast cement selling using triple exponential smoothing method in PT. Lafarge Holcim Cement Indonesia.

LITERATURE REVIEW

Selling and Forecasting

Selling is buying and selling process of goods or services carried out in a place/market or online, using a legal payment instrument to make a profit. Forecasting is an objective calculation using past data to determine the future conditions. This forecasting has two methods, namely qualitative methods, and quantitative methods. the qualitative method is a method that simply analyzes the objective conditions. Meanwhile, quantitative methods analyze the patterns of product and sales development [1]. Quantitative forecasting have several methods, one of which is the triple exponential smoothing method. This triple exponential smoothing method is the analytical method for selling forecasting in this study.

Triple Exponential Smoothing Method

This method is proposed by Brown, using quadratic equations. This method is suitable for forecasting fluctuations. The forecasting procedure is as follows: [2]

1. Determning the value of S't with the following formula:

   $$S'_t = \alpha X_t + (1 - \alpha) S'_t - 1$$

   For the first period, the value of S'1 cannot be found using the formula above but it can be determined freely. It is generally determined by the same value that occurred in the first period.

2. Determining the value of S "t using the formula:

   $$S''_t = \alpha S'_t + (1 - \alpha) S''_t - 1$$

   In the first period, the value of S "$_t$ is usually determined as the value that occurred in the first period.

3. Determining the value of S "'t with the following formula:

   $$S'''_t = \alpha S''_t + (1 - \alpha) S'''_t - 1$$

   For the first period, S" '$_t$ is generally considered the same as the first period data.

4. Determining the a_t value using the following formula:

   $$a_t = 3 S'_t - 3 S''_t - S'''_t$$

5. Determining the bt value using the following formula:

   $$b_t = \frac{\alpha}{2(1-\alpha)^2} [(6 - 5\alpha) S'_t - (10 - 8\alpha) S''_t + (4 - 3\alpha) S'''_t]$$

6. Determining the value of ct using the following formula:

   $$c_t = \frac{\alpha^2}{(1-\alpha)^2} (S'_t - 2 S''_t + S'''_t)$$

7. Producing a forecast equation as follows:

   $$F_{t+m} = a_t + b_t m + \tfrac{1}{2} c_t m^2$$

m is the forward period for how many future periods the forecast is carried out. a_t, b_t, c_t are values calculated according to the formula above.

Calculating Forecasting Errors

There are several calculations commonly used to calculate the total forecast error. This calculation can be used to compare different forecasting models, as well as to monitor forecasts, and to ensure that the forecast properly function. The validation of forecasting methods, especially using the methods above, cannot be separated from the indicators in measuring forecasting accuracy. There are several indicators for measuring forecasting accuracy, but the most commonly used are the mean absolute deviation, mean squared error, and mean absolute percent error. [3]

1. *Mean Absolute Deviation* (MAD)
   Forecasting accuracy is high if MAD's values, mean absolute percentage error, and mean squared error are getting smaller. MAD is the absolute total value of the forecast error divided by the data. The formula for calculating MAD is as follows: [3]

$$\text{MAD} = \sum \left| \frac{Aktual - Peramalan}{n} \right|$$

2. *Mean Squared Error* (MSE)
   The error value is calculated using the average squares difference between predicted and observed values. Mean Squared Error is also known as forecasting error. This forecasting error can also calculate the MAD value, which was discussed in the previous section. Forecast errors cannot be avoided in forecasting systems, but forecast errors must be appropriately managed. Management of forecast errors can be more effective if forecasters can take appropriate action regarding the forecast error. Various forecasting models provide different forecast values and different degrees of forecast error in a forecasting system. The average of square error strengthens the effect of large error rates but minimizes forecast error rates smaller than one unit. [3]

$$\text{MSE} = \sum \left| \left(\frac{(Aktual - \text{Peramalan})}{n} \right)^2 \right|$$

3. *Mean Absolute Percent Error* (MAPE)
   The problem with MAD and MSE is that their value depends on the size of the element being forecasted. If the element is calculated in thousands, the values for MAD and MSE can be tremendous. To avoid this problem, we can use the Mean Absolute Percent Error (MAPE). MAPE is calculated as the average of absolute differentiation between predicted and actual values, expressed as a percentage of actual value. If we have predicted and actual values for n periods, MAPE can be calculated using the following formula: [3]

$$\text{MAPE} = 100 \sum_{i=1}^{n} \frac{|aktual_i - ramalan_i|/aktual_i}{n}$$

METHOD

This research perform the field survey method (interviews and direct observation). The forcasting analysis in this research is using the method of triple exponential smoothing, which is also carried out by analyzing the forecast errors. This research data is taken from sales data from 2014 to 2016, at PT. Lafarge Holcim Cement Indonesia. The flowchart of this research at PT. Lafarge Holcim Cement Indonesia can be seen in Figure 1:

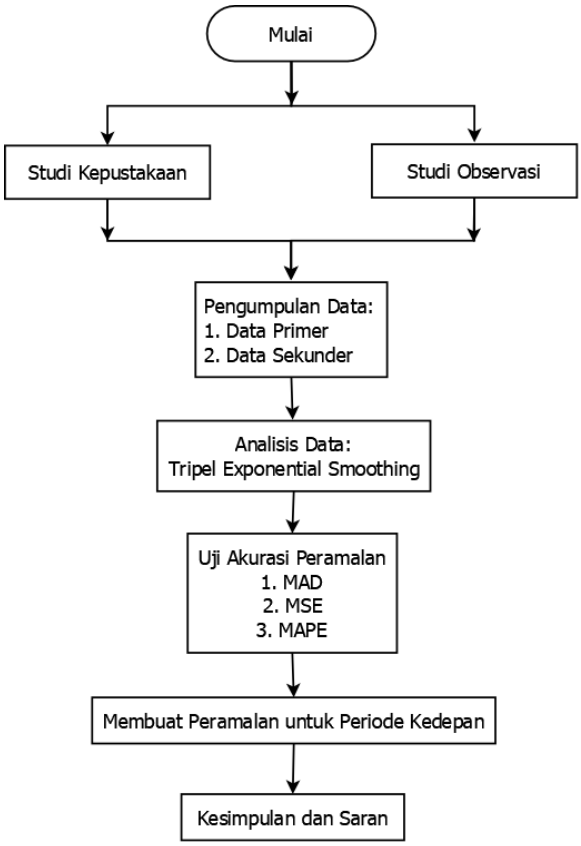

Figure 1. Research flow chart

Data Analysis

The data used for data analysis is the actual sales data obtained from PT. Lafarge Holcim Cement Indonesia from 2014 to 2016 for each type of cement. These data are then analyzed using the triple exponential smoothing formula, which is then tested for accuracy using Mean Absolute Deviation (MAD), Mean Squared Error and Mean Absolute Percent Error (MAPE).
Next is the selling forecast for each type of cement in the following years. The last is the conclusions and suggestions on how to forecast cement selling using the method of triple exponential smoothing.

RESULT AND DISCUSSION

First Data Discussion

Before calculating the sales forecast, the first thing to do is to record the actual sales. In this study, sales data were taken from 2014 to 2016. Data on sales of non-bulk cement at PT Lafarge Holcim Cement Indonesia can be seen in Table 1 below:

Table 1. Data on sales of non-bulk cement for the period 2014 - 2016

Years	Times Index (Month)	Actual Sales (Ton)	
		PCC Bag	OPC Bag
2014	January	34525	750
	February	25760	783
	March	27950	850
	April	30490	940
	May	28690	985
	June	32790	847
	July	27680	757
	Augusts	40987	987

Years	Times Index (Month)	Actual Sales (Ton)	
		PCC Bag	OPC Bag
	September	38790	725
	October	42690	732
	November	35462	780
	December	36578	683
2015	January	32659	705
	February	21760	736
	March	23950	850
	April	25490	924
	May	28750	970
	June	30980	825
	July	25680	598
	Augusts	40672	786
	September	31260	985
	October	42460	689
	November	35470	758
	December	38460	625
2016	January	33419	602
	February	23763	621
	March	24944	750
	April	24449	914
	May	28917	958
	June	29989	851
	July	24866	964
	Augusts	42572	1454
	September	32240	996
	October	41446	496
	November	32416	576
	December	34426	675

Source: PT. LHCI

Figure 2. shows a graph of non-bulk cement selling of PCC for the period 2014 - 2016. The results depict that in every February the cement selling is decreasing while it significantly increase in every August and October

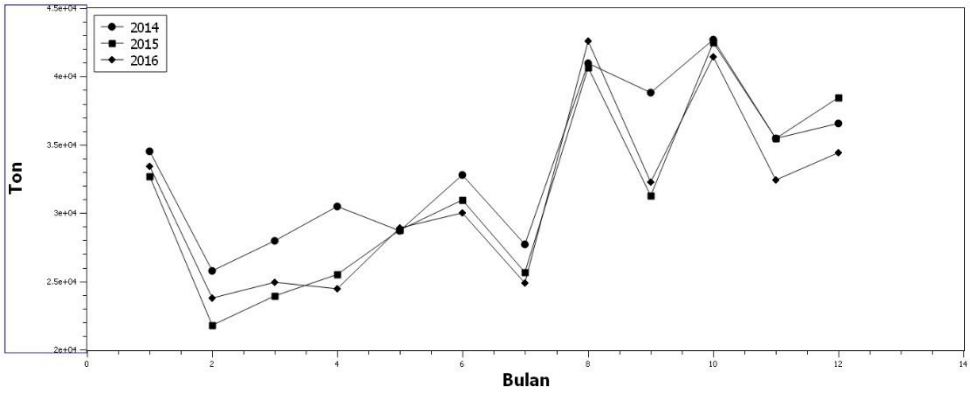

Figure 2. Graph of Non-Bulk Cement Selling of PCC Data for the Period 2014 - 2016

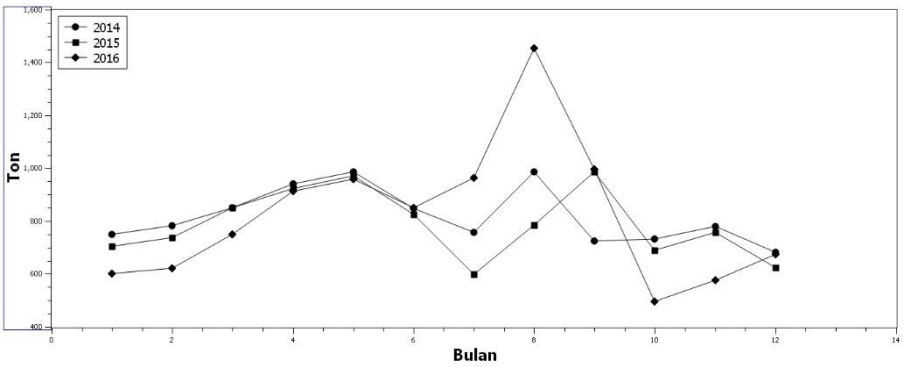

Figure 3. Graph of Non-Bulk Cement Selling of OPC Data for the Period 2014 - 2016

Figure 3. Shows the graph of non-bulk cement selling of OPC data for the period 2014-2016. The significant increase of cement selling can be clearly observed in every August every year.

Discussion of Selling Forecasting for PCC Cement

The calculation of Triple Exponential Smoothing of non-bulk cement Selling for the PCC cement type can be seen in Table 2.

Table 2. Forecasting Calculation of PCC Non-Bulk Cement Selling
Using the Method of Triple Exponential Smoothing

Period (Month)	Demand (x)	S't	S''t	S'''t	at	bt	ct	Forecast t+1
1	34525	34525	34525	34525	0	0	0	-
2	25760	33649	34437	34516	32150	-250	-9	31896
3	27950	33079	33592	34424	32885	16	4	32903
4	30490	32820	33053	34287	33588	203	12	33797
5	28690	32407	32778	34136	33021	184	12	33211
6	32790	32445	32411	33963	34067	366	20	34443
7	27680	31969	32397	33807	32520	176	12	32702
8	40987	32870	32059	33632	36067	635	29	36716
9	38790	33462	32930	33562	35160	325	14	35492
10	42690	34385	33555	33561	36052	283	10	36341
11	35462	34493	34396	33645	33935	-139	-8	33792
12	36578	34701	34514	33731	34294	-115	7	34176
13	32659	34497	34681	33826	33275	-258	-13	33011
14	21760	33223	34370	33881	30442	-501	-20	29931
15	23950	32296	33131	33806	31302	-129	2	31172
16	25490	31615	32228	33648	31810	116	10	31932
17	28750	31329	31587	33442	32668	336	20	33014
18	30980	31294	31325	33230	33136	424	23	33572
19	25680	30733	31238	33031	31515	238	16	31761
20	40672	31727	30832	32811	35495	756	35	36268
21	31260	31680	31722	32702	32576	210	12	32792
22	42460	32758	31788	32611	35521	517	22	36050
23	35470	33029	32785	32628	33360	47	1	33408
24	38460	33572	33083	32674	34140	72	1	34213
25	33419	33557	33571	32763	32722	-189	-10	32528
26	23763	32578	33459	32833	30189	-442	-19	29737
27	24944	31814	32501	32800	30739	-165	-5	30571
28	24449	31078	31740	32694	30705	-7	4	30700
29	28917	30862	31056	32530	31947	271	16	32225

Period (Month)	Demand (x)	S't	S''t	S'''t	at	bt	ct	Forecast t+1
30	29989	30774	30853	32362	32127	318	18	32454
31	24866	30183	30715	32198	30602	158	12	30766
32	42572	31422	30307	32009	35353	767	35	36138
33	32240	31504	31431	31951	32172	144	7	32319
34	41446	32498	31604	31916	34600	375	15	34983
35	32416	32490	32497	31974	31952	-122	-7	31827
36	34426	32684	32509	32028	32550	-51	-4	32498

Discussion of Selling Forecasting for OPC Cement

The calculation of forecasting non-bulk cement selling using the triple exponential method for OPC cement type can be seen in table 3.

Table 3. Calculation of OPC Non-Bulk Cement Selling Forecasting Using the Method of Triple Exponential Smoothing

Period (Month)	Demand (x)	S't	S''t	S'''t	at	bt	ct	Forecast t+1
1	750	750	750	750	0	0	0	-
2	783	753	750	750	759	1	0	760
3	850	763	752	750	784	4	0	788
4	940	781	755	751	829	8	0	837
5	985	801	759	751	877	12	0	890
6	847	806	764	753	878	12	0	890
7	757	801	768	754	854	8	0	863
8	987	819	773	756	896	12	0	908
9	725	810	776	758	859	7	0	866
10	732	802	779	760	830	4	0	833
11	780	800	781	762	819	2	0	821
12	683	788	782	764	784	-2	0	782
13	705	780	782	766	761	-4	0	757
14	736	776	781	767	751	-5	0	746
15	850	783	781	769	774	-2	0	772
16	924	797	783	770	813	2	0	815
17	970	814	786	772	857	6	0	864
18	825	815	789	774	853	5	0	859
19	598	794	789	775	788	-2	0	786
20	786	793	790	777	786	-2	0	784
21	985	812	792	778	839	4	0	842
22	689	800	793	780	801	-1	0	800
23	758	796	793	781	789	-2	0	787
24	625	779	792	782	743	-7	0	736
25	602	761	789	783	700	-11	0	689
26	621	747	784	783	670	-13	0	657
27	750	747	781	783	682	-11	0	671
28	914	764	779	782	737	-4	0	733
29	958	783	779	782	794	2	0	796
30	851	790	780	782	811	4	0	814
31	964	807	783	782	855	8	0	863
32	1454	872	792	783	1023	25	1	1049

Period (Month)	Demand (x)	S't	S''t	S'''t	at	bt	ct	Forecast t+1
33	996	885	801	785	1034	24	1	1059
34	496	846	806	787	907	9	0	916
35	576	819	807	789	824	0	0	824
36	675	804	807	791	783	-5	0	779

Calculation of Accuracy Value in Forecasting of Non-Bulk Cement Sales

After collecting and processing the data, the sales forecasting results are obtained. Furthermore, the accuracy value of the method that has been done is measured. To calculate the accuracy value, the MAD, MSE, and MAPE methods are used. The forecasting and accuracy values for two types of cement, namely the PCC and the OPC type can be seen in table 4 below:

Table 4. MAD, MSE, and MAPE Forecasting Accuracy

No	Type of Cement	Forcasting Method	Total Sales	Forecasting Accuracy		
				MAD	MSE	MAPE
1	PCC bag	Triple Exponential Smoothing	32498	3980	20925291	13 %
2	OPC bag	Triple Exponential Smoothing	792	105	19497	14 %

CONCLUSION

After collecting and processing data using predetermined forecasting methods, it can be concluded that the sales forecasting method using the Triple Exponential Smoothing method is very suitable for forecasting a fluctuative case due to its small bias.

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