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FORECASTING DEMAND OF PLASTIC IN PT LOWELL PACK TO MAXIMIZE THE PROFIT

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Abstract. Plastic has growth very rapidly in South East Asia. This make local plastic factory have to manage the produce they can make to maximize the profit the company can get, PT Lowell pack, as case study because PT Lowell pack is the new plastic factory and the capacity is quite much for small factory about 90 ton. This research found that in PT Lowell pack have produce with same capacity in 3 products. They have even thought if they produce more in one product than another they can make more profit. This situation is happened because they are only using judgmental decision by the owner to forecast the demand and produce the product in PT Lowell pack. And Judgmental decision cannot give accurate prediction. Therefore, there area lot of mismatches between supply and demand. Because that we have to know the best forecast method for demand plastic in PT Lowell pack and organize the produce per month per product to maximize the profit. And forecasting method we will use are Moving Average, Exponential Smoothing, Holt, trend analysis (regress over time). The research will search the best forecasting method to maximize the profit and The data which will be used is the secondary data from PT Lowell pack Sales report monthly by PT Lowell pack and profit report of PT Lowell pack monthly. These secondary data will be analysis further by forecasting method.so we can now the sales by PT Lowell pack monthly and maximize the profit PT Lowell pack monthly. And the result of this research PT Lowell pack have to choose to trend analysis method for forecasting. And have to produce more plastic kw2 after that kw1 after that Pure plastic. And PT Lowell pack get more profit if forecast the demand and get Rp13.077.500

Keyword: forecasting, demand plastic in Indonesia, growing market plastic

Introduction

The Southeast Asian polyolefin industry has made its presence felt with growing demand for polyolefin in the region. Especially in Indonesia and this growing demand because increase export to China and increase in market needs of plastic in Indonesia. .(pr newswire)(2013). But In Bandung. September and October 2015 plastic industry is in a condition of crisis because the decline of demand for plastic at about 50%. And in that month there are 3 companies of plastic industry that had shut downed because of huge losses and the absence of any request, according to Bandung trade bureau (Dinas Perdagangan Bandung)(2015) .And demand and price plastic in Bandung move very quickly. And the research will take local plastic factory , PT Lowell Pack is a private company that engaged in the production of plastic. This company was found in 2012 and had only 1 plastic production machinery. In its development, this company has managed to add 3 plastic machineries and keep in production for 24 hours. This company is located in Cimahi and owned by a man named bobby Lowell. And The researcher found in the company if the company cannot more efficient than this day the company can shut down, because now the company is not get profit and loss or the revenue only can only cover the cost of factory.

And to achieve efficient in producing plastic, it can gets by know the next month producing plastic. Because if the company know the demand of next month the company can know buy how much the plastic and how much employee is have employed. Because of that knowing next month producing is very important and to know next month demand we have to forecasting the demand of plastic in next month.. And know what plastic is to be produce, now the current situation the factory produce same with 3 product its produce by PT Lowell pack is about 30 ton per product and maximal production is 90 ton for all product. And the research questions is:

Which best demand forecasting that is proper to PT Lowell pack?
- How to devide product compotition for maximize profit in PT Lowell pack?
- How much the improvement this forecast and organize the produce to profit?
- And to achieve forecast the demand in PT Lowell pack. The first step is choosing forecasting methods and requirements planning methods that will be compared. For forecast methods, this research will use four methods. 1. Moving Average Model

The moving average method is used when demand has no observable trend or seasonality with formula:
Lt= (Dt+Dt-1+...+Dt-N+1)/N
With D is demand in certain period and N is total period which used for the calculation and Lt is level in certain period with could be used for the next period forecast (Ft+1) (Chopra and Meindl, 2013).

2. Simple Exponential Mode
Simple exponential smoothing method is appropriate when demand has no observable trend or seasonality with formula for determines the level in certain period is:

$$L_0 = \frac{1}{n}\sum_{i=1}^{n} D_I$$

and the forecast for future period is Ft+1= Lt(Chopra and Meindl, 2013).
3. Holt Model
Holt model method is appropriate when demand is assumed to have a level and a trend in the systematic component but no seasonality with the several formulas to observe. The first formula is to determine the demand in certain period is:
Dt= at + b
With a and b is variable, the second formula is to expressed forecasted for future periods which is:

$$F_{t+n} = L_t + nT_t$$

With n is period, the third formula is to estimates the level (L_{t+1}) and the trends (T_{t+1}) as follows to

$$L_{t+1} = \alpha D_{t+1} + (1-\alpha)(L_t + T_t) \; and \; T_{t+1} = \beta(L_{t+1} - L_t) + (1-\beta)T$$

where α is a smoothing constant for the level 0 < α < 1 and β is a smoothing constant for the trend, 0 < β < 1 (Chopra and Meindl, 2013).
.4. trend analysis (regress over time)
Trend analysis method can be used to make and justify statements about tendencies in the data, by relating the measurements to the times at which they occurred.
With the formula

$$\sum_t \{[(at+b) - y_t]^2\}$$

And the steps like below:

Figure 1 Forecasting steps

To choose the best forecast method, this research will compare the error measurement of each forecast method to find the smallest error. The smallest error forecast method will be chosen as forecast method for this company. The first thing to do the error measurement is calculating mean absolute error to as a standard to calculate mean absolute scaled error.

Error Measurement

For choosing the best possible forecast method, forecast error should be measured and the smallest error should be chosen. Forecast error has several measurement methods. Forecast error has several measurement methods. The first method is MSE (mean squared error) which related to the variance of the forecast error with the equation is:

MSEn=$\frac{1}{n}\Sigma_{t=1}^{n}\Sigma_{t}^{2}$(Chopra and Meindl,2013)$nt$=1.

With n is period and e is error. The second forecast measurement method is MAD (mean absolute deviation) with the equation is

MADn =$\frac{1}{n}\Sigma_{t=1}^{n}A_{t}$ (Chopra and Meindl, 2013).

With n is error and A is absolute error value. The next one is MAPE which is mean absolute percentage error with equation is MAPE

MAPE =$\frac{\Sigma_{t=1}^{n}\left|\frac{E_t}{D_t}\right|100}{n}$ (Chopra and Meindl, 2013).

The three errors above is used when the demand has no zero value. For measuring the error of intermittent demand's forecast, this research will use MAE (Mean Absolute Error):

$$MAE = \frac{1}{n}\sum_{i=1}^{n}\left|f_i - y_i\right| = \frac{1}{n}\sum_{i=1}^{n}\left|e_i\right|$$

With n is period, and ei is absolute error. The mean absolute error is *one of a number of ways of comparing forecasts with their eventual outcomes* (Hyndman et al, 2005). Well-established alternatives are *the mean absolute scaled error (MASE) and the mean squared error* (Hyndman et al, 2005). These all summarize performance in ways that disregard the direction of over- or under-prediction; a measure that does place emphasis on this is the mean signed difference (Hyndman et

al, 2005).Where a prediction model is to be fitted using a selected performance measure, in the sense that the least squares approach is related to the mean squared error, the equivalent for mean absolute error is least absolute deviations (Hyndman et al, 2005). The second forecast measurement method is MASE (mean absolute scale error) with the equation is mean absolute square error:

$$MASE = \frac{1}{n}\sum_{t=1}^{n}\left(\frac{|e_t|}{\frac{1}{n-1}\Sigma_{i=2}^{n}|y_i - y_{i-1}|}\right) = \frac{\Sigma_{t=1}^{n}|e_t|}{\frac{n}{n-1}\Sigma_{i=2}^{n}|y_i - y_{i-1}|}$$

With n is error, t is period, and y is forecast size. In statistics, the mean absolute scaled error (MASE) is a measure of the accuracy of forecasts. It was proposed in 2006 by Australian statistician Rob J. Hyndman, who described it as a *generally applicable measurement of forecast accuracy without the problems seen in the other measurements* (Hyndman, 2006) .

This scale-free error metric can be used to compare forecast methods on a single series and also to compare forecast accuracy between series. This metric is well suited to intermittent-demand series because it never gives infinite or undefined values except in the irrelevant case where all historical data are equal (Hyndman, 2006). After that, this research will use the data demand to divide product composition to maximize the profit of PT Lowell pack and know the improvement of this forecast to profit in PT Lowell pack and the step like below:

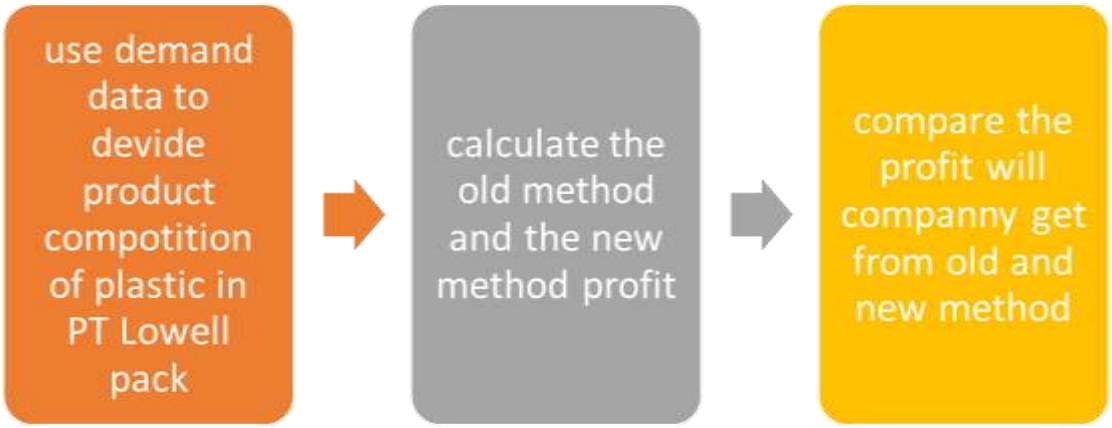

Figure 2 Maximize Profit And Prove It

For answer the first research questions we have to know demand plastic in PT Lowell pack. The image below will show monthly demand data of PT Lowell pack:

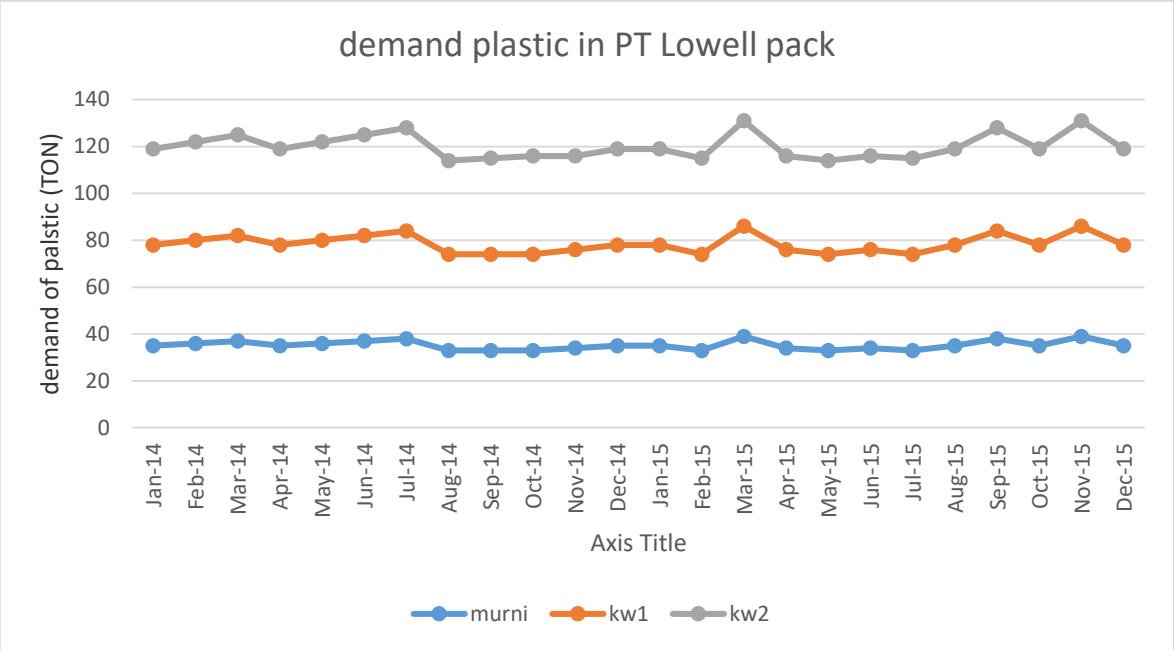

Figure 3 Demand Plastic

After that we have to forecast analysis and calculate error of the forecasting method and below is table for error:

Table 1 The Best Demand Forecast Method pure

Forecasting Method	Mean Absolute Deviation (MAD)	Mean Squared Error (MSE)	Mean Absolute Scaled Error (MASE)
three-period moving average	1.9	5.09	0.95
Simple exponential smoothing	1.61	4.05	0.805
Holt model	1.68	4.51	0.84
trend analysis	1.53	3.58	0.765

Table 2 The Best Demand Forecast Method kw1

Forecasting Method	Mean Absolute Deviation (MAD)	Mean Squared Error (MSE)	Mean Absolute Scaled Error (MASE)
three-period moving average	1.9	5.09	0.95
Simple exponential smoothing	1.61	4.05	0.805
Holt model	1.68	4.51	0.84
trend analysis	1.53	3.58	0.765

Table 3 The Best Demand Forecast Method kw2

Forecasting Method	Mean Absolute Deviation (MAD)	Mean Squared Error (MSE)	Mean Absolute Scaled Error (MASE)
three-period moving average	1.49	3.53	0.856322
Simple exponential	1.3	2.74	0.747126

smoothing			
Holt model	1.41	2.93	0.810345
trend analysis	1.25	2.31	0.718391

After we look the table of error we chose trend analysis because have the smallest error. And the table bellow will look the forecast of trend analysis:

Table 4 forecasting trend analysis

types	demand
Pure	35.2 Ton
Kw1	43.2 Ton
Kw2	41.69 Ton

After we know the forecast result , this research will give the company how much should be plastic roduced For PT Lowell pack to gain more profit and below is table profit:

Table 5 Profit Of Plastic

Types of palstic	profit
Pure	Rp3000.00
Kw1	Rp3500.00
Kw2	Rp4000.00

After look the table of profit we can assure to produce more plastic kw2 after that kw1 after that Pure. And we know the capacity of the factory is 90 ton per month. And next month to be produced by PT Lowell pack are as follows

Table 6 New Composition

Types of plastic	production
Pure	5.11 ton
Kw1	43.2 ton
Kw2	41.69 ton

The table up there will make PT Lowell pack get more profit from displace quantity the types of plastic commonly produced by PT Lowell pack. After that we have to know how much improvement from forecasting to the profit PT Lowell pack with no forecasting the company. And the old profit PT Lowell pack is Rp315.000.000 and the new profit in PT Lowell pack per month is Rp328.077.500Andis bigger than profit with no forecasting and is bigger about Rp13077500 per month. Because of this evidence. Proven forecasting demand for PT Lowell pack can get more profit.
After that the researcher get 3 conclusion:
1. This research select model as trend analysis is the best forecasting method for PT Lowell pack
2.PT Lowell pack have to produce more plastic kw2 after that kw1 after that Pure.
3.PT Lowell pack get more profit if forecast the demand and get Rp13.077.500

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