# FORECASTING THE NUMBER OF BRICK PRODUCTION USING THE METHOD OF EXPONENTIAL SMOOTHING HOLT-WINTER (CASE STUDY: PT SIK KRIAN)

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*ABSTRACT*

*PT. SIK is an industry that produces a light brick type of brick. At a certain period, some companies are rising and the decline in demand which is quite significant. This research aims to know the condition of the company to overcome the overstock in the warehouse. The methods used to conduct forecasting in this research is a method of Exponential Smoothing Holt-Winter with seasonal multiplicative component and the addition of seasonal. The value of alpha, beta and gamma used is 0.6, 0.1, and0.5. With the value of the parameter is capable of producing the best MSE values with the value 1 in forecasting the year 2011 in October for seasonal multiplicative component, and the value of 0.006 in MAPE and the same month. For the addition of a seasonal best MSE values obtained on forecasting in 2013 in February with the value and worth of 5.016 MSE MAPE 0.013. The results of this research, the company was able to reduce the buildup of inventory and maximizing production for the coming period without having to fear a shortage of stock and overstocking.*

Key word : *Production of light brick, exponential smooting holt-winter, MSE, MAPE, seasonal, seasonal addition multiplication*

## 1. INTRODUCTION

PT Sinar Indah Kencana is a company engaged in manufacturing buildings. I.e. produces concrete masonry such as brick. PT SIK located on JL. Ponokawan KM 27 No. 28 B Sidoarjo Krian areas include the company is developing. Is said to be growing because in the span of less than 10 years of development, the company was able to send a light brick production results to various cities in Indonesia. Used for the development of private or public.

With the growing number of consumer demand against a brick light, poses some obstacles for the company, where the company is required to increase the amount ofproduction. In addition to adding to the hours of work on the part of the production, the company also adds some of the tools of production to meet the needs of consumers taking action against brick. However, not every time the demand for lightweight bricks are always high, sometimes request only slightly, causing the stock digudang accumulate.

From some of these obstacles, the most caught my attention is the buildup of stocks of light bricks digudang. Stacking bricks light for too long, will result in a reducedquality against such items such as brick easily broken and easily destroyed. Thus causing a negative impact for companies and for consumers.

To address this, then it needs a calculation to be able to predict the amount of production that must be provided upon request data and the production of the earlier period. These data can be used to estimate the amount of production that must be provided by the warehouse.

Accordingto Makridakis and Wheelwright (1992:81), Exponential Smoothing methods Holt-Winter very precisely used to handle seasonal data other than data that has a trend. The benefits of using the method of Exponential Smoothing Holt-Winter is easy to use because it is relatively simple and low-cost (Arsyad, 1994). The mean squared error (MSE) or error (error) generated by the method

of Exponential Smoothing Holt-Winter is relatively smaller compared to the method of Exponential Pemulusan Holt and Brown (Arsyad, 1994).

This application designed using the method of Exponential Smoothing Holt-Winter forecasting calculations as the solution since the data digudang data production trend and seasonal data. Application of forecasting made are expected to produce a report on the results of forecasting production of bricks to come. The report and the list is expected to help the employees of PT. SIK Krian areas in addressing the shortage of stock and surplus stock of digudang.

## 2. RESEARCH METHODOLOGY

This research is divided into 5 stages, namely, needs analysis, system design, implementation, testing, system maintenance, report writing

1. Needs Analysis

At this stage the author conducting interviews with some of the production employees to know problems occurred and collect production data needed for research.

2. The design of the system

The author in this stage do designing systems and software using uml, erd diagramand flowchart to get an overview of the system to be built.

3. Implementation

At this stage the author started making php programming language system and conduct testing to look for errors that may occur on his programming. The results obtained will be re-evaluated, if it is not correct and appropriate expectations, then returned to the previous stage, namely the stage of designing.

4. Test system

This step the author doing a test run of the system which was built to the user or the user that is lab admin or quality control to help determine the amount of the monthly brick production.

5. Maintanance

In this stage the author doing the maintenance of the system by fixing the system in case of error or damage as well as evaluate to seeking weakness-kelamahan are there to do completion at a later date.

6. Report writing

This stage the author makes reports ranging from introduction to cover.

## 3. The DESIGN

The system was created to
help employees part production in light brick productionamount foreseen. On the process of forecasting Exponential Smoothing method using Holt
Winter with seasonal multiplicative component and the addition of seasonal. For more details can be seen in Picture 3.1 below.

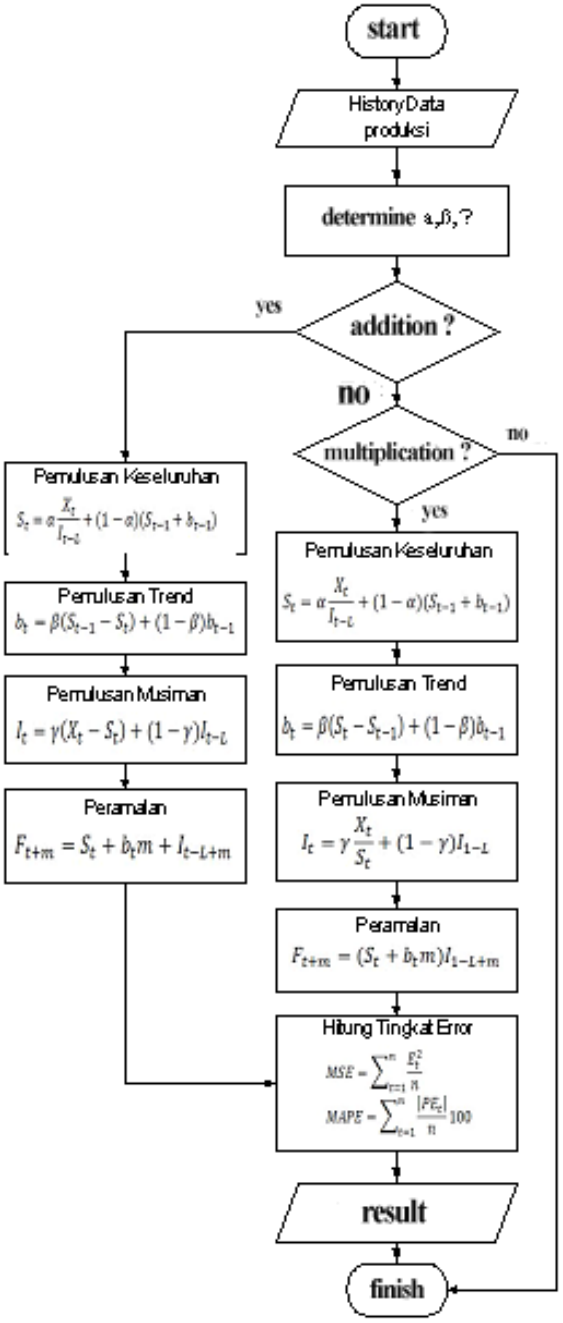



Figure 3.1 Flowchart metode Exponential Smoothing holt-winter

In Figure 3.1 describes the plot of exponential smoothing method holt-winters. From the production of data input, then the initialization parameters α, β, and ´Y. Proceed with the calculation of the holt-winter with seasonal multiplicative components as well as the addition of seasonal. The calculation of the level of the error using the MSE and MAPE, to forecasting results obtained in the period to come.

3.1 Exponential Smoothing Seasonal Multiplicative Holt-Winter

Themethodof Exponential PemulusanWinters Seasonal Multiplicative method(Multiplicative Seasonal Method) used for the seasonal variation of data increase/decrease (fluctuations) with the formula

Overall Pemulusan

$$S_t = \alpha \frac{X_t}{I_{t-L}} + (1-\alpha)(S_{t-1} + b_{t-1}) \quad (3.1)$$

Pemulusan Trend

$$b_t = \beta(S_t - S_{t-1}) + (1-\beta)b_{t-1} \quad (3.2)$$

Seasonal Pemulusan

$$I_t = \gamma \frac{X_t}{S_t} + (1-\gamma)I_{1-L} \quad (3.3)$$

Forecast

$$F_{t+m} = (S_t + b_t m)I_{1-L+m} \quad (3.4)$$

3.2 Exponential Smoothing Holt-Winter Seasonal Additions

The method of Exponential Pemulusan Holt-Winters Seasonal Additions methods (Additive Seasonal Method) used for the seasonal variations that are constant with the formula

Overall Pemulusan

$$S_t = \alpha(X_t - I_{1-L}) + (1-\alpha)(S_{t-1} + b_{t-1}) \quad (3.5)$$

Pemulusan Trend

$$b_t = \beta(S_{t-1} - S_t) + (1-\beta)b_{t-1} \quad (3.6)$$

Seasonal Pemulusan

$$I_t = \gamma(X_t - S_t) + (1-\gamma)I_{t-L} \quad (3.7)$$

Forecast

$$F_{t+m} = S_t + b_t m + I_{t-L+m} \quad (3.8)$$

The meanings of the symbols used in equation (3.1) to (2.4) are:
XT = actual value at end of period t
α = smoothing constants for data (0 < α < 1)
β = smoothing constants for trend (0 < β < 1)
γ = smoothing constants for seasonal (0 < γ < 1)
St = value pemulusan the beginning
BT = constants pemulusan
I = the seasonal adjustment factor
L = length of the season
FT = forecast for + m m forward of period t

### *3.3 MSE* dan *MAPE*

*Mean Squared Error* (MSE)

$$\text{MSE} = \sum_{t=1}^{n} \frac{e_t^2}{n} \quad (3.9)$$

*Mean Absolute Percentage Error* (MAPE)

$$\text{MAPE} = \sum_{t=1}^{n} \frac{|PE_t|}{n} \quad (3.10)$$

The meanings of the symbols used in equation (3.1) and (3.11) are:

Pet = percentage error = x 100
Et = error period t = Xt-Ft
XT = actual period t data
n = a lot of period t.

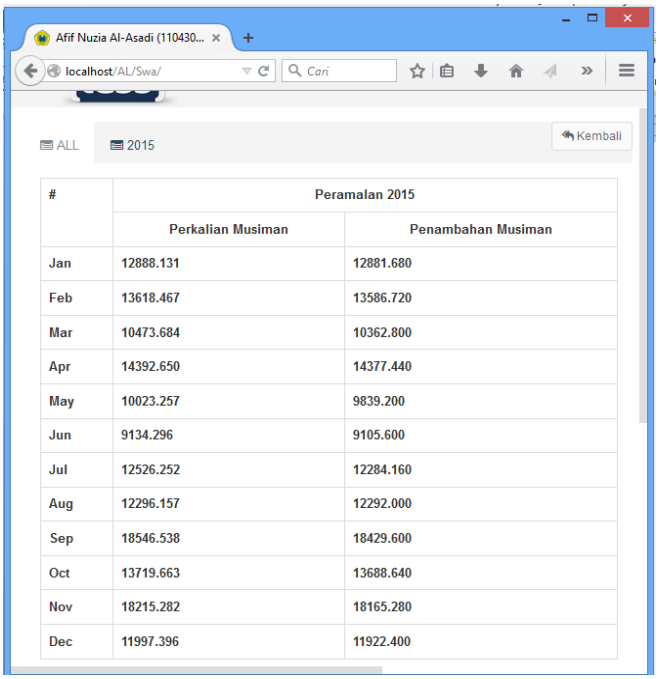
## 4. RESULTS and DISCUSSION

A series of trials that have been done, the application of forecasting made able to help employees of PT. SIK Krian areas in brick production amount foreseen for the coming period in addressing the overstock digudang. Experiments
conducted is intheprocessof forecasting calculations using multiplication andadditionof componentswit h merandom nialai alpha, beta and gamma. The combination of parameter values that generate value MSE smallest MAPE and the most that will be used to conductforecasting. Experiments done on forecasting for the year from January to December 2014 to know the values of MSE smallest MAPE and the combination of the value of alpha, beta and gamma. For more details can be seen in table 4.1.

Table 4.1 testing the value of alpha, beta, and gamma against forecast results

| experiment | alpha | beta | Gamma |
|---|---|---|---|
| 1 | 0.2 | 0.1 | 0.5 |
| 2 | 0.3 | 0.2 | 0.8 |
| 3 | 0.4 | 0.3 | 0.5 |
| 4 | 0.5 | 0.4 | 0.9 |
| 5 | 0.6 | 0.1 | 0.8 |
| 6 | 0.7 | 0.5 | 0.4 |
| 7 | 0.8 | 0.6 | 0.7 |
| 8 | 0.9 | 0.7 | 0.6 |
| 9 | 0.1 | 0.2 | 0.3 |
| 10 | 1 | 1 | 1 |

From table 4.1, a combination that produces a very small error value that will be used for forecasting for the year 2015. From potentially experiencing unplanned tests that have been done, the combination of parameters that yield the value of the MSEand the smallest MAPE is a combination of experimental parameters on the 7th with a value of 0.5, 0.6, and 0.4. This parameter value is used to predict the amount of production for the coming period, i.e. 2015, shown in Figure 4.1.




| # | Peramalan 2015 | |
|---|---|---|
| | Perkalian Musiman | Penambahan Musiman |
| Jan | 12888.131 | 12881.680 |
| Feb | 13618.467 | 13586.720 |
| Mar | 10473.684 | 10362.800 |
| Apr | 14392.650 | 14377.440 |
| May | 10023.257 | 9839.200 |
| Jun | 9134.296 | 9105.600 |
| Jul | 12526.252 | 12284.160 |
| Aug | 12296.157 | 12292.000 |
| Sep | 18546.538 | 18429.600 |
| Oct | 13719.663 | 13688.640 |
| Nov | 18215.282 | 18165.280 |
| Dec | 11997.396 | 11922.400 |

Figure 4.1 Results forecasting the year 2015

## 5. CONCLUSION

The conclusion that can be drawn from the design of the application of forecasting production amount of exponential smoothing method using Holt-Winter are:
1) value of alpha, beta, gamma that is able to generate maximum value of forecasting error is small, 0.6, 0.1, 0.5 so that it is able to maximize the amount of production and were able to reduce the overstock in the warehouse.
2) MSE and MAPE of alpha, beta and gamma best retrieved about 1 to 7 for MSE, and 0 to 1 for MAPE

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