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To cite this article: F Sidqi and I D Sumitra 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **662** 032031

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EXTENDED ABSTRACT DEADLINE: DECEMBER 18, 2020

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Forecasting Product Selling Using Single Exponential Smoothing and Double Exponential Smoothing Methods

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Abstract. The purpose of research is to observe forecasting product selling. The methods used are Single Exponential Smoothing and Double Exponential Smoothing. The result showed that MAPE of Single Exponential Smoothing is 20% and MAPE of Double Exponential Smoothing around 24%. The use of Single Exponential Smoothing method has a lower error. The finding shows that forecasting with single exponential smoothing is recommended to be used by XYZ store in this case. Therefore, the data proceed by those methods will be the beneficial outcome the issue of XYZ store in determining their product stock in the future time.

1. Introduction

The process of decision making consists of three significant steps; collecting the data, processing the data and storing the data has been processed. Forecasting is an estimate of an upcoming request based on several predictor variables, often based on historical time series data [1]. Forecasting is an activity wherein a business company analyzing to predict the request of products and services which will come in the future. The business company is forecasting influences the production schedule, purchase of raw materials, and sales quota. Therefore, a business company has to be aware of determining forecast method which is suitable to their business. The false forecasting will cause false planning that will lead to increased expenditure costs for a business company [2,3]. Forecasting has been done by most of the people including government, entrepreneurs, or common people. The matter of forecast is also varied for instance, weather forecast, inflation rate, political situation or even exchange rate. Forecast is defined as a tool or technique to predict or estimate specific values for future time in the manner of observing relevant data or information from the past and present [4].

Forecasting process which follows the right steps or organized procedure will lead to efficient forecasting. There are three essential points in the forecasting process [5]:

1. Analyzing the prior data, this point is beneficial to see the pattern occur in the past.
2. Determining data used. A method can be considered as the right method if the outcome of forecasting is not too far differs from reality.
3. Projecting the last data from the method used while taking into consideration of any shift factors (policy shift which might occur including government policy, potential society development, technology development, and new inventions)

Time series is a row of recorded observations in a certain period (weeks, months, or quarters). Time series has four key components:



1. Secular trend (T)
2. Periodic variation (S)
3. Cycle variation (C)
4. Irregular variation (I)

Single Exponential Smoothing which used in short term forecasting is commonly used in one month period. The model assuming the data fluctuated around the static mean value, without trend or consistent growing pattern [6]. Below is the formula of Single Exponential Smoothing: This method used when the data shows there is a trend. Exponential Smoothing with the trend is like simple smoothing except both of the component must be updated in every level-periodic and its trend. The level is a smoothed estimation from data value at the end of each period. The trend is a smoothed estimation from average growth at the end of each period [7,8]. The accuracy of the forecast will be measured by using the function of *Root Mean Square Error* (RMSE) and *Mean Absolute Percentage Error* (MAPE), as well as deviation standard. *Root Mean Square Error* (RMSE) commonly used to evaluate the model performance in term of its compatibility with the data or in forecasting the data. RMSE calculates the deviation between the predicted value from the model and its real value [9,10]. RMSE does not have minimum standard values to recognize model performance unlike MAPE (Duke University, n.d.). *Mean Absolute Percentage Error* (MAPE) MAPE shows the accuracy of the forecast in the form of a percentage. The calculation of MAPE accuracy usually more widely used because it is easy to read (due to its percentage form).

The lower MAPE score indicating that the forecasting model has a good performance [11]. The range of the MAPE score can be seen in Table 1 below.

Table 1. MAPE score significantly

| MAPE | Significant |
|--------|--------------------------------|
| <10% | Excellent forecasting ability |
| 10-20% | Good forecasting ability |
| 20-50% | Reasonable forecasting ability |
| >50% | Bad forecasting ability |

Standard deviation, symbolized by s , is describing the variability of individual time series [11,12]. The purpose of research is to observe forecasting product selling in XYZ Store.

2. Methods

The selling of a product during weeks period from October 2017 – March 2018. The selling of a product during weeks period from October 2017 - December 2017 for data test actual January 2018 – March 2018 to know the MAPE.

2.1 Single Exponential Smoothing

Single Exponential Smoothing used in short term forecasting is commonly used in one month period. The model assuming the data fluctuated around the static mean value, without trend or consistent growing pattern [5]. This forecasting method is most widely used of all forecasting techniques. It requires little computation. This method is used when the data pattern is approximately horizontal (i.e., there is no neither cyclic variation nor obvious trend in the historical data) [7,8]. The general equation for single exponential smoothed statistics is given as below is the formula of Single Exponential Smoothing:

$$F_{t+1} = \alpha * X_t + (1 - \alpha) * F_t$$

F_t = forecasting for period t .

$X_t + (1-\alpha)$ = actual value of time series

F_{t+1} = forecasting in time of $t + 1$

α = constantly leveling between 0 and 1

2.2 Double Exponential Smoothing

This method used when the data shows there is a trend. Exponential smoothing with the trend is like simple smoothing except both of the component must be updated in every level-periodic and its trend. The level is a smoothed estimation from data value at the end of each period. The trend is a smoothed estimation from average growth at the end of each period [7,8].

The formula of double exponential smoothing is:

$$S_t = \alpha * Y_t + (1 - \alpha) * (S_t - 1 + b_t - 1)$$

$$b_t = \gamma * (S_t - S_{t-1}) + (1 - \gamma) * b_{t-1}$$

$$F_{t+m} = S_t + b_t m$$

S_t = forecasting for period t .

$Y_t + (1 - \alpha)$ = Actual value of time series

b_t = trend in which period to t

α = first leveling parameter between zero and

1, = to leveling the observation value

γ = second parameter, to smoothen the trend

F_{t+m} = forecasting output to m

m = the number of periods to be predicted

3. Results and Discussion

3.1 Time Series

Sales product data of the XYZ store has 24 entry which matches with a number of weeks in the period from October 2017 to March 2018. Every data entry has shown the number unit of a gram from chicken egg sold in each week. The data plot sell can be seen in Figure 1 below:

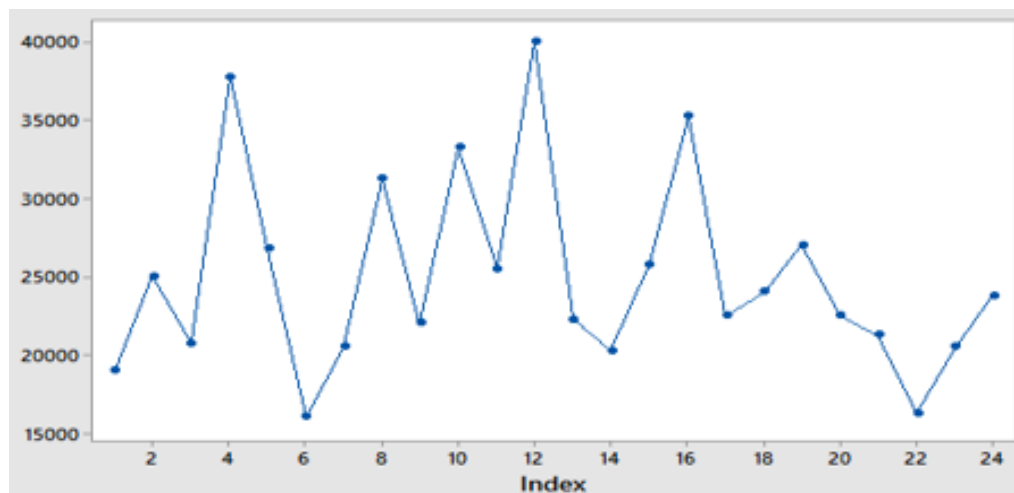


Figure 1. Time Series Plot

3.2 Single Exponential Smoothing Forecast method

This forecasting process used product selling data from October 2017 to March 2018 in a week. The data have been examined come from October till December 2017 data to forecast the upcoming data from January to March 2018. The result of forecasting used to measure the level of accuracy from Single Exponential Smoothing model. The result for Forecast SES can be seen in Figure 2 below:

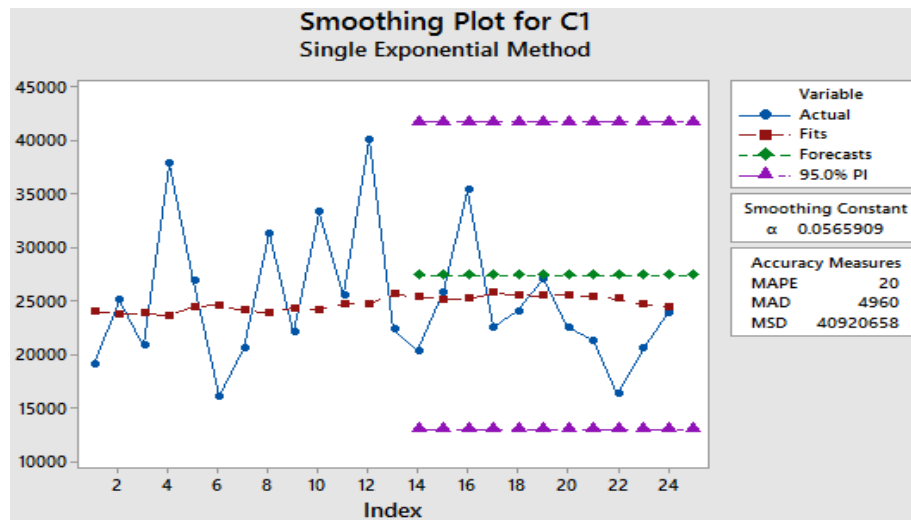


Figure 2. The test result for Forecast SES

It can be seen that the forecasting result test using SES method has 20% MAPE, 4960 MAD, and 40920658 MSD.

3.3. Double Exponential Smoothing Forecast Method

This forecasting process used product selling data from October 2017 to March 2018 in weeks. The data have been examined come from October to December 2017 data to forecast the upcoming data from January till March 2018. The result of forecasting used to measure the level of accuracy from Double exponential smoothing model can be seen in Figure 3 below:

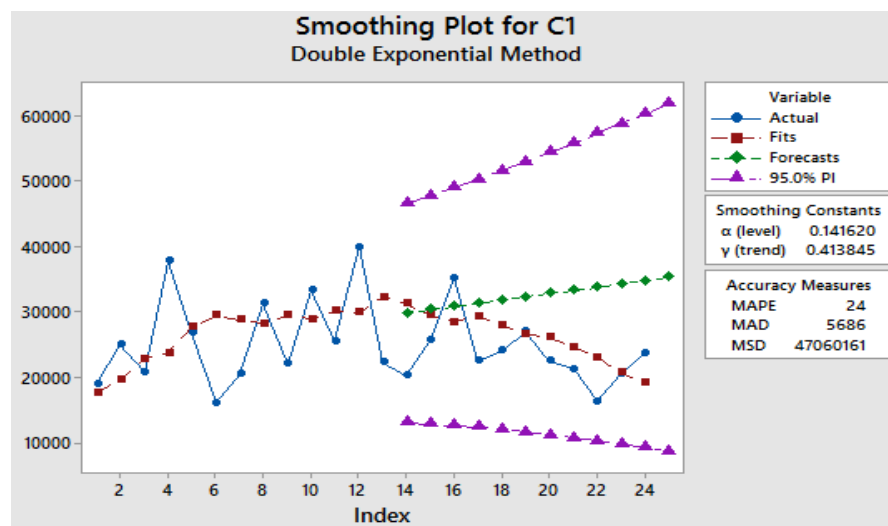


Figure 3. The test result for Forecast DES

It can be seen that the forecasting result test using the DES method has 24 % MAPE, 5686 MAD, and 47060161 MSD.

3.4 Model Analysis

This steps used to obtain forecasting method which has high accuracy level than another by looking at the lower MAPE score result (See Table 2).

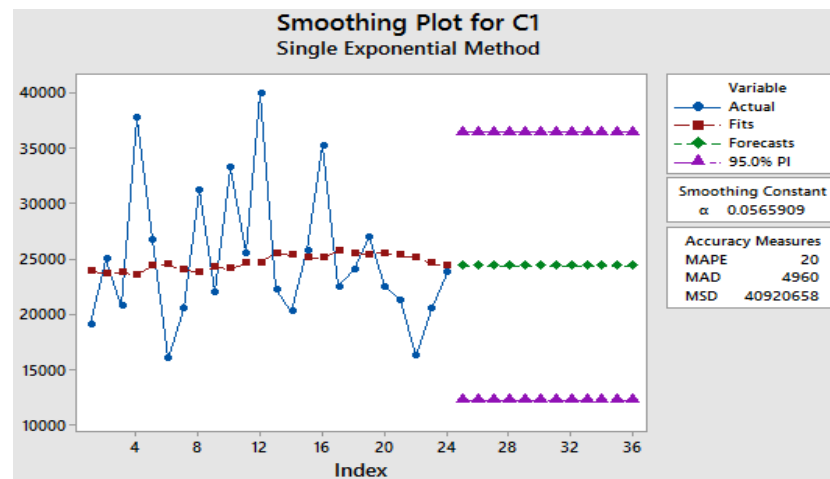
Table 2. The result of the MAPE Score

| Method | MAPE |
|------------------------------|------|
| Single Exponential Smoothing | 20 % |
| Double Exponential Smoothing | 24 % |

Based on the table above, the Single Exponential Smoothing method has the lowest MAPE score of about 20% which makes SES can be categorized as an adequate forecasting method. Therefore, the next forecasting will be more suitable to use SES as a forecasting method.

3.5 Forecasting Result Analysis

The forecasting process has been done after discovering which model or method of forecast that has the lowest error score. In this stage, forecasting was conducted for the next 12 weeks. The result can be seen in Figure 4 below:

**Figure 4.** Forecasting Result for the next 12 Weeks

Similar research was conducted by [7], the study using the Single Exponential Smoothing, Double Exponential Smoothing, Holt's and ARRES method was carried out to forecast Malaysia population, this research only focused on process forecast Malaysia population in 1957-2013.

Therefore, based on Figure 4, it was made a forecast for sales data for the next 12 weeks with Single Exponential Smoothing method. Then the XYZ Store can make decisions about the future of stock based on the data.

4. Conclusion

In conclusion, based on the finding above, it was discovered that forecasting by using Single Exponential Smoothing produced 20 % MAPE score, whereas forecasting by using Double Exponential Smoothing produced 24 % MAPE score. Therefore, forecasting process using Single Exponential Smoothing method is the method or model which has the lowest error with 20% MAPE score than another forecast method, which means Single Exponential Smoothing is an adequate forecasting method to be used in this case of study.

Acknowledgment

I would like to thank you for the school of Universitas Komputer Indonesia, Postgraduate Information System Department and Irfan Dwiguna Sumitra, Ph.D. who support and give advice in this research.

References

- [1] Gaspersz, V. 2004. Production planning and inventory control. *PT Gramedia Pustaka Umum, Jakarta*.
- [2] Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., and Cochran, J. J. 2016. *Statistics for business and economics*. Nelson Education.
- [3] Anderson, D. R., Sweeney, D. J., Williams, T. A., Camm, J. D., and Cochran, J. J. 2015. *An introduction to management science: quantitative approaches to decision making*. Cengage learning.
- [4] Nachrowi, D., and Usman, H. 2004. *Teknik Pengambilan Keputusan*. Grasindo.
- [5] Assauri, S. 1984. Teknik dan Metode Peramalan. *Lembaga Penerbit FE UI, Jakarta*.
- [6] Makridakis, S., Wheelwright, S. C., and McGee, V. E. 1999. Metode dan Aplikasi Peramalan edisi kedua. *Jakarta: Erlangga*.
- [7] Nazim, A., and Afthanorhan, A. 2014. A comparison between single exponential smoothing (SES), double exponential smoothing (DES), holt's (brown) and adaptive response rate exponential smoothing (ARRES) techniques in forecasting Malaysia population. *Global Journal of Mathematical Analysis*, **2**(4), pp.276-280.
- [8] Kalekar, P. S. 2004. Time series forecasting using holt-winters exponential smoothing. *Kanwal Rekhi School of Information Technology*, 4329008 (13).
- [9] Hutasuhut, A. H., Anggraeni, W., and Tyasnurita, R. 2014. Pembuatan Aplikasi Pendukung Keputusan untuk Peramalan Persediaan Bahan Baku Produksi Plastik Blowing dan Inject Menggunakan Metode ARIMA (Autoregressive Integrated Moving Average) di CV. Asia. *Jurnal Teknik ITS*, **3**(2), pp. A169-A174.
- [10] Voulgaraki, M. 2013. Forecasting sales and intervention analysis of durable products in the Greek market. *Empirical evidence from the new car retail sector. London School of Economics and Political Science*.
- [11] Chang, P. C., Wang, Y. W., and Liu, C. H. 2007. The development of a weighted evolving fuzzy neural network for PCB sales forecasting. *Expert Systems with Applications*, **32**(1), pp. 86-96.
- [12] Hutasuhut, A. H., Anggraeni, W., and Tyasnurita, R. 2014. Pembuatan Aplikasi Pendukung Keputusan untuk Peramalan Persediaan Bahan Baku Produksi Plastik Blowing dan Inject Menggunakan Metode ARIMA (Autoregressive Integrated Moving Average) di CV. Asia. *Jurnal Teknik ITS*, **3**(2), pp. A169-A174.
- [13] Ostertagova, E., and Ostertag, O. 2012. Forecasting using simple exponential smoothing method. *Acta Electrotechnica et Informatica*, **12**(3), pp. 62.