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The Analysis of Forecasting Demand Method of Linear Exponential Smoothing (A Case Study in Batik Fendy Product, Klaten, Indonesia)

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#### **ABSTRACT**

The purpose of this study was to evaluate the accuracy of forecasting demand for Batik Fendy using MAPE techniques. The type of this research is a quantitative descriptive study, using secondary data from the sales of the company Batik Fendy in the period November 2018 - Onkoter 2019. There are 5 stages in data analysis, namely 1) tabulating sales data and production data of Fendy batik, 2) evaluating sales forecasting methods conducted by the Batik Fendy company with the MAPE technique, 3) projecting alpha and beta values as the basis for forecasting linear exponential smoothing, 4) forecasting requests for Batik Fendy with the Linear Exponential Smoothing method, and 5) evaluating the forecasting method with the MAPE technique. The results of this study are the MAPE value of demand forecasts made by the Batik Fendy company is 17.5%; This figure shows the highest percentage of error in the variant of the Sarimbit Long Sleeve Batik, then with the sales data this variant is forecasted by using the Linear Exponential Smoothing method and obtained a MAPE of 9.21%. So it can be concluded that the use of the Linear Exponential Smoothing method in predicting sales of the Sarimbit Arm Long variant Batik is more accurate.

Keywords: Sales Forecasting; Linear Exponential Smoothing; Long Arm Sarimbit; Mean Absolute Precentage Error.

### INTRODUCTION

The batik industry in Indonesia in the era of technological disruption and modern globalization experienced significant turbulence (Diharto et al., 2018; Heriyawati, 2020; Nurcahyanti et al., 2020). Value chains that have been built for a long time are resilient in such a way as to continue to exist in line with developments and rapidly changing market needs. There is often a shock in the conventional system of batik production which causes increasingly fierce competition in fighting over the market (Heizer, Jay. Render, Barry, Munson, 2017; Kusumawati et al., 2020). The majority of batik entrepreneurs are home-based businesses with little labor and simple technology overwhelmed in fulfilling consumer orders that suddenly come from various regions that have not been unexpected by the batik entrepreneurs (Abbas, 2018; Cunningham et al., 2019; Kusumawati et al., 2020). The online market place which has recently become popular has been utilized in such a way by dropshippers to connect between consumers and the desired batik products (Jufri et al., 2018; Rengifurwarin et al., 2018; Souisa et al., 2019; A. Syam et al., 2018; H. Syam et al., 2018)(A. Syam et al., 2018; H. Syam et al., 2018)(Jufri et al., 2018; Rengifurwarin et al., 2018; Souisa et al., 2019). This has led to new problems related to the number of products that must be provided by batik entrepreneurs in order to continue to be able to fulfill all consumer orders directly through the showroom or dropshipper.

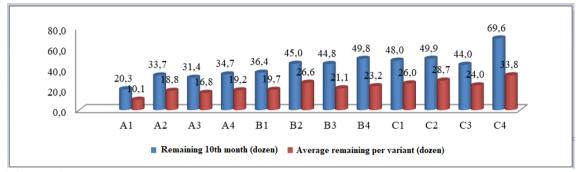
In Klaten district, Kalikotes district is one of the centers of the batik industry. The development of sales turnover from batik entrepreneurs, both in the form of cloth and apparel, various models are increasingly increasing, Batik Fendy as one of the businesses producing batik cloth and apparel in Kalikotes sub-district is also experiencing the same thing. Founded in 1992 by Mr. Haji Muhammad Waluyo, originally only made batik cloth with 3 people Pengobeng, in 2019 it has employed more than 100 people, with diverse fabric variants and apparel. The number of products made is also increasing with sales turnover increasing from year to year. The following table is an increase in sales turnover and the amount of batik production in the batik business Fendy:

**Table 1**. Number of production and sales turnover Batik Fendy from 2013 to 2018

Year	<b>Production Amount</b>	Sales Turnover	<b>Enhancement (%)</b>
2013	5.135	Rp 590.525.000	-
2014	5.546	Rp 637.790.000	8.00
2015	5.870	Rp 675.050.000	5.84
2016	6.150	Rp 707.250.000	4.77
2017	6.596	Rp 758.540.000	7.25
2018	6.825	Rp 784.875.000	3.47

Source: Batik Fendy secondary data

In table 1, Batik Fendy's sales turnover continues to increase from year to year even though the increase is fluctuating. The least increase was in 2017 to 2018 which increased by only 3.47%, while the largest percentage indicated in 2013 to 2014 experienced an increase of 8%. Along with the increase in the number of production, Fendy batik also continues to strive to improve its production system, related to the number of products made for each variant of batik, both batik cloth and apparel, Fendy's batik business often experiences errors in predicting the number of products it produces, resulting in a buildup of finished products in its showroom. Some variants of ready-made batik that are currently in demand by consumers actually experience delays in manufacturing and run out of inventory, while variants of batik clothing that tend to decrease demand are actually produced in large quantities, so it is difficult to market.



**Figure 1.** Graph of the number of unsold clothes in October and the average unsold clothes per variant in Lusin units

From the picture above, it can be seen that the C4 variant (Sarimbit long arm furing) shows the highest product residual rate of 69.6 Lusin in October which will burden sales in November 2019. The variant of the Sarimbit long arm furing also shows the average number of products which are not sold the most compared to other variants. This becomes a problem in the Batik Fendy Business, because the number of unsold products will burden sales in the next period. During this time to predict sales per month, batik business owner Fendy did demand forecasting based on intuition or habit alone, not yet implementing any kind of advanced methods. The following are the number of products sold based on the variants of batik clothing produced by Batik Fendy during the period November 2018 - October 2019.

Based on the description above, the habit of producing batik clothing without predicting and considering unsold clothing in the previous period can be detrimental to the company, so it is necessary to make changes to eliminate this waste, one of which is to forecast demand. Sales forecasting can be done with certain methods to obtain accurate results. In this study, the authors used the linear exponential smoothing method as its forecasting method and used alpha 0.8 to see fluctuations in demand data in the previous period and beta 0.1 to predict data trends.

#### **METHOD**

#### **Understanding Forecasting**

According to Maricar (2019) mentioning forecasting is a process for estimating the magnitude of needs / events that occur in the future. These needs include the dimensions of quantity, quality, time, and location needed to achieve the targets set. According Yuniastari & Wirawan (2016), forecasting is an art of the science of predicting something in the future which aims to predict events that will occur by always requiring data from the past. Mongomery (2017) added forecasting is an important thing which covers various fields including business and industry, government, economics - finance, environmental sciences, medicine, social science - politics. This is in line with the understanding of the concept of forecasting put forward by Maricar (2019) that forecasting is a field of science that is used as a tool to predict something on the basis of existing data and processed in a certain way.

## **Purpose of Forecasting**

Forecasting method

1. Time Series Analysis

According to Taylor & Letham (2018) companies are more interested in doing deepening on the basis of sales data in the past period, assuming that what happened in the past will be repeated at this time. There are several methods included in the time series analysis.

a) Method of moving averages: forecasting activities which refers to the number given point of time engaged in a systematic, the number of activities during the relevant point of time divided by the number of points in the meanLand (2015). In this method, the assumption is that all volumes of activity covered have the same opportunity to repeat. A simple formula for determining the deepening with the Moving Average method is

$$F_{n+1} = \frac{X_1 + X_2 + \dots + X_n}{n}$$

$$F_{n+1} = \text{Forecasting Period } n+1$$

 $F_{n+1}$  = Forecasting Period n+1

n = Number of Periods

Weighted moving average: a method of forecasting the volume of activities or requests in the future. This research is a descriptive study with a quantitative approach. The data used in the analysis are secondary data based on records from the Fendy Batik Business, Klaten, namely batik product sales data for each variant from November 2018 to October 2019. Data analysis techniques were carried out in 3 stages, namely:

- 1. Collect production data and Batik Fendy sales data from November 2018 to October 2019. Make a graph showing the distribution of data,
- 2. Determine the effectiveness of forecasting methods conducted by Batik Fendy with MAPE techniques.
- 3. Determine data projections in the form of  $\alpha$ , and  $\beta$
- 4. Calculate forecasting for each period using the holt winter's linear exponential smoothing method, and
- 5. Determine the effectiveness of forecasting methods using the MAPE technique.
- b) refers to the number of time points that move systematically and the probabilities of returning Land (2015). The formula used is

$$F_{n+1} = \frac{\sum (bobot \ periode \ n) (Permintaan \ dalam \ periode \ n)}{\sum bobot}$$

According to Heizer & Render (2014) usually the data in the closest period is given the greatest weight, this assumption arises with the data base in the closest period having the greatest possibility to be repeated. Exponential Refinement.

1) Single Exponential Smoothing

According to Heizer dan Render (2017) this method is a method of forecasting moving averages with sophisticated weighting, namely by calculating the level of fluctuations in the actual data of the past which is symbolized by  $\alpha$  (alpha). Alpha value is between 0-1, if the actual data is stable then the alpha value is close to 0 (zero), conversely if the actual data is fluctuating then the alpha value is set to 1. Here is the formula:

$$F_{t+1} = \alpha.X_{t-1} + (1-\alpha), F_{t-1}$$

Where:

 $X_{t-1} = data periode t-1$ 

 $\alpha$  = smoothing constant factor

 $F_{t-1} = forecast period t-1$ 

 $F_{t+1} = forecast period t+1$ 

#### 2) Linear Exponential Smoothing

This method is used for data series that have consistent trend or trend elements.

This tendency is symbolized by  $\beta$  (beta). The formula used is:

$$\begin{split} S_t &= \ \alpha.X_t + (1-\alpha) \big( S_{t-1} + T_{t-1)} \big) \\ T_t &= \ \beta. \big( S_t - S_{t-1} \big) + (1-\beta). \, T_{t-1} \\ F_{t+m} &= S_t + T_t \\ T_1 &= \frac{\big( X_2 - X_1 \big) - \big( X_3 - X_2 \big) - \big( X_4 - X_3 \big)}{3} \end{split}$$

Dimana :

 $S_t$  = forecasting for data fluctuation elements

 $T_t$  = forecasting for data trend elements

 $F_{t+m}$  = forecast period t+m

 $T_1 = data trend period 1$ 

## 2. Asosiative Method

This method is usually done by using more than one variable to predict other variables, for example to predict product sales, the variable number of salespeople is used and expand the marketing area of the product. This method is commonly called the linear regression method.

**Evaluation of Forecasting Methods** 

#### 1. MAD (Mean Absolut Deviation)

This forecasting evaluation technique is used to measure forecasting accuracy by averaging forecasting errors. The formula used is

$$MAD = \frac{\sum_{t=1}^{n} |Y_t - F_t|}{n}$$

#### 2. MSE (Mean Squared Eror)

An alternative technique to evaluate a forecasting technique, where every error or residual is squared.

$$MSE = \frac{\sum_{t=1}^{n} (Y_t - F_t)^2}{n}$$

#### 3. MAPE (Mean Absolute Precentage Eror)

Calculated by determining the absolute error of each period by dividing the value of observations in that period then in percentage. This method provides a hint of forecast error compared to the actual value..

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$$MAPE = \frac{\sum_{t=1}^{n} \frac{IY_t - F_tI}{Y_t} x100}{n}$$

4. MPE (Mean Percentagee Eror)

Calculated by finding errors every period and then divided by the actual value and then in percentage. If the percentage is close to zero, the forecasting accuracy level is higher.

$$MPE = \frac{\sum_{t=1}^{n} \frac{(Y_t - F_t)}{Y_t} x100}{n}$$

Dimana:  $Y_t = Actual Data Period t$  $F_t$  = Forecasting period t

n = amount of data

## **RESULT AND DISCUSSION**

# Expose data on observations

**Table 2**. Average data on sales of Batik Fendy, period November 2018 - October 2019

Month	Average Sales (Dozen)	Month	Average Sales (Dozen)
11	42.7	5	43.1
12	42.2	6	43.3
1	41.8	7	45.9
2	42.1	8	43.4
3	41.1	9	43
4	43.4	10	42.6

Source: secondary data processed, 2019

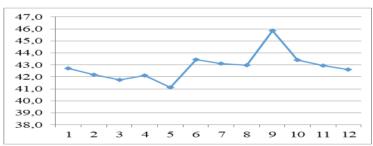


Figure 2. Graph of average monthly sales (dozen)

Table 3. Average Data of Batik Fendy Production, period November 2018 - October 2019

Month	Average Production (Dozen)	Month	Average Production (Dozen)
11	46.4	5	47.3
12	45	6	46.6
1	44.7	7	48.6
2	46.1	8	47
3	44.5	9	46.9
4	46.7	10	46.6

Source: Secondary data processed, 2019

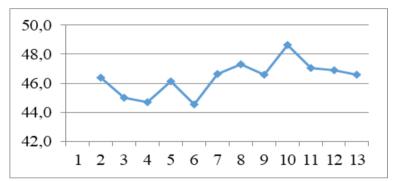
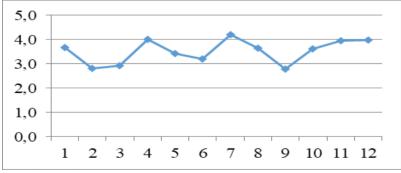


Figure 3. Graph of Average Monthly Production (dozen)

**Table 4.** Average unsold residual production (monthly - dozen), Batik Fendy for the period November 2018 - October 2019

	110101111001 2010 0010001 2019		
Month	Average Remaining Production not sold per month (Dozen)	Month	Average Remaining Production not sold per month (Dozen)
11	3.7	5	4.2
12	2.8	6	3.6
1	2.9	7	2.8
2	4	8	3.6
3	3.4	9	3.9
4	3.2	10	4

Source: secondary data, 2019



**Figure 4.** The remaining graph of Batik Fendy's production period November 2018 - October 2019

## Effectiveness of demand forecasting according to Batik Fendy with MAPE Technique

Table 5. Results of MAPE calculation

No.	Varian	MAPE (%)
1	Men's Short Sleeve Shirts	3.68
2	Men's Short Sleeve Furing Shirt	5.85
3	Men's Long Sleeve Shirt	5.79
4	Men's Long Sleeve Furing Shirt	6.04
5	Short sleeve combination blouse	6.27
6	Furing short sleeve combination blouse	6.18
7	Long sleeve combination blouse	6.02
8	Furing long sleeve combination blouse	6.59
9	Sarimbit's short sleeves	10.37
10	Sarimbit short sleeved furing	12.56
11	Sarimbit long arms	17.50
12	Sarimbit long sleeved furing	15.07

Source: Secondary data processed, 2019

Table 5 represents a calculation result T ingkat effectiveness or accuracy of forecasting carried out by the company Batik Fendy. The forecasting accuracy with the MAPE Technique is close to 0 (zero), ie the smaller the MAPE value, the more accurate the forecasting is done. In table 4 it can be seen that the smallest MAPE value is in the Short Sleeve Cowboy Shirt variant of 3.68%, so it can be concluded that this variant of demand forecasting done by Batik Fendy company has an accuracy rate of 96.32%. While the biggest result of MAPE calculation is the Sarimbit Arm Panjang variant of 17.5%, which means that the error rate of demand forecasting done by Batik Fendy company is 17.5% with an accuracy rate of 82.5%.

## Determination of the value of $\alpha$ , and $\beta$

Determination of  $\alpha$  and  $\beta$  values is done through a justification procedure based on data plots drawn in graph 2. Based on graph 2, the data distribution pattern tends to fluctuate, so the authors justify the  $\alpha$  value of 0.8; and low or sloping data tendencies, so the  $\beta$  value is set at 0.1.

#### Determine the demand forecast using the linear exponential smoothing method

At the MAPE calculation stage with Batik Fendy sales and production data, it was found that the largest MAPE number was in the Long arm sarimbit variant. So the researcher determines demand forecasting with linear exponential smoothing method for sales data of long-sleeved Sarimbit batik variants from November 2018 to October 2019. The following is the result of forecasting calculations:

Table 6. Results of forecasting sales of Fendy batik long-sleeved sarimbit variants

Month	<b>Actual Data</b>	$S_t$	$\mathbf{T}_{\mathbf{t}}$	F
November	216	216	-12	
Desember	225	221	-10	204
January	185	190	-12	210
Fabruary	176	176	-12	178
March	155	157	-13	164
April	203	191	-8	144
May	225	217	-5	183
June	219	217	-4	211
July	216	215	-4	213
August	223	221	-3	211
September	215	215	-3	217
October	219	218	-3	212
November	?	-	-	215

Source: results of calculations with Microsoft Excel, 2020

Based on the results of Microsoft Excel calculations in table 6, column St is an element of data fluctuation, while column Tt is an element of trend or trend data, which is used as a basis for predicting sales for the next period. So that in November 2019 Fendy batik sales can be predicted for the long-sleeved sarimbit variant is 215 pieces of clothing, or about 18 dozen.

#### Measuring the effectiveness of forecasting demand for Batik Fendy with MAPE Technique

In table 7, it can be seen for the long-sleeved sarimbit batik variant, the percentage of errors in predicting the biggest sales was in April 2019, which was 29.28%, while the percentage of the smallest forecasting error occurred in September, amounting to 0.93%. Error in predicting this is caused by fluctuations in actual sales data. And overall by using the mean Absolute Precentage Error evaluation technique, the average forecasting error is 9.21%.

**Table 7.** Measurement of forecasting effectiveness exponential smoothing with the MAPE technique

Month	<b>Actual Data</b>	F	forecasting error (%)
November	216		
Desember	225	204	9.33
January	185	210	13.51
February	176	178	1.14
Maret	155	164	5.81
April	203	144	29.28
Mei	225	183	18.82
Juni	219	211	3.44
Juli	216	213	1.37
Agustus	223	211	5.30
September	215	217	0.93
Oktober	219	212	3.19
November	?	215	
	MAPE		9.21

Source: Calculation results using Microsoft Excel, 2020

## **CONCLUSION**

Based on the results of the research that has been done, the researcher concludes, that by using the MAPE forecasting evaluation technique, the resulting Linear Exponential Smoothing forecasting method is more accurate than the forecasting method conducted by the manager of Batik Fendy, this can be seen from the results of the MAPE with the Linear forecasting method Exponential Smoothing was 9.21% smaller than MAPE from the forecasting method by the manager of Batik Fendy by 17.5%. So to predict November sales, Batik Fendy should produce batik for the Sarimbit variant with 215 pieces of clothing or around 18 dozen.

#### REFERENCES

- Abbas, S. A. (2018). Entrepreneurship and information technology businesses in economic crisis. *Abbas*, *SA*, 682–692.
- Cunningham, J. A., Lehmann, E. E., Menter, M., & Seitz, N. (2019). The impact of university focused technology transfer policies on regional innovation and entrepreneurship. *The Journal of Technology Transfer*, 44(5), 1451–1475.
- Diharto, A. K., Resmi, S., Siswanti, Y., Retnaningdiah, D., Ghofar, A., & Kusumawati, R. A. (2018). The role of women empowerment and Organizational agility toward the Resilience of disaster-affected batik small medium enterprises: an effort to overcome technology disruptive. *International Journal of Mechanical Engineering and Technology*, 136–144.
- Heizer, Jay. Render, Barry. Munson, C. (2017). Operations management: sustainability and supply chain management. In *Journal of purchasing and supply management*.
- Heriyawati, Y. (2020). The Convergence of the Era of Disruption, Industri 4.0, and Society 5.0. *e- Prosiding Pascasarjana ISBI Bandung*, *I*(1).
- Jay, H., & Barry, R. (2014). Principle of Operational Management. *Igarss* 2014. https://doi.org/10.1007/s13398-014-0173-7.2
- Jufri, M., Akib, H., Ridjal, S., Sahabuddin, R., & Said, F. (2018). Improving attitudes and entrepreneurial

- behaviour of students based on family environment factors at vocational high school in Makassar. *Journal of Entrepreneurship Education*, 21(2).
- Kusumawati, N., Rahmadyanti, E., & Sianita, M. M. (2020). Batik became two sides of blade for the sustainable development in Indonesia. In *Green Chemistry and Water Remediation: Research and Applications* (hal. 59–97). Elsevier.
- Land, K. C. (2015). Forecasting. In *International Encyclopedia of the Social & Behavioral Sciences:* Second Edition. https://doi.org/10.1016/B978-0-08-097086-8.10544-6
- Maricar, M. A. (2019). Analisa Perbandingan Nilai Akurasi Moving Average dan Exponential Smoothing untuk Sistem Peramalan Pendapatan pada Perusahaan XYZ. 13, 36–45.
- Mongomery, D. C. (2017). Montgomery: Design and Analysis of Experiments. In John Willy & Sons.
- Nurcahyanti, D., Sachari, A., Destiarmand, A. H., & Sunarya, Y. Y. (2020). Ideal Discourse on Batik Development of Society 5.0 Era in Indonesia. *e-Prosiding Pascasarjana ISBI Bandung*, *1*(1).
- Rengifurwarin, Z. A., Akib, H., Jasruddin, & Salam, R. (2018). Snapshot of public service quality in the center for integrated business service (CIBS), cooperative micro small and medium enterprises (CMSME), Maluku province, Indonesia. *Journal of Entrepreneurship Education*, 21(3).
- Souisa, W., Musa, C. I., Akib, H., Anshari, & Bado, B. (2019). Determinats of the performance of cooperative manager in ambon city, indonesia. *Journal of Entrepreneurship Education*, 22(1).
- Syam, A., Hasbiah, S., Yunus, M., & Akib, H. (2018). Determinants of entrepreneurship motivation for students at educational institution and education personnel in Indonesia. *Journal of Entrepreneurship Education*, 21(2).
- Syam, H., Akib, H., Patonangi, A. A., & Guntur, M. (2018). Principal entrepreneurship competence based on creativity and innovation in the context of learning organizations in Indonesia. *Journal of Entrepreneurship Education*, 21(Special Issue).
- Taylor, S. J., & Letham, B. (2018). Forecasting at Scale. *American Statistician*. https://doi.org/10.1080/00031305.2017.1380080
- Yuniastari, N. L. A. K., & Wirawan, I. W. W. (2016). Peramalan Permintaan Produk Perak Menggunakan Metode Simple Moving Average Dan Single Exponential Smoothing. *Sistem dan Informatika STIKOM Bali*, 97–106.

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