

Forecasting System of Office Supplies Demand Using Simple Moving Average and Simple Exponential Smoothing (Case Study: Regional Office of The Ministry of Religious Affairs of Jakarta)

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Abstract

The focus of this paper is to calculate the forecast of office supplies demand in the Regional Office of The Ministry of Religious Affairs of Jakarta. The major research is to compare two techniques of forecasting, namely simple moving average (MA) and simple exponential smoothing (SES) with the least of forecasting error of Mean Absolute Deviation (MAD) in order to get high accuracy of future office supplies demand. Every year, the Regional Office has to purchase and provide office supplies to its employees. However, the management still has difficulties to determine the quantity of office supplies that have to be stored in the inventory to avoid the stock-out. It happens because the management does not have an accurate prediction of office supplies that are required by the employees. Therefore, to get more accurate forecast, the future demand will be calculated based on last three years data of demand using the above methods. Then, the forecast value with the least of error will be used. It is expected that once the management has an accurate demand predicted then the insufficiency as well as excess of inventory would be minimized.

Keywords: MAD, Forecasting, SES, MA, Inventory

1. Introduction

Inventory control aims to monitor and keep what has been planned before in accordance with the reality. The inventory control system can help to control the number of stock of goods in the warehouse. It is important because if the number of excess stock is high then it will affect the cost of storage in the warehouse. In addition, it will affect the latent capital and will minimize the availability of spaces for other supplies. Meanwhile, if the stock is too small, it will increase the possibility of stock out or stock shortages, that can disrupt the distribution of the company's activities [1].

In terms of inventory management, the Regional Office of the Ministry of Religious Affairs still uses a simple system to manage incoming and outgoing inventory data. This office does not calculate and predict the number of future demand of office supplies for the next order so that it often stockouts or even has some excess stocks.

1.1. Problem Summary

Based on the background described above, then the underlying problems are: How to compare and choose the most effective forecasting methods to calculate and predict the demand in order to determine the number of quantity to order. All of these are required to avoid the the inventory problems of stock out.

1.2. Scope Of Problems

This research is limited only on :

1. the Regional Office of the Ministry of Religious Affairs of DKI Jakarta in the Division of Maintenance and Management of State Property (BMN) or State Property.
2. Comparing only two types of forecasting methods which are imple Moving Average and Simple Exponential Smoothing with Mean Absolute Deaviation to calculate the forecsting error.
3. In this study only discusses stationery consumables, do not discuss the maintenance and or the damage of stationeries.

1.3. Research Methodology

Methodology of research activity which writer use consist of:

1.3.1 Data Collection Method

1. Observation
2. Interview
3. Library and Literature Studies

2. Theoretical Basis

2.1 System Definition

The system is a unit unity that can not be separated between one unit with other units in achieving one predetermined goal [2].

2.2 Inventories Definition

According to Pardede in [3], inventory is the quantity of material or goods held or available that has an amount greater than the amount used in order to at any time in the future can be used.

2.3 Inventory Control Definition

Herjanto in [4] defines inventory control as a set of policy that determine and ensure the availability of appropriate inventories in the right of time. Inventory control determines the level of inventory to be maintained, the time when the order should be taken place and the quantity of order should be held.

2.4 Forecasting

Prasetya and Lukiastuti in [5] view forecasting as a process of prediction of the future based on the trends and testing of the past data. Further Pardede [4] defines forecasting as a scientific method to determine what will happen in the future.

3. Research Methodology

3.1 Observation

Data collection is done by observing directly the object and by looking directly the process and business activities running on the General Division Office of the Ministry of Religious Affairs of DKI Jakarta on 05 October - 16 February 2016. It is expected to see the business processes of the system to find the data needed for research.

3.2 Interview

This interview was conducted by having a discussion and by asking questions about all the necessary data in order to calculate the forecasting demand of office supplies

3.3 Library and Literature Studies

This study is conducted by studying various books, e-books, Journals, final assignments or theses, articles, and similar research related to concept of information systems, inventory control, Simple Moving Average (SMA), Simple Exponential Smoothing (SES), Mean Absolute Deviation (MAD), Economic Order Quantity (EOQ) and Safety Stock.

4. Result and Discussion

The calculation is done by comparing two methods of forecasting, which are Moving Average and Exponential Smoothing. Once it is done, then the calculation is

continued by determining the least of forecasting error to find out the most accurate method. To simulate the calculations, three years (from 2014- 2016) of Pantel pen's data is used which is as the following:

Table 1. The used of Pantel pen for three year

Item	Years	Used Quantity
Pantel Pen	2014	90
Pantel Pen	2015	80
Pantel Pen	2016	100

4.1 Simple Moving Average

The formula of simple moving average to calculate the forecasting data is as the following:

$$FMA_n = \frac{\sum_{i=1}^n D_i}{n}$$

Where:

F_{MA_n} = the forecast for the upcoming period

n = number of periods

D_i = data in period - i

The Calculation of the forecast data for the year of 2017 :

$$\text{Year 2015} = \frac{90}{1} = 90$$

$$\text{Year 2016} = \frac{90+80}{2} = 85$$

$$\text{Year 2017} = \frac{90+80+100}{3} = 90$$

Table 2. Demand Forecast Result for Pantel pen in the year of 2017

Year	Item	Used Quantity	Forecast demand
2014	Pantel Pen	90	-
2015	Pantel Pen	80	90
2016	Pantel Pen	100	85
2017	Pantel Pen	-	90

4.2. Simple Exponential Smoothing

The formula of Simple Exponential Smoothing to calculate the forecasting data is as the following:

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

Where:

F_{t+1} = the forecast for the next period

D_t = actual Demand in the current period

F_t = the previous determined forecast for the current period

α = smoothing constant (between 0-1)

For this research, smoothing constant of 0.1, 0.2, 0.3, 0.4 and 0.5 are used in the forecast calculation respectively such as the subsequent:

$\alpha = 0.1$

F2014 = 90

F2015 = $(0.1 * 90) + (1-0.1) * 90 = 90$

F 2016 = $(0.1 * 80) + (1-0.1) * 90 = 89$

F 2017 = $(0.1 * 100) + (1-0.1) * 89 = 90$

$\alpha = 0.2$

F2014 = 90

F2015 = $(0.2 * 90) + (1-0.2) * 90 = 90$

F2016 = $(0.2 * 80) + (1-0.2) * 90 = 88$

F2017 = $(0.2 * 100) + (1-0.2) * 88 \approx 90$

$\alpha = 0.3$

F2014 = 90

F2015 = $(0.3 * 90) + (1-0.3) * 90 = 90$

F2016 = $(0.3 * 80) + (1-0.3) * 90 = 87$

F2017 = $(0.3 * 100) + (1-0.3) * 87 \approx 91$

$\alpha = 0.4$

F2014 = 90

F2015 = $(0.4 * 90) + (1-0.4) * 90 = 90$

F2016 = $(0.4 * 80) + (1-0.4) * 90 = 86$

F2017 = $(0.4 * 100) + (1-0.4) * 86 \approx 92$

$\alpha = 0.5$

F2014 = 90

F2015 = $(0.5 * 90) + (1-0.5) * 90 = 90$

F2016 = $(0.5 * 80) + (1-0.5) * 90 = 85$

F2017 = $(0.5 * 100) + (1-0.5) * 85 \approx 93$

Table 3. Demand Forecast Result for Pantel pen in the year of 2017 Using Simple Exponential Smoothing

Year	Item	Q	$\alpha = 0.1$	$\alpha = 0.2$	$\alpha = 0.3$	$\alpha = 0.4$	$\alpha = 0.5$
2014	Pantel Pen	90	90	90	90	90	90
2015	Pantel Pen	80	90	90	90	90	90
2016	Pantel Pen	100	89	88	87	86	85
2017	Pantel Pen	-	90	90	91	92	93

4.3. The accuracy of forecast data

To find the most accurate forecast data then it is required to calculate which forecast that has the least value of error. The Mean Absolute Deviation (MAD) can be used to calculate the forecast error whose formula is as the following:

$$\text{MAD} = \frac{\sum |D_t - F_t|}{n}$$

Where:

D_t = Demand in period t
 F_t = the forecast for period t
 n = total number of period

Using the forecast data of Moving average method, the MAD calculation is as the following:

$$\frac{\sum |D_t - F_t|}{n} = \frac{90+5+10}{3} = 47.5 \approx 48$$

Using the forecast data of Simple Exponential Smoothing the Calculation of MAD is as below:

$\alpha = 0.1$

$$\frac{\sum |D_t - F_t|}{n} = \frac{0+9+10}{3} = 6.3 \approx 6$$

$\alpha = 0.2$

$$\frac{\sum |D_t - F_t|}{n} = \frac{0+8+10}{3} = 6$$

$\alpha = 0.3$

$$\frac{\sum |D_t - F_t|}{n} = \frac{0+7+9}{3} = 5.3 \approx 6$$

$\alpha = 0.4$

$$\frac{\sum |D_t - F_t|}{n} = \frac{0+6+8}{3} = 4.6 \approx 5$$

$\alpha = 0$

$$\frac{\sum |D_t - F_t|}{n} = \frac{0+5+7}{3} = 4$$

Table 4. MAD in year 2014-2017

	MA	SES 0.1	SES 0.2	SES 0.3	SES 0.4	SES 0.5
MAD	48	6	6	5	5	4
Data Forecast for 2017	90	90	90	91	92	93

5. Conclusion and Recommendation

5.1. Conclusion

1. The forecast method that has the least forecast error is Simple Exponential Smoothing (SES) with smoothing constant of 0.5.
2. The forecast data of SES with smoothing constant 0.5 for the year 2017 is 93.

5.2. Recommendation

It is expected that the forecast data with the least forecast error is used to calculate the economic order quantity dan safety stock to minimize the inventory cost and to avoid stockout.

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