Sales and Inventory Prediction with the EOQ Method based on Single Exponential Smoothing Forecasting

Alfin Andika Putra
Putra Indonesia University YPTK Padang
alfinandika93@gmail.com

Abstract

Along with the development of the era where technology is increasingly sophisticated as it is today, the needs are also increasing. Science and Technology also experienced drastic progress. Forecasting forecasting is a method for making estimates of future data by involving the use of past data in a systematic model form, and the forecasting method used is Single Exponential Smoothing. Planning for this EOQ method can minimize the occurrence of out of stock so that processes in a business are not disrupted and are able to save costs incurred due to the efficiency of inventory at the place of business concerned. Application of Supply Chain Management with data mining systems on CV. Amifa Keluarga Lestari can simplify the management of raw materials by implementing an SCM system which can reduce excess stock purchases. With the Single Exponential Smoothing method, you can predict the number of best sales for the following month in one period by looking at the smallest error. The calculation results show that the most economical order in one order is 1291 kilograms, and the total storage cost is Rp. 154,919 per Kilogram.

Keywords: Supply Chain Management, Single Exponential Smoothing, EOQ, Forecasting.

1. Introduction

Along with the development of the era where technology is increasingly sophisticated as it is today, the needs are also increasing. Science and Technology also experienced drastic progress. An example of technology that is progressing is laptops, now laptops are a basic need for people to do business, education, play games and even to create games, communicate and so on. Not only that, laptops can also be taken anywhere so that these activities can be carried out at any time and more easily. [1]

All businesses basically plan and control goods with the main objective of minimizing costs and maximizing profits. In planning and controlling goods the problem is how to organize the most appropriate inventory so as not to disrupt production activities and the costs required are not excessive. [2]

Today's global competition has given rise to companies that have succeeded in adapting and innovating. This success is also influenced by the ability to utilize technology, communication, and information. The global market requires every company to compete, with higher expectations for products and services, and shorter product life cycles, has encouraged companies to prioritize their focus in their supply chain to achieve competitive advantages that can support the continuity of their business processes. The integration of activities that procure materials and services, convert them into intermediary goods and final products, and deliver them to customers is referred to as supply chain management. This concept puts more emphasis on the transformation of raw goods into finished goods sent to customers. [3]

Forecasting forecasting is a method for making predictions of future data by involving the use of past data in a systematic model form. The forecasting model used in forecasting cracker sales is a Time Series or commonly called a time series and the forecasting method used is Single Exponential Smoothing. The reason the author chose this method is because compared to several other forecasting methods such as Single Moving Average and Double Exponential Smoothing, the Single Exponential Smoothing method provides better forecasting accuracy because it produces fewer errors if the data used has a stationary data pattern. [4]

The single exponential smoothing method is a development of the single moving averages method where this forecasting method is carried out by repeating calculations continuously using the latest data and each data is given a weight [5]. Single Exponential Smoothing uses very little past data recording. This model assumes that data fluctuates around a fixed average value, without following a pattern or trend [6].

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overcome this problem a management strategy is needed in the form of forecasting sales and inventory of goods in preparation for meeting customer demand in the coming period. Planning the EOQ method can minimize the occurrence of out of stock so that processes in a business are not disrupted and are able to save costs incurred due to the efficiency of inventory at the place of business concerned [7].

EOQ is the value of the number of materials needed during each purchase using the most economical cost [8]. EOQ (Economic Order Quantity) is the amount of goods that can be purchased at a minimum cost. The purpose of this method is to determine the number of orders that can minimize storage costs and inventory ordering costs [9]. Previous research using the EOQ method is widely used such as raw material inventory [10] [11] [12], product sales analysis [13], generic drug inventory [14], and others.

2. Research methodology

To assist in the preparation of this research so that the steps in solving the problems to be discussed can be clearly structured, it is necessary to have a framework arrangement. The research framework contained in Figure 1.

![Figure 1. Research Framework](image)

The research stage is a sequence of processes or steps that will be carried out in completing this research. The stages of this research are as follows:

2.1 Preliminary Research
This research was conducted by interviewing Mr. Aditya AN, who is a manager at CV. Amifa Keluarga Lestari, asks questions and analyzes problems and obtains the necessary data.

2.2 Data collection
This library research was carried out by reading journals, books, the internet, articles discussing Economic Order Quantity, Single Exponential Smoothing and those related to forecasting. So that the data obtained can be used as a basis for further research stages.

2.3 Analysis
The analysis contains the problems faced and system requirements. The results of the analysis are then written in system requirements analysis, requirements analysis, functional requirements analysis, and non-functional requirements analysis. Researchers conducted data analysis first. This is so problem solving can produce new solutions.

2.4 Design
In this design stage, researchers used the Unified Modeling Language (UML) as a tool in explaining the flow of program analysis, where UML was used, namely: use case diagrams, class diagrams, sequence diagrams, activity diagrams, deployment diagrams.

2.5 Implementation
Implementation is a stage that is carried out when the designed application is ready to operate. Implementation is carried out aiming to confirm the results of application design, so that users can provide input to application developers. Implementation is done using PHP and MYSQL programming languages.

2.6 Testing
System testing is the stage that will be carried out on the resulting system to find out whether the expert system that has been designed can run correctly and in accordance with the design carried out in diagnosing broiler chicken diseases.

3. Results and Discussion
This study uses data on sales of CV. Amifa Keluarga Lestari crackers in the period January 2022 to May 2022.

<table>
<thead>
<tr>
<th>No</th>
<th>Month</th>
<th>Sales Turnover</th>
<th>actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>January</td>
<td>92,990,400</td>
<td>5166</td>
</tr>
<tr>
<td>2</td>
<td>February</td>
<td>72,259,760</td>
<td>4014</td>
</tr>
<tr>
<td>3</td>
<td>March</td>
<td>74,073,280</td>
<td>4115</td>
</tr>
<tr>
<td>4</td>
<td>April</td>
<td>36,681,440</td>
<td>2037</td>
</tr>
<tr>
<td>5</td>
<td>May</td>
<td>29,060,080</td>
<td>1614</td>
</tr>
</tbody>
</table>

3.1 Single Exponential Smoothing
The stages of Single Exponential Smoothing to determine the best forecast are as follows:
1. Calculate the forecast for the following month using α 0.1 to 0.9
2. Calculating MAE (Mean Absolute Error)
3. Calculating MSE (Mean Squared Error)
4. Calculating MAPE (Mean Absolute Percentage Error)
Alfin Andika Putra

In this method, an alpha value has been determined to assist the calculation process in order to obtain appropriate forecasting results. [7]

\[ St = a \times X - 1 + (1 - a) \times St - 1 \]

Forecasting search with alpha value = 0.1

\[ St_1 = 5166 \] (the first forecasting data still cannot be calculated because there is no forecasting data for the previous month).

\[ St_2 = 0.1 \times 5166 + (1 - 0.1) \times 5166 = 5166 \]
\[ St_3 = 0.1 \times 4014 + (1 - 0.1) \times 5166 = 5050.8 \]
\[ St_4 = 0.1 \times 4115 + (1 - 0.1) \times 5050.8 = 4957.22 \]
\[ St_5 = 0.1 \times 2037 + (1 - 0.1) \times 4957.22 = 4665.2 \]
\[ St_6 = 0.1 \times 1614 + (1 - 0.1) \times 4665.2 = 4360.1 \]

Forecasting search with alpha = 0.2

\[ \text{Table 2. Forecasting result data alpha 0.2} \]

<table>
<thead>
<tr>
<th>No</th>
<th>Forecast (St)</th>
<th>Mean Absolute Error</th>
<th>Mean Squared Error</th>
<th>MAPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5166</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5166</td>
<td>1152</td>
<td>1327104</td>
<td>28.6995517</td>
</tr>
<tr>
<td>3</td>
<td>4935.6</td>
<td>820.6</td>
<td>673384.36</td>
<td>19.9416769</td>
</tr>
<tr>
<td>4</td>
<td>4771.48</td>
<td>2734.48</td>
<td>7477380.87</td>
<td>134.240548</td>
</tr>
<tr>
<td>5</td>
<td>4224.584</td>
<td>2610.54</td>
<td>6815148.81</td>
<td>161.742206</td>
</tr>
<tr>
<td>6</td>
<td>3702,4672</td>
<td>522</td>
<td>272588.41</td>
<td>162</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3. Forecasting Result Data for June 2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>1</td>
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<td>7</td>
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<td>8</td>
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<tr>
<td>9</td>
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</tbody>
</table>

From the table above it can be seen the results of the calculation of forecasting sales data. So the results of forecasting using the Single Exponential Smoothing method in June 2022 with the smallest percentage error value, namely the value \(\alpha = 0.9\) with a Forecast result of 1677.094 and a MAPE of 39.00%.

3.2 Economic Order Quantity

Stages for calculating EOQ and TIC to find out the best total orders and efficient costs.

1. Calculating EOQ
2. Calculate TIC

Based on the data from the object, it is known:

<table>
<thead>
<tr>
<th>Total Needs of Goods (D)</th>
<th>10,000 Kg/month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order Cost (S)</td>
<td>Rp. 10,000/Kg</td>
</tr>
<tr>
<td>Storage Cost (H)</td>
<td>Rp. 120/Kg</td>
</tr>
</tbody>
</table>

Based on the table above, we can calculate EOQ and TIC with the following formula:

\[ EOQ = \sqrt{2(D.S) / (H)} \]
\[ E O Q = \sqrt{2(10000 \times 10000) / 120} \]
\[ = \sqrt{\frac{200,000,000}{120}} = \sqrt{1.666666666} = 1291 \]
\[ T IC = \left(\frac{D}{Q} \times S\right) + \left(\frac{Q}{2} \times H\right) \]
\[ T I C = \left(\frac{10000}{1291} \times 10000\right) + \left(\frac{1291}{2} \times 120\right) \]
\[ = \left(\frac{100,000,000}{1291}\right) + (77,460) \]
\[ = (77,459) + (77,460) = 154,919 \]

So, it can be seen that the most economical order in one order is 1291 Kilograms, and the Total Storage Cost is Rp. 154,919 per Kilogram.

3.3 System Testing

1. Raw Material Data Page

On the data page raw materials where admin users can add, edit and delete raw material data in Figure 2 below.

2. Purchase Transaction Page

On the purchase transaction page where admin users can add, edit and delete purchase data in Figure 3 below.
3. Sales Transaction Data Page

The image below is a sales transaction page where the admin user can add, edit and delete sales data. In Figure 4 below

4. Forecasting Count Page

The image below is the admin page for adding forecasting data to predict next month's sales.

5. Forecasting Results Page

The image below is a page for calculating sales forecasts to predict sales in the following month.

6. Print Page

On this page the owner can print reports on the results of purchase transactions and forecasting results that have been calculated.

4. In conclusion

Based on direct research from and analysis conducted at CV. Amifa Keluarga Lestari it can be concluded that the application of Supply Chain Management with a data mining system can facilitate the management of raw materials by implementing an SCM system which can reduce excess stock purchases which can cause excess stock so that more expenditure costs. The system is equipped with a monthly sales transaction menu so that predictions will be calculated from the previous month's sales. And with the Single Exponential Smoothing method, you can predict the number of best sales for the following month in one period by looking at the smallest error.

References


