OPTIMUM INVENTORY POLICY AT PT. SENAHOY OPTIKA PRATAMA IN INDONESIA

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Abstract

Purpose of this research is to determine optimum inventory policy at PT. SENAHOY OPTIKA PRATAMA that located in Bandung, Indonesia. This research discussed demand forecasting for lens and contact lens in 2015, to be used in calculating inventory cost of lens and contact lens. Using QM for Windows 2 software to determine demand forecasting of lens and contact lens, and EOQ model to determine inventory policy and minimizing costs. The result showed that the best forecasting method is Linear Regression model and using EOQ model could have saved the company's cost more than 20 % from procuring those products. The 2015 forecasted demand for lens and contact lens respectively are 2.524,08 and 1.436,08 boxes. Optimum inventory policies for lens and contact lens respectively are to purchase 207,45 pieces when reorder points reache 207,45 pieces with 25 times order per year and to purchase 200,12 boxes when reorder point reaches 118,05 boxes with 7,18 times order per year. The EOQ model can reduce inventory costs over 90 million Rupiah.

Keywords
Forecasting Demand, Economic Order Quantity (EOQ), Optimum Inventory Policy

1. INTRODUCTION

Background

Nowadays, trend of globalization has been creating competitive position in a market. Companies are forced to operate more effectively and efficiently to win the competition as well as to increase customer satisfaction and brand loyalty. They are not only competing in giving better added value to customer but also competing in their operation performance. PT. SENAHOY OPTIKA PRATAMA sells best quality and wide range of exclusive optical products and service such as glass, sunglass, contact lens, lens, and free eye-checking. For lens, PT. SENAHOY OPTIKA PRATAMA categorizes its products into two—near-sighted lens and cylindrical lens. There are 32 types of lens with different negative power—ranging from 0,25 to 10 and 256 types with different mixed power between negative power and cylindrical power—ranging from 0,25 to 2. For contact lens, there are 36 types of contact lens with different negative power, ranging from 0,5 to 12.

Researcher found out that the lens and contact lens sales increased, the total costs increased, and the profits decreased during past four years from 2011 until 2014. The researcher believes that profit can increase not only through increasing sales, but also through decreasing cost and increasing profit margin. Charts below show the data of the sales, the total cost, and the total profit.

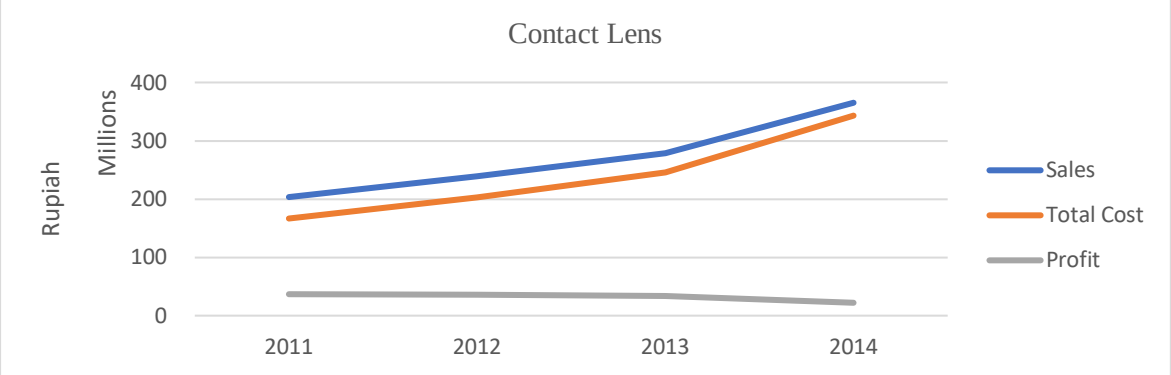

Figure 1. Sales, Total Cost, and Profit of Contact Lens
Source: PT. SENAHOY OPTIKA PRATAMA

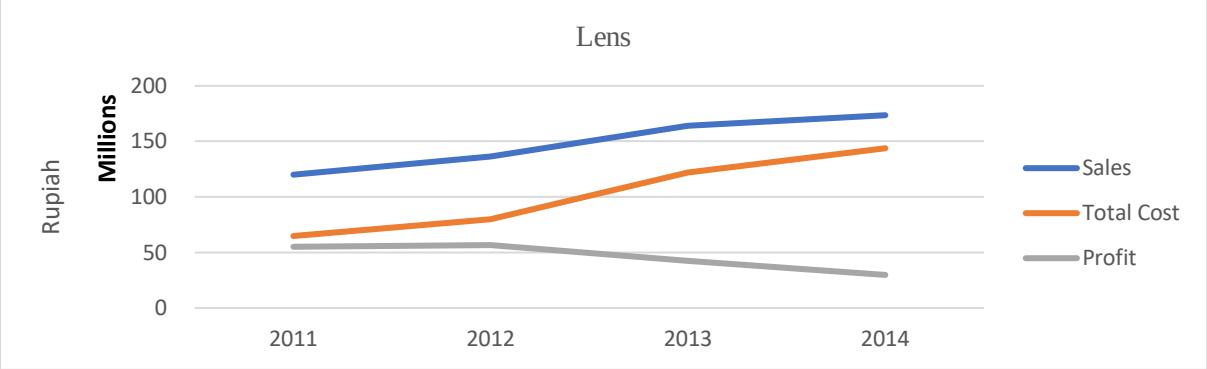

Figure 2. Sales, Total Cost, and Profit of Lens
Source: PT. SENAHOY OPTIKA PRATAMA

PT. SENAHOY OPTIKA PRATAMA purchases lens and contact lens from supplier and stores them in a warehouse. The company forecasts the sales based on manager's intuition to determine the next sales and often tends to round up or double up its order for fast-moving items. As the result, the company experiences increasing overstock every year, caused by the mismatch between order and sales of lens and contact lens. The increasing overstock will automatically cause excess in inventory investment and will directly decrease company's profit. Here is table of order and sales of lens and contact lens from 2011 until 2015:

Table 1. Order and Sales of Contact Lens

	2011	2012	2013	2014	2015
Total Order	1080	1200	1320	1680	2040
Total Sales	1017	1089	1152	1372	-
Overstock	**63**	**111**	**168**	**308**	**-**

Source: PT. SENAHOY OPTIKA PRATAMA

Table 2. Order and Sales of Lens

	2011	2012	2013	2014	2015
Total Order	1800	2040	2880	3120	3480
Total Sales	1.715,5	1.770,0	2.134,0	2.254,0	-
Overstock	**84,5**	**270,0**	**746,0**	**866,0**	**-**

Source: PT. SENAHOY OPTIKA PRATAMA

To improve operation performance, PT. SENAHOY OPTIKA PRATAMA needs to predict lens and contact lens demand for the next period by forecasting its sales properly and systematically. It will help the company to determine the next sales strategy and create an optimum inventory policy with minimum cost. The policy is a standard set of rules or boundaries and guidelines that provide framework for a company to handle its idle stock without incurring unnecessary costs and make better informed and timely decisions on how many products to order, when to order product, and how many times to order per year.

Model that can be used is *Forecasting* and *Economic Order Quantity* (EOQ) because the more accurate demand forecasting, the more efficient decisions for the planned production, lower inventory levels, and costs of maintaining inventory (Kot, Grondys, and Szopa, 2011). According to Adeyemi and Salami (2010), inventory management has become highly developed to meet the rising challenges in most corporate entities. The inventory management situation has been revealed using the EOQ model. It was also seen that the company through a well-built policy is able to handle its idle stock without incurring unnecessary costs. According to Matthew, Nair, and Joseph E (2013), the EOQ model is optimizing the order quantity for each product when an order is placed. Therefore, researcher would like to determine optimum inventory policy on how many products to order, when to

order product, and how many times to order per year at PT. SENAHOY OPTIKA PRATAMA with minimum costs?

2. LITERATURE REVIEW

Operation Management

Operation Management defines as the design, operation, and improvement of the systems that create and deliver the firm's primary products and services (Chase, Jacobs, and Acquilano, 2006). Like marketing and finance, operation management is a functional field of business with clear line management responsibilities. Operational management is concerned with the management of the entire system that produces a good or delivers a product. Within the three-operation function, management decisions can be divided into three broad areas:

1. Strategic (long-term) decisions.
2. Tactical (intermediate-term) decisions.
3. Operational planning and control (short-term) decisions.

According to Heizer and Render in Operations Management (2011), to create goods and services, all organizations perform three functions. These functions are the necessary ingredients not only for production, but also for an organization's survival. They are:

1. Marketing, which generates the demand, or at least takes the order for a product or service.
2. Production / operations, which creates the product.
3. Finance / accounting, which tracks how well the organization is doing, pays the bills, and collects the money.

Forecasting

Forecasting is a common statistical task in business, where it helps in making decision about scheduling of production, transportation and personnel, and provides to guide to long-term strategic planning. Forecasting is about predicting the future as accurately as possible, given all the information available including historical data and knowledge of any future events that might impact the forecasts (Saurabh and Nishant, 2013). There are eight steps can help in the development of a forecasting system as follows: (Render, Stair Jr, and Hanna, 2012).

1. Determine the use of the forecast.
2. Select the items or quantities that are to be forecasted
3. Determine the time horizon of the forecast.
4. Select the forecasting model(s).
5. Gather the data or information needed to make the forecast.
6. Validate the forecasting model.
7. Make the forecast.
8. Implement the results.

Despite increased use of systematic methods, most forecasting undertaken in business and government today remains a mixture of formal modeling and informal (subjective) judgments. As Glenn Stevens (Governor of the Reserve Bank of Australia) notes in a paper on this topic: 'We will probably get the most useful forecasts by combining stable, simple models that capture empirically the most important macroeconomic dynamics in the economy, with judgment informed by the vast array of non-model, and sometimes non-quantitative, information about the current state of the economy which is available in the plethora of partial indicators (not all of which are published by the official statistical agencies). Forecasting model used are *Moving Average, Weighted Moving Average, Exponential Smoothing, Exponential Smoothing with Trend, Naïve Method* and *Linear Regression*. These models use historical sales data from 2011 until 2014. We use measure of accuracy mean absolute deviation (MAD) and the mean squared error (MSE), which is the average of the squared errors:

Economic Order Quantity (EOQ)

The EOQ model we use to find an optimal order size that minimizes the sum of the two annual costs. In EOQ computations, the term carrying cost is used in place of holding cost and setup cost is used in place of order cost. According to Heizer and Render (2011), this technique is relatively easy to use but it is based on several assumptions:

a. Demand for an item is known, reasonably constant, and independent of decisions for other items.
b. Lead time—that is, the time between placement and receipt of the order—is known and consistent.
c. Receipt of inventory is instantaneous and complete. In other words, the inventory from an order arrives in one batch at one time.
d. Quantity discount are not possible
e. The only variable costs are the cost of setting up or placing an order (setup or ordering cost) and the cost of holding or storing inventory over time (holding or carrying cost).
f. Stockouts (shortages) can be completely avoided if orders are placed at the right time.

With the EOQ model, the optimal order quantity will occur at a point where the total setup cost is equal to the total holding cost. Using the following variables, we can determine setup and holding costs and solve for *Q** (optimal order size)

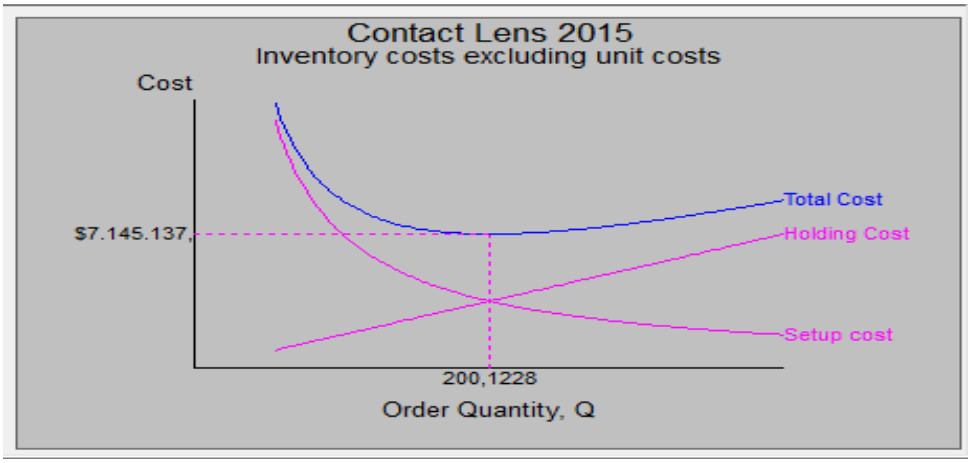

Figure 3. EOQ Inventory Model for optimal Q

3. RESEARCH METHODOLOGY

This is applied research because it intends to improve inventory management efficiency and effectiveness of lens and contact lens at PT. SENAHOY OPTIKA PRATAMA. This research conducted at PT. SENAHOY OPTIKA PRATAMA, where variables of interest are lens and contact lens. There are two sources of research data, which are primary and secondary data. Primary data refer to information obtained first-hand by a researcher on the variables of interest or specific purpose of a study. Secondary data refer to information gathered by someone other than the researcher conducting the current study. This research uses secondary data which are gathered by PT. SENAHOY OPTIKA PRATAMA is obtained through review of textbooks, articles, and international journals on *forecasting* and inventory management with EOQ model. The collected data and information are analyzed using *Forecasting* and *Economic Order Quantity* (EOQ) model. *Forecasting* will be carried out with the aid of *QM for Windows 2* software. This forecasting system consists of several factors as follows:

1. This forecast is used to determine sales demand in 2015.
2. Items or quantities that are to be forecasted are past sales data from 2011 until 2014.
3. The time horizon of the forecast is medium-range.
4. *Forecasting* methods that are selected are *Moving Average, Weighted Moving Average, Exponential Smoothing, Exponential Smoothing with Trend, Naïve Method*, and *Linear Regression.*

Economic Order Quantity (EOQ) model was used to determine the optimum and economic order quantity, reorder point, and total inventory cost. This technique is based on several assumptions as follows:

1. Demand is assumed and adjusted reasonably constant every month through advertising and promotion.
2. Lead time is 30 days and consistent.
3. The inventory from an order arrives in one batch at one time.
4. No quantity discount
5. The only variable costs are cost of setup or ordering cost and cost of holding or carrying cost).

Economic Order Quantity (EOQ)

EOQ model is used to determine optimum ordered quantity of products to get a minimum total inventory cost. There are some calculations such as EOQ, Daily demand, Orders per period, Reorder point, Annual setup / ordering cost, Annual carrying / holding cost, Total cost per unit, and Total cost.

EOQ determines a point in which summation of ordering costs and holding costs are the lowest. One of advantages of EOQ model in this research is to provide information on how many inventory levels needs to be hold, when reordering products needs to be done, and how many products need to be ordered. Below is mathematical model of EOQ manual calculation:

1. $EOQ\ (Q^*) = \sqrt{\frac{2\ x\ Co\ x\ D}{Ch}}$
2. $Order\ per\ period = \frac{D}{Q}$

3. $Annual\ Setup\ Cost = \frac{D}{Q}\ x\ S$
4. $Annual\ Holding\ Cost = \frac{Q}{2}\ x\ H$
5. $Total\ Unit\ Cost =\ Unit\ Cost\ x\ D$
6. $Total\ Cost = Annual\ Setup\ Cost +\ Annual\ Holding\ Cost + Total\ Unit\ Cost$
7. $ROP = SS + (Lt\ x\ DD)$

4. DATA ANALYSIS AND RESULTS

Using data in Table 1. and Table 2. to forecast:

Lens

Forecasting results and graphics of lens' sales from six methods, which are *Moving Average, Weighted Moving Average, Exponential Smoothing, Exponential Smoothing with Trend, Naïve Method, and Linear Regression* by using *QM for Windows 2* software are summarized below:

Table 3. Forecasting results of Lens and Contact Lens with MAD and MSE

Methods	MAD	MSE
Moving Average	24,6667	1.111,54
Weighted Moving Average	24,0633	1.084,193
Exponential Smoothing	24,4839	1.000,946
Exponential Smoothing with Trend	25,5869	1.171,944
Naïve Method	27,2979	1.262,372
Linear Regression	**24,2703**	**896,8417**

Source: Data Processing Results

Using Linear regression model for Lens and Contact Lens
Demand(y) = 126,1747 + 1,5443 x Time(x) for lens where the period starts from 49th to 60th and;
Demand(y) = 77,49026 + 0,7742 x Time(x) for contact lens where the period starts from 49th to 60th

Table 4 Demand of Lens and Contact Lens in 2015

	Lens	Contact Lens
Total	**2524,079**	**1436,215**

Source: Calculation results

Economic Order Quantity for Each Product in 2015

The economic order quantity for procurement of lens and contact lens are as follows

Lens

EOQ of Lens in 2015

a) EOQ (Q*) = $\sqrt{\frac{2\ x\ 2.252{,}08x\ 1.540.825}{7.600{,}29}} =\ 101{,}65\ pieces\ /\ order$
b) Order per period (year) = $\frac{D}{Q*} = \frac{2.524{,}08}{101{,}65} = 25\ times$
c) Total Cost = Annual Setup Cost + Annual Holding Cost + Total Unit Cost
= 98.186.670
d) $ROP = SS + (Lt\ x\ DD)$
= 207.45 pieces

Contact Lens

EOQ of Contact Lens in 2015

a) EOQ (Q*) = $\sqrt{\frac{2\ x\ 1436{,}22\ x\ 497.805}{35.703{,}76}} =\ 200{,}12\ boxes\ /\ order$
b) Order per period (year) = $\frac{D}{Q*} = \frac{1436{,}228}{200{,}12} = 7{,}18\ times$
c) Total Cost = Annual Setup Cost + Annual Holding Cost + Total Unit Cost

= 262.040.300

d) $ROP = SS + (Lt\ x\ DD)$

= 118,05 boxes

EOQ versus Traditional (Current) Practice

From the company's traditional practice, pattern can be taken into their purchasing habit. If company still uses the previous method, total cost incurred in 2015 will be likely shown below on Table 5.

Table 5. Comparison between Traditional Practice and EOQ Model

	Lens	Contact Lens	
Demand	2524,079	1436,215	
Cost per unit	Rp 35.853,81	Rp 177.476,37	
Total unit cost	Rp 90.497.848,89	Rp 254.894.224,74	
Ordering cost	Rp 1.540.825	Rp 497.805	
Number of order	12	12	
Total order cost	Rp 18.489.900	Rp 5.973.660	
Holding cost	Rp 7.600,29	Rp 35.703,76	
Holding unit	3480	2040	
Total holding cost	Rp 26.449.009	Rp 72.835.670	Total
Total Cost	Rp 135.436.758	Rp 315.370.170	Rp 450.806.928
Total costs EOQ	*Rp 98.186.670*	*Rp 262.040.300*	*Rp 360.226.970*
Saving	**Rp 37.250.088**	**Rp 53.329.870**	**Rp 90.579.958**

Source: Calculation Result

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5. CONCLUSION AND RECOMMENDATION

Based on this research, the results of the analysis on lens and contact lens at PT. SENAHOY OPTIKA PRATAMA can be concluded as follows:
Both demand of lens and contact lens show that *Linear Regression* method provides the lowest MAD and MSE, which means it is the most accurate method among other five methods applied in this research. The result showed total demand in 2015 for lens and contact lens respectively are 2.524,08 pieces and 1.436,08 boxes. These demands are lower than forecasted demand of the company which are 3.480 pieces and 2.040 boxes respectively. While the optimum inventory policy is that, the company should purchase 101,65 pieces of lens when reorder point reaches 207,45 pieces with 25 times order per year, and purchase 200,12 boxes of contact lens when reorder point reaches 118,05 boxes with 7,18 times order per year. PT. SENAHOY OPTIKA PRATAMA could have saved Rp 90.579.958 in 2015 or 20%

It is recommended in predicting the future demand (2015, 2016, and so on), PT. SENAHOY OPTIKA PRATAMA can use several forecasting methods and choose the most suitable method based on the lowest MAD and MSE. After conducting EOQ model, the results show that the total inventory cost is reduced. Therefore, PT. SENAHOY OPTIKA PRATAMA should implement EOQ model as its inventory system to minimize inventory cost. By doing so, the company can save more money and increase profit.

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Biographies

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