

# Implementation of The Economic Order Quantity Method For Inventory of Goods

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## Abstract

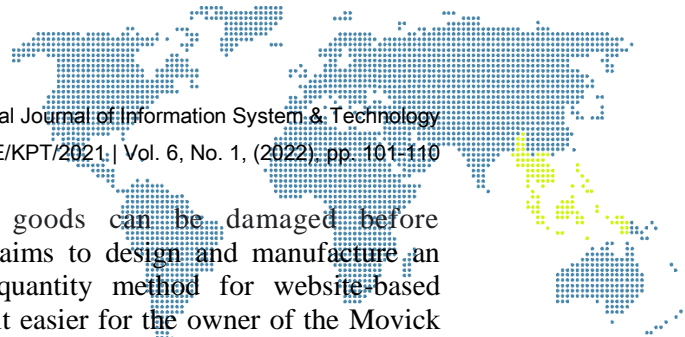
The inventory system that is being carried out at this time is by manual method where the inventory is still made using Microsoft Office in the form of Microsoft Word and Microsoft Excel in which data is written about data on the presentation of basic food items sold, expenditure of goods and orders. However, the presentation of goods is less efficient and effective. By looking at this situation and condition, the author makes a system "implementation of the economic order quantity method for inventory" where this system can help shop owners and employees who work at the shop make their work easier and also help streamline and be effective in recording the goods sold, issuing goods, and also ordering goods. In this system the author uses the PHP programming language with a MySQL database, where later the data will be entered and stored in the database and connected to PHP programming so that inventory control is easier, more efficient, and effective.

**Keywords:** inventory, economic order quantity

## 1. Introduction

The store is a business that operates in the grocery store that sells basic necessities such as rice, sugar, cooking oil, instant noodles, eggs and so on. Based on the results of interviews with the owner of the Movick store processing sales transaction data, inventory data still uses the manual method by writing into a notebook. This method still takes a long time and is prone to miscalculations in determining the amount of stock that must be available in the warehouse which causes the store to experience some losses due to ineffective and efficient stock revenues, due to limited warehouse and funds at the Movick store. so it must optimize the use of warehouses and available funds and if the amount of inventory is too large, it will result in the funds being spent being too large, besides that the risk of damage to goods is also greater and the use of warehouses is less than optimal. However, if there is too little inventory, it will result in a shortage of inventory which can cause loss of profits. Based on the problems above, a system is needed that can optimize the use of warehouses and funds in determining the inventory of goods, in this case the researcher uses the Economic Order Quantity (EOQ) method. The EOQ method is a way to obtain a number of items with a minimum cost and supervision of the ordering cost of storage costs[1].

The inventory management system that is made must be able to do several things, including the system must be able to estimate the amount of goods needed for one period with certainty and determine the time for ordering goods back. In addition, the system can also record the transaction process with suppliers. The inventory management system that is made is also expected to be able to process data quickly and precisely, the system can be used easily by the owner, and time efficiency in performing calculations. Predictions need to be done to avoid errors in data collection of goods availability [8][9][10][11]. Errors in recording the availability of goods can cause losses. Excessive inventory



of goods can provide another risk, namely goods can be damaged before experiencing a sales transaction. So the author aims to design and manufacture an implementation system of the economic order quantity method for website-based inventory using the EOQ method in order to make it easier for the owner of the Movick store to optimize the use of warehouses and funds by determining the time of ordering goods back with the amount of inventory needed, quickly and precisely.

## 2. Research Methodology

Software development uses the waterfall method which is divided into 4 stages, namely[2]:

- a) *Requirements Analysis*
- b) *System and Software Design*
- c) *Implementation and System Testing*
- d) *Integration and System Testing*

### 2.1. Economic Order Quantity (EOQ)

The Economic Order Quantity (EOQ) method is one of the most well-known methods in inventory management and is a classic and simple method. In theory, the EOQ concept is the simplest inventory model. The EOQ model is the traditional approach to inventory control. According to Handoko (2014-339):

“The EOQ concept is also known as the fixed-order-quantity model which is a simple model and is used to determine the order quantity of inventory that minimizes direct and indirect costs of storage and can minimize ordering costs. The EOQ model or so-called fixed-order quantity (fixed-order-quantity) is an inventory control model with the quantity ordered is the same every time the inventory reaches the reorder point”[3].

Meanwhile, EOQ is an inventory control method that answers 2 (two) important questions, when to order and how much to order[4]. Furthermore, Economic Order Quantity (EOQ) can be interpreted as the number of purchases of raw materials at each time a message at a low cost[5]. The Economic Order Quantity (EOQ) model that has been discussed previously has policies in its use. The policy is an assumption or conditions that must be met in the use of the EOQ model. The policies in the EOQ are as follows[3]:

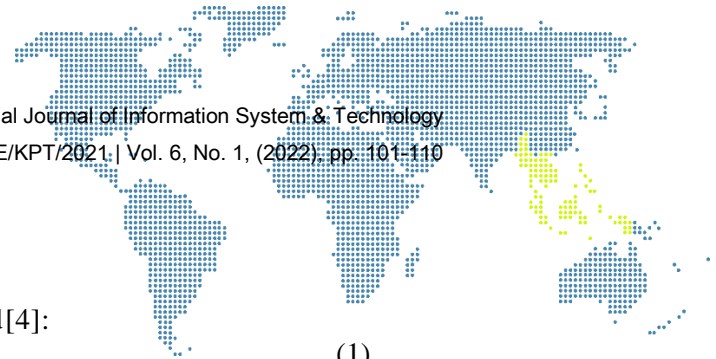
- a) The demand for the product is constant, uniform and deterministic.
- b) The price per unit of product is constant.
- c) The storage cost per unit (H) is constant.
- d) Order cost per unit (S) is constant.
- e) The time between the order being placed and the goods being received (lead time) is constant.
- f) There is no shortage of goods or "back orders".

These assumptions illustrate the limitations of the basic EOQ (Economic Order Quantity) model and the ways in which the model can be modified. Understanding the limitations and assumptions of the EOQ (Economic Order Quantity) model is an important basis for managers to make inventory decisions.

In general, the inventory model aims to minimize total costs. In implementing EOQ to minimize inventory costs, there are several costs that must be considered in determining the purchase amount or profit, including:

- a) Order Fee

Order costs are costs that will be directly related to order activities that will be carried out by the company. Order costs fluctuate not with the quantity ordered, but with the frequency of orders. Order costs consist not only of explicit costs but also of opportunity costs. For example, time wasted on processing orders, running order administration and so on. Some examples of order costs include:



- 1) Preparation fee
- 2) Phone charges
- 3) Shipping costs

To find the ordering cost, the formula is used[4]:

$$\text{Order fee} = \frac{D}{Q} \times S \tag{1}$$

Information :

- Q = Quantity of goods per order.
- D = Number of needs/demands in units per period
- S = Order cost for each order.

b) Storage Fee

Storage costs are costs that must be borne by the company in connection with the raw materials stored in the company. Storage costs include:

- 1) Maintenance costs,
- 2) Insurance fee,
- 3) Damage costs in storage
- 4) Rental fee
- 5) Storage facility fee

to calculate storage costs formulated as follows [4]:

$$\text{Storage fee} = \frac{Q}{2} \times H \tag{2}$$

Information :

- Q = Quantity of goods per order.
- H = Unit storage cost per period.

In determining the cost of inventory there are 2 costs that need to be considered, namely ordering costs and storage costs. After determining the two costs, the next step is to determine the total required inventory cost (TC) by adding up the ordering cost and the storage cost.

The formula for total inventory costs is as follows[4]:

$$\text{Total inventory cost (TC)} = \frac{D}{Q} \times S + \frac{Q}{2} \times H \tag{3}$$

Information :

- TC = Total inventory cost
- Q = Quantity of goods per order.
- D = Number of needs/demands in units per period
- S = Order cost for each order.
- H = Unit storage cost per period.

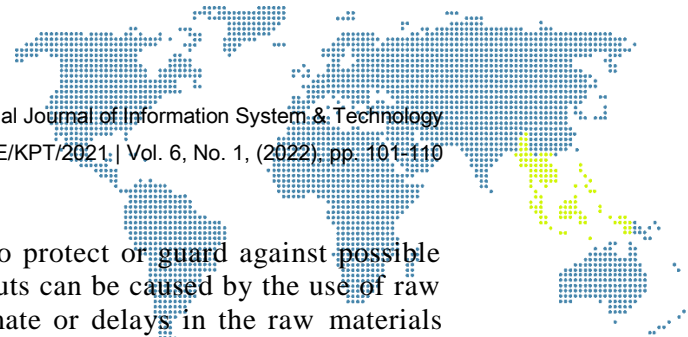
After determining the costs mentioned above, then calculate how many economical orders are to be able to minimize inventory costs using the Economic Order Quantity (EOQ) method.

The EOQ formula is as follows[4]:

$$Q^* = \sqrt{\frac{2.S.D}{H}} \tag{4}$$

Information :

- Q\* = Economical order quantity
- D = Number of needs/demands in units per period.
- S = Order cost for one order.
- H = Holding cost per unit per period.



## 2.2. Safety Stock

Safety stock is an additional inventory held to protect or guard against possible shortages of materials. The possibility of stock outs can be caused by the use of raw materials that are greater than the original estimate or delays in the raw materials ordered [6]. To determine the cost of security supplies, statistical analysis is used, namely by considering the deviations that have occurred between the use of raw materials and the actual use so that the standard deviation is known.

The standard deviation is formulated as follows:

$$SD = \sqrt{\frac{\sum(x-\bar{x})^2}{n}} \quad (5)$$

Information :

- SD = Standard deviation.
- x = Number of request.
- $\bar{x}$  = Average number of request.
- n = Number of data.

While the formula used to calculate security inventory is as follows:

$$SS = SD \times Z \quad (6)$$

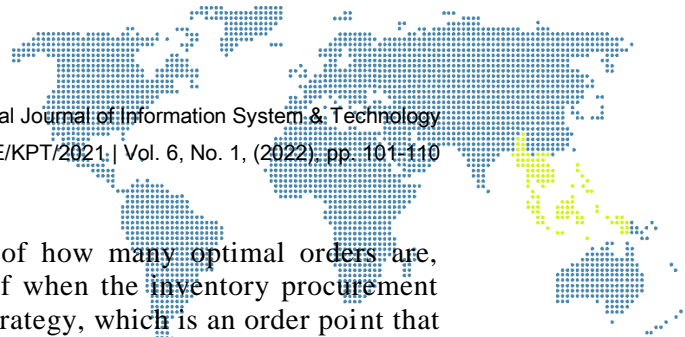
Information :

- SS = Safety stock.
- SD = Number of request.
- Z = Safety factor used by the company.

In this case, the security factor in question is the probability used by the company against the occurrence of stock outs. For example, a company has a 1% probability of stock outs and with a service level of 99%, then by using a normal frequency distribution table the value of  $Z_{0.01} = 2.33$  is obtained[4].

**Table 1.** Normal Frequency Diagram (Heizer, Jay and Barry Render. 2010)

Normal Distribution	
Service Rate	Z= Service Coefficient
99.9%	3.09
99%	2.33
98%	2.05
97%	1.88
96%	1.75
95%	1.64
94%	1.55
93%	1.48
92%	1.41
91%	1.34
90%	1.28
89%	1.23
88%	1.17
87%	1.13
86%	1.08
85%	1.04
84%	0.99
83%	0.95
82%	0.92



### 2.3. Reorder Points

In the EOQ model, it answers the question of how many optimal orders are, while the Re-order Point answers the question of when the inventory procurement begins. Reorder Point is an inventory operation strategy, which is an order point that must be made by a company in connection with the lead time[5]. Meanwhile, "Reorder Point is the level of inventory where when the inventory has reached that level, the order must be placed immediately"[4].

Furthermore[7]: "Reorder Point is a point where orders must be held again in such a way that the arrival or receipt of the ordered material is on time". Reorder Point occurs when the amount of inventory contained in the stock decreases continuously so that we have to determine how much the minimum level of inventory is. The expected amount is calculated during the grace period, it may also be added to the safety stock which usually refers to the possibility of a shortage of stock during the grace period.

To calculate ROP can use the following formula:

$$ROP = (L \times D) / W \tag{7}$$

Information :

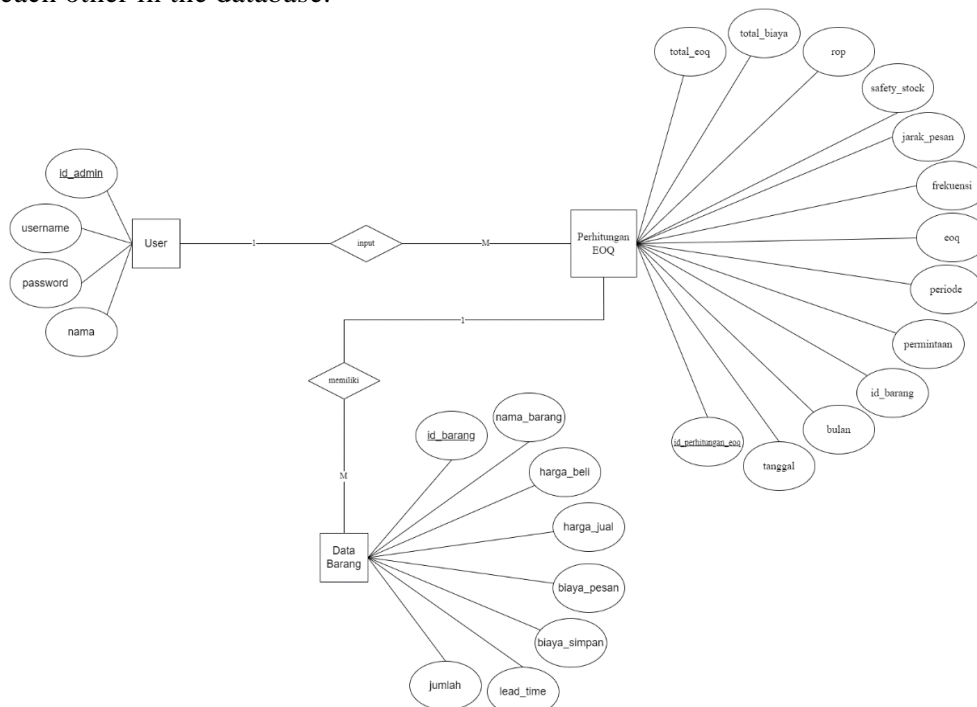
L = Lead time (waiting time).

D = Demand in units per period.

W = Time period in days.

### 2.4. Entity Relationship Diagram (ERD)

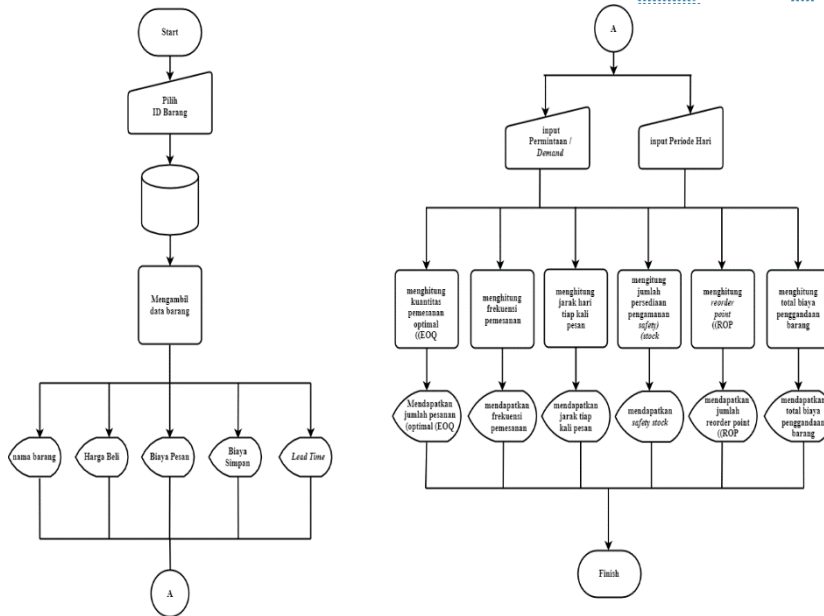
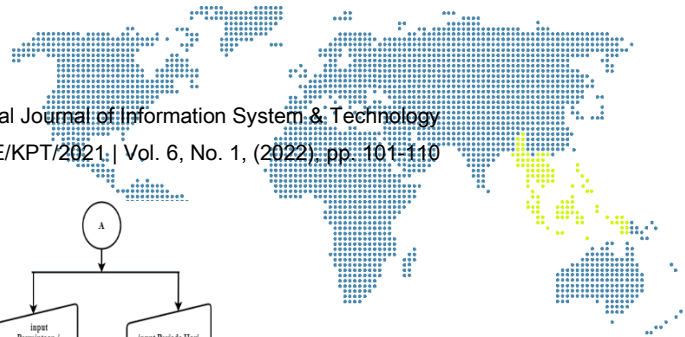
The database design produces a table mapping that is described by an Entity relationship diagram (ERD) which shows the relationship between tables that relate to each other in the database.



**Figure 1.** ERD Implementation of data storage and management in the calculation of economic order quantity

### 2.5. EOQ Flowchart

In Figure 2. EOQ flowchart explains the calculation stages using the EOQ method.



**Figure 2. EOQ Flowchart**

### 2.6. Interface Design

Describes the interface design contained in the Movick store inventory system application, namely EOQ calculation interface design design, on the eoq calculation menu displays the input form to calculate inventory using the EOQ method.

**Figure 3. EOQ calculation page design**

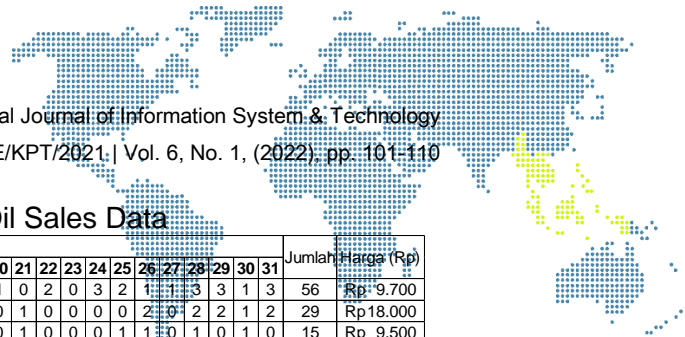
## 3. Results And Discussion

### 3.1. Data Analysis

This stage is used to find data related to the method that will be used to build the system, namely looking for store data at Movick stores regarding the amount of sales data in previous months, ordering cost data, and storage cost data. Furthermore, the data that has been collected was analyzed using the EOQ method.

#### a) Cooking Oil Sales Data

In Table 2. Cooking oil sales data is shown sales in January 2022.



**Table 2. Cooking Oil Sales Data**

Minyak Goreng	Bulan Januari																															Jumlah	Harga (Rp)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
Bimoli Klasik 1 liter	2	0	2	4	3	0	1	2	3	0	1	0	4	4	3	1	2	0	4	1	0	2	0	3	2	1	1	3	3	1	3	56	Rp 9.700
Bimoli Klasik 2 liter	2	0	0	2	0	1	2	2	1	1	0	0	0	0	2	1	2	2	1	0	1	0	0	0	0	2	0	2	2	1	2	29	Rp 18.000
Bimoli Spesial 1 liter	0	1	1	0	1	1	0	0	0	1	0	0	1	0	1	0	1	1	1	0	1	0	0	0	0	1	1	0	1	0	15	Rp 9.500	
Bimoli Spesial 2 liter	2	0	2	2	1	0	1	2	0	1	2	0	1	0	2	2	1	1	0	0	2	1	0	1	0	0	2	0	1	0	1	28	Rp 18.400
Hemart 1 liter	3	4	1	2	0	4	3	2	0	1	1	2	2	1	2	4	0	1	0	4	2	3	4	4	2	1	0	4	4	1	0	62	Rp 7.400
Hemart 2 liter	2	2	1	0	1	1	2	2	0	1	2	2	0	2	1	0	2	0	0	2	1	0	1	2	1	1	1	1	1	0	2	34	Rp 14.400
Sunco 1 liter	2	0	0	2	1	2	2	0	1	0	0	0	1	1	0	0	0	2	0	1	2	0	2	1	2	0	0	0	1	1	2	26	Rp 8.900
Sunco 2 liter	2	0	0	2	0	1	2	1	2	1	1	0	0	0	0	0	0	0	2	1	2	0	1	0	1	1	1	1	1	1	1	24	Rp 17.000
Fortune 1 liter	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	1	1	1	1	1	0	1	0	1	0	0	0	1	0	0	1	13	Rp 9.100
Fortune 2 liter	1	1	1	0	0	1	0	1	0	1	0	0	1	1	1	1	1	1	0	1	0	1	0	1	0	1	1	0	1	1	0	19	Rp 16.900
Tropical 1 liter	2	2	0	1	0	2	1	1	0	2	1	1	1	0	2	1	1	2	1	0	2	2	2	0	0	1	0	2	0	0	2	32	Rp 9.300
Tropical 2 liter	0	0	1	1	1	0	2	1	2	0	0	1	0	0	1	2	2	1	2	1	1	1	1	1	2	2	1	0	0	1	2	30	Rp 17.300
Sania 1 liter	3	0	2	0	3	0	0	1	3	0	1	1	1	2	0	0	0	1	3	2	1	2	3	0	1	2	3	3	2	0	2	42	Rp 8.700
Filma 1 liter	1	1	0	0	1	0	1	0	0	1	0	1	1	0	1	0	0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	12	Rp 8.600
Filma 2 liter	1	0	0	1	0	0	0	1	1	1	1	1	0	1	1	0	1	1	0	0	0	0	0	1	0	0	1	1	0	1	1	17	Rp 16.500

**b) Cooking Oil Ordering fee**

In Table 3. the message costs in January 2022 are detailed.

**Table 3. Booking Fee for January 2022**

No	Minyak Goreng	harga	isi per karton	total harga per karton	Biaya pemesanan			Jumlah
					Transportasi	Kuli	Telephone dan ATK	
1	Bimoli Klasik 1 liter	Rp 9.700	12	Rp 116.400	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
2	Bimoli Klasik 2 liter	Rp 18.000	6	Rp 108.000	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
3	Bimoli Spesial 1 liter	Rp 9.500	12	Rp 114.000	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
4	Bimoli Spesial 2 liter	Rp 18.400	6	Rp 110.400	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
5	Hemart 1 liter	Rp 7.400	12	Rp 88.800	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
6	Hemart 2 liter	Rp 14.400	6	Rp 86.400	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
7	Sunco 1 liter	Rp 8.900	12	Rp 106.800	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
8	Sunco 2 liter	Rp 17.000	6	Rp 102.000	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
9	Fortune 1 liter	Rp 9.100	12	Rp 109.200	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
10	Fortune 2 liter	Rp 16.900	6	Rp 101.400	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
11	Tropical 1 liter	Rp 9.300	12	Rp 111.600	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
12	Tropical 2 liter	Rp 17.300	6	Rp 103.800	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
13	Sania 1 liter	Rp 8.700	12	Rp 104.400	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
14	Filma 1 liter	Rp 8.600	12	Rp 103.200	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166
15	Filma 2 liter	Rp 16.500	6	Rp 99.000	Rp 8.666	Rp 15.000	Rp 12.500	Rp 36.166

**c) Cooking Oil Storage Fee**

In table 4. the amount of each deposit cost in January 2022 is detailed.

**Table 4. Storage Cost for January 2022**

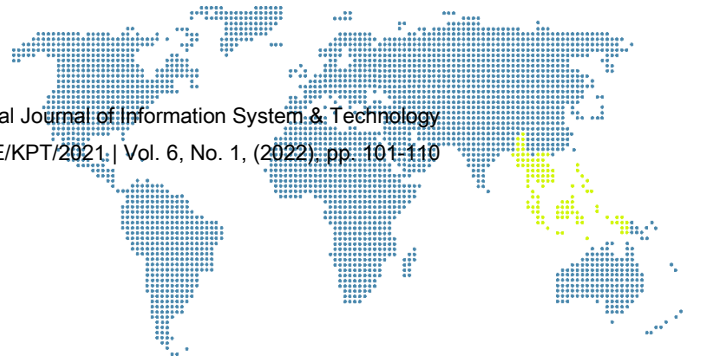
No	Minyak Goreng	Harga	Isi Per Karton	Total Harga per Karton	Biaya Penyimpanan		Jumlah
					Pemeliharaan Gudang	Listrik	
1	Bimoli Klasik 1 liter	Rp 9.700	12	Rp 116.400	Rp 10.000	Rp 7.200	Rp 17.200
2	Bimoli Klasik 2 liter	Rp 18.000	6	Rp 108.000	Rp 10.000	Rp 7.200	Rp 17.200
3	Bimoli Spesial 1 liter	Rp 9.500	12	Rp 114.000	Rp 10.000	Rp 7.200	Rp 17.200
4	Bimoli Spesial 2 liter	Rp 18.400	6	Rp 110.400	Rp 10.000	Rp 7.200	Rp 17.200
5	Hemart 1 liter	Rp 7.400	12	Rp 88.800	Rp 10.000	Rp 7.200	Rp 17.200
6	Hemart 2 liter	Rp 14.400	6	Rp 86.400	Rp 10.000	Rp 7.200	Rp 17.200
7	Sunco 1 liter	Rp 8.900	12	Rp 106.800	Rp 10.000	Rp 7.200	Rp 17.200
8	Sunco 2 liter	Rp 17.000	6	Rp 102.000	Rp 10.000	Rp 7.200	Rp 17.200
9	Fortune 1 liter	Rp 9.100	12	Rp 109.200	Rp 10.000	Rp 7.200	Rp 17.200
10	Fortune 2 liter	Rp 16.900	6	Rp 101.400	Rp 10.000	Rp 7.200	Rp 17.200
11	Tropical 1 liter	Rp 9.300	12	Rp 111.600	Rp 10.000	Rp 7.200	Rp 17.200
12	Tropical 2 liter	Rp 17.300	6	Rp 103.800	Rp 10.000	Rp 7.200	Rp 17.200
13	Sania 1 liter	Rp 8.700	12	Rp 104.400	Rp 10.000	Rp 7.200	Rp 17.200
14	Filma 1 liter	Rp 8.600	12	Rp 103.200	Rp 10.000	Rp 7.200	Rp 17.200
15	Filma 2 liter	Rp 16.500	6	Rp 99.000	Rp 10.000	Rp 7.200	Rp 17.200

**3.2. The Calculation Results**

In this study, a calculation test using the EOQ method has been carried out on each of the cooking oil sales test data contained in table 2. As follows:

1) Determine the value of EOQ.

Calculation of EOQ on 1 liter Bimoli Classic cooking oil



$$EOQ = \sqrt{\frac{2 \cdot S \cdot D}{H}}$$

$$EOQ = \sqrt{\frac{2 \times 36.166 \times 56}{17.200}}$$

$$EOQ = 15,3459941 \text{ rounded up to } 15$$

2) Determine the order frequency value.

Calculation of the frequency of orders on Bimoli Classic 1 liter cooking oil

$$\text{Order frequency} = \frac{D}{EOQ}$$

$$\text{Order frequency} = \frac{56}{15,3459941}$$

$$\text{Order frequency} = 3,64916079 \text{ rounded to } 4$$

3) Determine the distance each time you order.

Calculation of the distance every time you order on Bimoli Classic 1 Liter cooking oil

$$\text{distance each time order} = \frac{\text{time period}}{\text{frequency of order}}$$

$$\text{distance each time order} = \frac{31}{3,64916079}$$

$$\text{distance each time order} = 8,49510388$$

4) Determine the Safety Stock

Calculation of Safety Stock on Bimoli Classic 1 liter cooking oil.

$$\bar{x} = \frac{D}{\text{day period}}$$

$$= \frac{56}{31} = 1,80645161$$

$$SD = \sqrt{\frac{\sum(x - \bar{x})^2}{n}}$$

$$SD = \sqrt{\frac{182.742976}{31}}$$

$$SD = 2,42794866$$

$$SS = SD \times Z = 2,42794866 \times 2,33 = 5,65712038$$

5) Determine the reorder point

Calculation of reorder point on 1 liter Bimoli Classic cooking oil.

$$ROP = (L \times D) / W$$

$$ROP = \frac{5 \times 56}{31} = \frac{5 \times 56}{31} = \frac{280}{31} = 9,03225806$$

From the above calculation, it is obtained the optimal number of goods that must be available in the warehouse (EOQ), the frequency of orders, the distance each time you place an order, the amount of safety stock (safety stock), the time for ordering goods back (ROP) that Movick stores must have. With this data, the store can reduce the risk of too large an inventory of goods which can result in the emergence of funds being too large, besides that the risk of damage to goods is also greater and the use of warehouses is less than optimal because the stock of goods exceeds the number of sales for one period. However, if there is too little inventory, it will result in a shortage of inventory which can lead to loss of profits.





### 3.3. Interface Design Implementation

The eoq calculation page is an inventory calculation display using the EOQ method

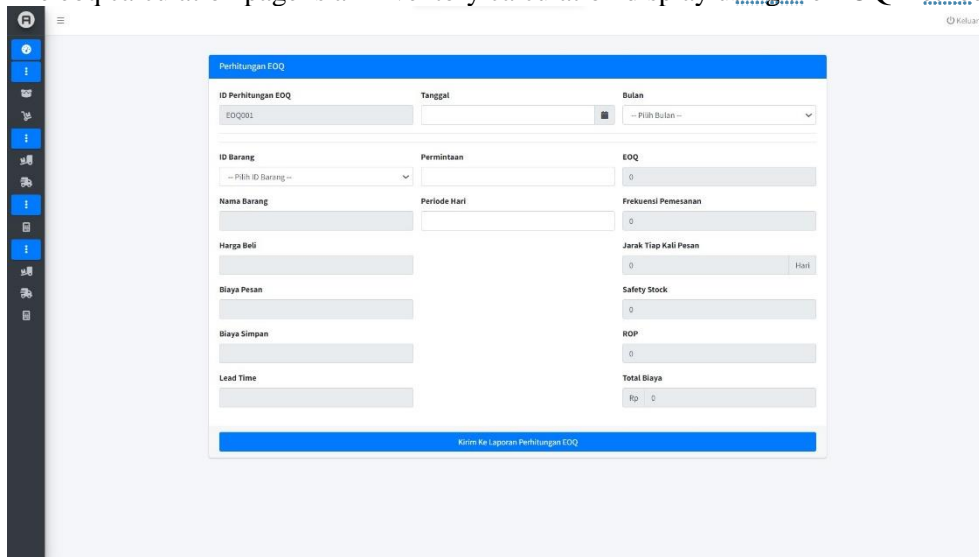


Figure 5. EOQ calculation page

## 4. Conclusion

The conclusions that can be obtained from this research are based on the results of data calculations using the economic order quantity method at the Movick store, the optimal number of goods that must be available in the warehouse (EOQ) is obtained. From the results of these calculations, the Movick store can optimize the use of the warehouse by knowing the items that must be available in the Movick store warehouse. The Economic Order Quantity (EOQ) method used in this research can be used to calculate the fulfillment of the most economical needs, namely a number of goods that will be obtained by purchasing using minimal costs. In this inventory system, the designs made include the Entity Relationship Diagram (ERD) design, flowchart design, display design, and defining the concept of EOQ calculation. Some suggestions that can be taken from this research are based on the results of the research above, the researcher proposes to the Movick store to use the EOQ method as a reference for making decisions in determining the optimal number of orders. So Movick store orders stock according to need in order to minimize the total cost of inventory.

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