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Optimization of Furniture Raw Material Inventory Using the EOQ-Lagrange Multiplier Method

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Abstract

PT XYZ is a furniture company specializing in products made from wood and rattan. PT XYZ has sub-optimal problems in controlling raw material inventories, resulting in inventory cost overruns and warehouse overcapacity. This research aims to determine the optimization of the raw material in the inventory according to the available warehouse capacity using the Economic order quantity-Lagrange Multiplier method. From the research results, it was found that the total warehouse using the Lagrange Multiplier method was 107,922 m^3, which shows that this value is optimal because it does not exceed the capacity of the warehouse owned by PT XYZ, which is 108 m^3. By applying the Lagrange Multiplier method, it is possible to save total inventory costs of IDR 17.219.173 or 6.36% of the company's total inventory costs, with an order size of 37 m^3 for mindi wood and 26 m^3 for mahogany wood.

A. Introduction

Industry in the world has grown and developed rapidly along with its development, and competition between companies will become increasingly fierce, especially in various fields in various industries [1]. Companies must be able to develop strategies to survive, namely effective means of fulfilling consumer desires, which can be realized by establishing inventory control [2]. Good inventory management will ensure a production system runs smoothly and vice versa [3]. Inventory is the need for goods, including raw materials, semi-finished goods, and finished goods, which will be arranged and processed by the company according to needs to meet production needs well in stable and fluctuating market conditions [4]. Even though inventory is important, many companies compete to minimise or eliminate their inventory. This is because the costs incurred for inventory do not directly provide added value to the product [5].

Even though inventory does not add value to a product, it has a function. Inventory has an important function, such as balancing consumer demand with raw material supplies and the time required to procure supplies [6]. Having an inventory will avoid erratic price changes in the market and shortages of raw material stock and maintain a smooth production process so that it is not hampered [7]. Every company wants to procure the right inventory, so there is no increase in inventory costs, likewise. PT XYZ is a company that specializes in products made from wood and rattan, which are included in the furniture company. Of course, the manufacturing industry has problems. PT XYZ has recently experienced problems in the inventory sector. PT XYZ often buys excess raw materials from mahogany and mindi wood. Mahogany wood and mindi wood are the most widely used raw materials because of their affordable prices and lightweight nature, which will reduce shipping costs.

Excessive purchasing of raw materials will cause many problems if not resolved immediately. Based on data from the company, wood purchases and usage for one year, namely February 2023 to January 2024, resulted in Mindi wood purchases amounting to 1160,931 m^3, with a total usage of 1123,596 m^3, or 96.78% of the total wood purchases, leaving 37,335 m^3. Meanwhile, mahogany wood purchases for one year, namely February 2023 to January 2024, amounted to 472,787 m^3, and wood usage amounted to 445,0435 m^3, or around 94.1319% of the total wood purchases, leaving 27,744 m^3. PT XYZ also has limitations in its warehouses. PT XYZ's warehouse for storing mindi wood and mahogany wood measures 60 m^2 with a length of 10 meters and a width of 6 meters. This excess stock occurs at the end of each period, and the overstock condition always exceeds the existing warehouse capacity. This excess stock occurs at the end of each period, and this condition always exceeds the existing warehouse capacity. When there is excess stock, it will also affect the costs borne by storage. When the warehouse is full, the wood will be placed outside the warehouse, reducing the quality of the wood. Given this, it is necessary to plan optimal raw material supplies using the Lagrange Multiplier method.

The Economic Order Quantity (EOQ) with lagrange method is highly suitable for application in cases where there are constraints in inventory management [8]. The Lagrange method itself has been widely applied to various planning-related problems with constraints, including material planning with capacity constraints [9], [10], [11] and supply chain planning with cost and capacity constraints [12]. Therefore, this research proposes controlling inventory using warehouse capacity using the Lagrange Multiplier method at PT XYZ.

B. Research Method

1) Identification and Operational Definition of Variables

a. Dependent variable

The dependent variable is a result of the existence of the independent variable. Included in the dependent variable in this research is the optimal supply of raw materials at PT XYZ.

b. Independent Variable

Independent variables include influence variables, where this variable exists and will change other variables. The independent variables in this research are:

1. Need for Furniture Raw Materials (mahogany wood and mindi wood) during February 2023–January 2024.
2. Ending Inventory.
3. Inventory Costs (Order Costs and Holding Costs).
4. Price of Each Wood Material.
5. Warehouse Storage Capacity to Determine Warehouse Space Capacity Constraints for Raw Materials.
6. Safety Stock of Mindi Wood and Mahogany Wood.
7. Lead Time Data.
8. Order Size.

2) Problem Solving Steps

a. Variable Identification

Identify variables to find out what variables influence and are related to solving problems using the Lagrange Multiplier method.

b. Data collection

In the data collection process, researchers collect the data and information needed from the company to solve the problem being studied.

c. Calculation of Warehouse Capacity using the Company Method

At this stage, warehouse capacity is calculated using the company method. This is to determine whether the storage space has excess capacity..

d. Total Cost with Company Method (TCp)

After calculating the warehouse capacity using the company method, total costs (holding costs and ordering costs) are also calculated based on the warehouse capacity using the company method.

e. Calculation of Inventory Without Constraints Using the EOQ (Q*) Method

Calculate inventory without constraints using the EOQ method based on demand data, order cost data, and purchase price data to calculate the order size [13].

f. Calculate the Total Warehouse Space with EOQ.

   Calculate total warehouse space based on order size and calculation (Qi^*) using EOQ so that it can be seen in the latest capacity figures [14].

g. Calculations with Inventory Capacity Constraints using the Lagrange Multiplier Method

   Calculating inventory with constraints using the Lagrange multiplier method (Q_{Li}^*). After calculating the latest capacity with EOQ, calculate inventory with constraints using the proposed method. The number of orders can be found based on existing storage data, the latest total capacity using EOQ, and Q_i^* calculations using the EOQ method.

h. Calculation of Total New Storage Space using the Lagrange Multiplier Method.

   Based on warehouse capacity data and calculations (Q_{Li}^*) using the Lagrange Multiplier method, the total capacity of the new warehouse is calculated.

i. Calculation of Total Cost using the Lagrange Multiplier Method (TC Q_{Li}^*)

j. Comparison of Real Company Data with the Lagrange Multiplier Method.

   In this section, two conditions will be compared, namely looking at the condition of the company with the proposed method, namely the Lagrange Multiplier method. If the total cost of the company method is greater than the total cost of the Lagrange multiplier method, then there will be efficiency, and you can continue with the next process, namely plotting the data [15].

k. Forecasting

   Data plotting is the first step in forecasting calculations to determine what data patterns are studied to form data patterns. The data used is raw material purchase data from February 2023 to January 2024. After knowing the data pattern, the next step is to determine a forecasting method that matches the data pattern. Data calculations use a predetermined forecasting method that matches the data pattern. Next, an error test calculation will be carried out. The results of the smallest error test reflect a more accurate forecast because the error rate is small. At this stage, forecasting verification will be carried out, resulting from forecasting data from future purchases of furniture raw materials (mahogany and mindi wood), which are by the data obtained and will be used to determine purchase calculations in inventory control.

l. Results and Discussion

   The results of all calculations are then analyzed and discussed to find out the final results of solving the problem using the Lagrange Multiplier method.

3) Data Collection Methods

a. Primary Data

This data is data collected by researchers directly in the field. Primary data in this research was obtained through interviews, observation and documentation.

b. Secondary Data

Secondary data is data that comes from indirect sources or from the results of previous research that is related to the object being studied. Secondary data can be obtained by taking data from books, literature, or documents from the company, as well as other information related to the object under study.

C. Result and Discussion

1) Data Collection

Data on Furniture Raw Material Requirements can be seen in Table 1.

Table 1. Wood Material Needs Data (February 2023 - January 2024)

No.	Month	Mindi Wood (m^3)	Mahogany Wood (m^3)
1	February 2023	90.201	38.0656
2	March 2023	100.189	42.6054
3	April 2023	92.268	37.5747
4	May 2023	91.628	40.9817
5	June2023	92.406	37.9435
6	July 2023	94.995	39.3949
7	August 2023	101.113	37.3104
8	September 2023	91.673	38.4069
9	October2023	101.737	40.501
10	November 2023	91.914	38.4242
11	December 2023	102.047	39.4641
12	January 2024	110.761	42.1147
	Total	**1160,931**	**472,787**

Final Inventory data can be seen in Table 2.

Table 2. Final Inventory Data for Wood Materials

No.	Wood Materials	Ending Inventory (m^3)	Purchase Cost (m^3)	Final Product Residual Value (IDR)
1	Mindi Wood	58	IDR 2.806.504	IDR 162.777.232
2	Mahogany Wood	25	IDR 2.253.690	IDR 56.342.250
		Total		**IDR 219.119.482**

Inventory Costs can be seen in Table 3.

Table 3. Inventory Cost Data

No.	Type of Fee	Overall Cost	Description
1	Ordering Cost		
	a. Telephone Fee	IDR 200.000	Per Month
	b. Administration fee	IDR 500.000	Per Month
	c. Labour costs	IDR 4.300.000	Per Month
	Total Order Cost	IDR 5.000.000	Per Month
2	Holding Cost		
	Raw Material Storage Cost	5 %	Per Year
	Risk of damage	2 %	Per Year
	Total Holding Costs	7 %	Per Year

Unit price for the products can be seen below.

Table 4. Price of Each Wood Material

No.	Wood Materials	Purchase Cost (m^3)
1	Mindi Wood	IDR 2.806.504
2	Mahogany Wood	IDR 2.253.690

The warehouse is a temporary place to store raw materials before they enter the production section. However, warehouses certainly have limitations in accommodating these raw materials. PT XYZ has a warehouse for storing mindi and mahogany wood with an area of 60 m^2, which has a length of 10 meters and a width of 6 meters with a stacked wood pile height of 3 meters, resulting in a warehouse space volume of 180 m^3. Of the volume of warehouse space, 40% is used as an access road for laying wood, namely by using a forklift, so that the warehouse capacity for mindi wood and mahogany wood can accommodate around 108 m^3 of wood.

Table 5. Data on Wood Material Storage Media, Capacity, and Dimensions

No.	Wood Materials	Product Handling Media	Wood Capacity per Handling Media (m^3)	Product Storage Dimensions (w_i) (length x width x height) (m^3)
1	Mindi Wood	Wood Stick	4,6	1,5 x 1,5 x 3,5 = 7,88
2	Mahogany Wood	Wood Stick	4,6	1,5 x 1,5 x 3,5 = 7,88
	Wooden warehouse area			**108 m^3**

Safety Stock of Mindi Wood and Mahogany Wood can be seen below.

Table 6. Safety Stock

No.	Wood Materials	Safety Stock (m^3)
1	Mindi Wood	50
2	Mahogany Wood	30

Lead Time Data can be seen below.

Table 7. Lead Time

No.	Wood Materials	Lead Time
1	Mindi Wood	2 Weeks
2	Mahogany Wood	2 Weeks

Order Sizecan be seen below.

Table 8. Order Size of Each Wood Material

No.	Wood Materials	Order Size (m^3)
1	Mindi Wood	30
2	Mahogany Wood	35

2) Data Processing

A. Inventory Control Using Company Methods

Based on warehouse capacity data and order size data, the total warehouse inventory calculation is calculated using the following formula:

Total storage warehouse = $\sum_{i=1}^{n} w_i Q_i \leq W$ (1)

$7{,}88 \text{ x } \dfrac{30}{4.6} + 7{,}88 \text{ x } \dfrac{35}{4.6} \leq 108 \text{ m}^3$

$51{,}391 \text{ m}^3 + 59{,}957 \text{ m}^3 \leq 108 \text{ m}^3$

$111{,}348 \text{ m}^3 \leq 108 \text{ m}^3$

Based on the calculation above, the capacity obtained from the company method is 111,348 m^3, and this value is not optimal because it exceeds the existing capacity of PT XYZ, which is 108 m^3.

Calculation of Total Cost Company Method can be seen below.

a) Ordering Cost

Mindi Wood

Order Frequency $= \left(\frac{\text{Total Mindi Wood Needs per Year}}{\text{Order Size}}\right)$ (2)

$= \left(\frac{1160{,}931}{30}\right)$

$= 38{,}698 \approx 39$ times

Ordering Cost = Order Frequency x Order Cost (3)

= 39 x IDR 5.000.000

= IDR 195.000.000

Mahogany Wood

Order Frequency $= \left(\frac{472{,}782}{35}\right)$ (4)

$= 13{,}508 \approx 14$ times

Ordering Cost = 14 x IDR 5.000.000

= IDR 70.000.000

b) Holding Cost

Mindi Wood $= \left(\frac{Q}{2}\right)$ x (α x Purchase Price) (5)

$= \left(\frac{30}{2}\right)$ x (7% x IDR 2.806.504)

= IDR 2.946.829

Mahogany Wood $= \left(\frac{35}{2}\right)$ x (7% x IDR 2.253.690)

= IDR 2.760.770

c) Total Cost Company Method (TC_p)

TC_p = Ordering Cost + Holding Cost (6)

= IDR 195.000.000 + IDR 70.000.000 + IDR 2.946.829 + IDR 2.760.770

= IDR 270.707.599

B. Inventory Control using the Lagrange Multiplier Method

The EOQ (Q_i*) calculation will be calculated based on data on wood material requirements, inventory cost data, and purchase price data so that the order quantity can be calculated using the following formula:

$$Q^* = \sqrt{\frac{2 \text{ x } \mathrm{D_i} \text{ x } \mathrm{A_i}}{a \text{ x } \mathrm{C_i}}} \tag{7}$$

a) Mindi Wood $= \sqrt{\frac{2 \text{ x } 1160{,}931 \text{ x IDR } 5.000.000}{0{,}07 \text{ x IDR } 2.806.504}}$ = 243 m^3

b) Mahogany Wood $= \sqrt{\frac{2 \text{ x } 472{,}787 \text{ x IDR } 5.000.000}{0{,}07 \text{ x IDR } 2.253.690}}$ = 173 m^3

Based on existing warehouse capacity data and calculations using the EOQ (Q^i*) method, the total new storage space is calculated using the Economic Order Quantity (EOQ) method with:

$$\sum_{i=1}^{n} w_i Q_i^{\,*} \leq W \tag{8}$$

$$7{,}88 \text{ x } \frac{243}{4{,}6} + 7{,}88 \text{ x } \frac{173}{4{,}6} \leq 108 \text{ m}^3$$

$$416{,}270 \text{ m}^3 + 296{,}357 \text{ m}^3 \leq 108 \text{ m}^3$$

$$712{,}626 \text{ m}^3 \leq 108 \text{ m}^3$$

Based on the calculations above, the total new storage (warehouse) space is 712,626 m^3. These results are still not optimal because the order placed exceeds the warehouse capacity owned by PT XYZ, which is 108 m^3, so the settlement will continue using the Lagrange Multiplier method.

Inventory calculations using the Lagrange Multiplier method can calculate the optimal production volume (Q_{Li}*) as follows:

$$\mathrm{Q}_{\mathrm{Li}}^* = \left(\frac{W}{E}\right) \text{ x } \mathrm{Q}_{\mathrm{i}}^* \tag{9}$$

Mindi Wood $= \left(\frac{108}{712{,}626}\right) \text{ x } 243$ = 37 m^3

Mahogany Wood $= \left(\frac{108}{712{,}626}\right) \text{ x } 173$ = 26 m^3

Based on the results of inventory calculations using the Lagrange Multiplier (Q_{Li}*) method above and warehouse capacity data, the total new warehouse inventory can be calculated using equation 8 as follows:

$$7{,}88 \text{ x } \frac{37}{4{,}6} + 7{,}88 \text{ x } \frac{26}{4{,}6} \leq 108 \text{ m}^3$$

$$63{,}383 \text{ m}^3 + 44{,}539 \text{ m}^3 \leq 108 \text{ m}^3$$

$$107{,}922 \text{ m}^3 \leq 108 \text{ m}^3$$

Based on the calculations above, the total new storage (warehouse) space obtained using the Lagrange Multiplier method is 107,922 m^3. These results show optimal values because the orders made do not exceed the warehouse capacity owned by PT XYZ, which is 108 m^3, so there is no excess capacity in the mindi wood and mahogany wood material warehouses.

C. Calculation of Total Cost Using the Lagrange Multiplier Method

Total cost using the Lagrange Multiplier method (TC_2):

$$TC_2 = \sum_{i=1}^{n}\left(\frac{A_i.D_i}{{Q_{Li}}^*}\right) + \sum_{i=1}^{n}\left(\frac{{Q_{Li}}^*.C_i.\alpha}{2}\right) \tag{10}$$

$$= \left(\begin{array}{c}\left(\frac{\text{IDR 5.000.000 x 1160,931}}{37}\right) + \left(\frac{\text{37 x IDR 2.806.504 x 0.07}}{2}\right) \\ + \left(\frac{\text{IDR 5.000.000 x 472,787}}{26}\right) + \left(\frac{\text{26 x IDR 2.253.690 x 0.07}}{2}\right)\end{array}\right)$$

= (IDR 156.882.568) + (IDR 3.634.423) + (IDR 90.920.577) + (IDR 2.050.858)

= IDR 253.488.426

D. Comparison of Total Inventory Costs

After knowing the inventory costs from both methods, the obtained inventory costs can be compared with the proposed method based on the Lagrange Multiplier method. The table below shows a comparison between the total inventory costs of the company and the results obtained from the Lagrange Multiplier method as follows:

Table 9. Comparison of Total Company Inventory Costs with the Lagrange Multiplier Method

Company Method	Lagrange Multiplier Method
IDR 270.707.599	IDR 253.488.426

From the Table 9, it can be concluded that the total inventory costs obtained using the Lagrange Multiplier method are smaller than the company's total costs, namely IDR 17.219.173. So, it can be concluded that the Lagrange Multiplier method can provide the best solution with the total saving 6,36%, with the total inventory costs obtained being smaller than the total inventory costs in the company.

E. Inventory Planning using the Lagrange Multiplier Method for the Period February 2024 – January 2025

The first step in planning production using the Lagrange Multiplier method is forecasting the need for raw materials, such as mindi wood and mahogany. Therefore, to carry out forecasting, data plots will be carried out to determine existing data patterns. The data processed is the company's historical data on material needs for mindi wood and mahogany wood from February 2023 to January 2024. The following is a historical plot image for each wood material:

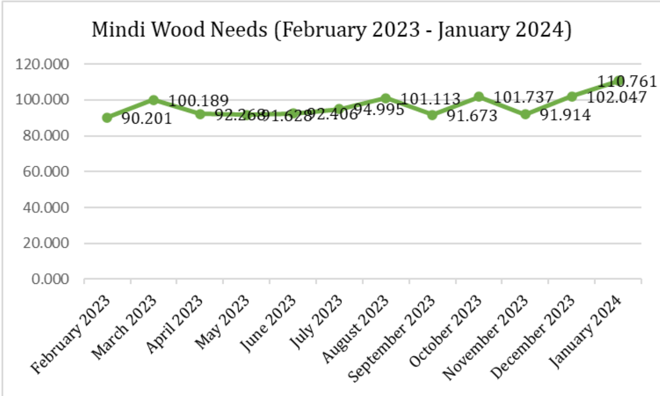

Figure1. Data's Plot Mindi Wood Needs

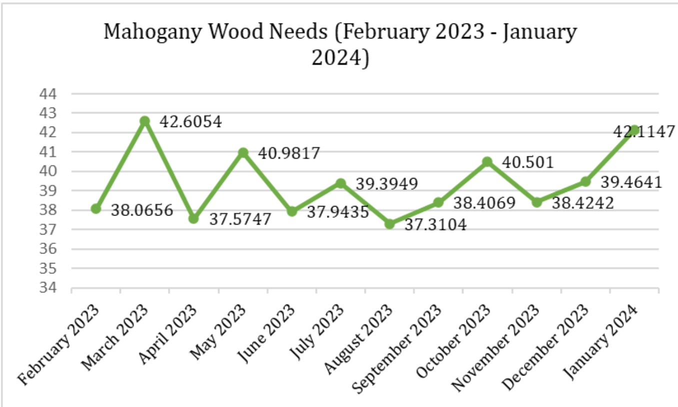

Figure2. Data's Plot Mahogany Wood Needs

After plotting historical data regarding the need for mindi wood and mahogany wood, it can be seen that the need for wood during the period February 2023 to January 2024 is included in the seasonal data pattern. So, the forecasting method that suits seasonal data patterns is:

a) Moving Average Method.
b) Single Exponential Smoothing Method.
c) Double Exponential Smoothing Method.
d) Winter

Table 10. Comparison of MSE Values for Each Forecasting Method

Wood Type	**Moving Average Method (3 months)**	**SES Method ($\alpha = 0,28$)**	**DES Method ($\alpha = 0,1$ dan $\beta = 0,1$)**
Mindi Wood	41,7833	38,3002	26,9551
Mahogany Wood	2,7896	3,68478	3,20265
Wood Type	Winter Method ($\alpha = 0{,}1, \beta = 0{,}5, \& \gamma = 0{,}9$)	Winter Method ($\alpha = 0{,}5, \beta = 0{,}1, \& \gamma = 0{,}9$)	Winter Method ($\alpha = 0{,}9, \beta = 0{,}1, \& \gamma = 0{,}5$)
Mindi Wood	8,79659	2,62035	1,72386
Mahogany Wood	0,035100	0,010834	0,007267

Based on the comparison above, the smallest MSE value is found in the Winter forecasting method with $\alpha = 0{,}1, \beta = 0{,}1$, and $\gamma = 0{,}5$. So, the Winter forecasting method was chosen to predict the need for both mindi wood and mahogany wood from February 2024 to January 2025.

The MRC test will be performed when the least MSE value has been determined using the aforementioned predicting procedure. This is done to assess whether the need for wood material can be controlled using the forecasting approach. Here is a verification of predictions for all raw materials:
Mindi Wood

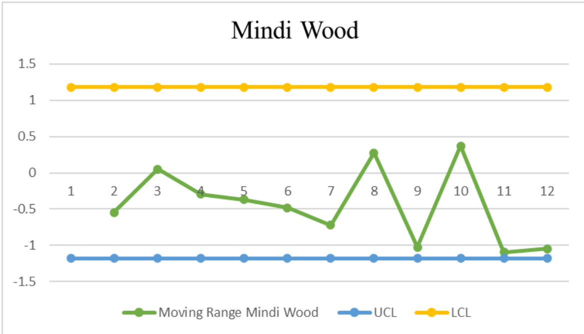

Figure3. Moving Range Chart for Mindi Wood

Based on the Mindi Wood MRC Test, the estimated needs are within control limits. The UCL value is -1,18 and the LCL is +1,18 with a moving range value of -0,55; 0,05; -0,30; -0,37; -0,48; -0,72; 0,27; -1,02; 0,37; -1,09; -1,05. So, all the data is under control.
Mahogany Wood

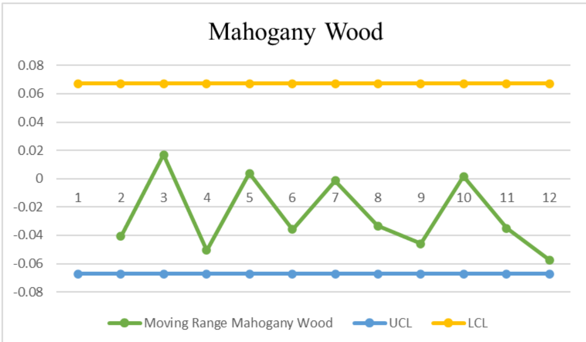

Figure4. Moving Range Chart for Mahogany Wood

Based on the MRC Mahogany Wood Test, the estimated needs are within control limits. The UCL value -0.07 and the LCL +0.07 with moving range value -0.04; 0.02; -0.05; 0.00; -0.04; 0.00; -0.03; -0.05; 0.00; -0.03; -0.06. So, all the data is under control. After the MRC test, a forecast of the respective needs for Mindi and Mahogany wood in the period February 2024 to January 2025 was obtained, namely:

Table 11. Forecasting the Need for Wood Materials (February 2024 - January 2025)

No.	Month	Mindi Wood (m^3)	Mahogany Wood (m^3)
1	February 2024	94.205	38.341
2	March 2024	104.739	42.921
3	April 2024	96.767	37.873
4	May 2024	96.424	41.331
5	June2024	97.574	38.289
6	July 2024	100.645	39.776
7	August 2024	107.484	37.693
8	September 2024	97.77	38.823
9	October2024	108.858	40.963
10	November 2024	98.664	38.884
11	December 2024	109.891	39.959
12	January 2025	119.652	42.667
	Total	**1232,673**	**477,521**

F. Inventory Control using the Lagrange Multiplier Method (February 2024 – January 2025)

The EOQ (Q_i*) calculation will be calculated based on data on wood material requirements, inventory cost data, and purchase price data so that the order quantity can be calculated using the following formula:

$$Q^* = \sqrt{\frac{2 \text{ x } D_i \text{ x } A_i}{a \text{ x } C_i}}$$

Mindi Wood $= \sqrt{\frac{2 \text{ x } 1232{,}673 \text{ x Rp } 5.000.000}{0{,}07 \text{ x Rp } 2.806.504}} = 250 \text{ m}^3$

Mahogany Wood $= \sqrt{\frac{2 \text{ x } 477{,}521 \text{ x Rp } 5.000.000}{0{,}07 \text{ x Rp } 2.253.690}} = 174 \text{ m}^3$

Based on existing warehouse capacity data and calculations using the EOQ (Q^i*) method, the total new storage space is calculated using the Economic Order Quantity (EOQ) method with:

$$7{,}88 \text{ x } \frac{250}{4{,}6} + 7{,}88 \text{ x } \frac{174}{4{,}6} \leq 108 \text{ m}^3$$
$$428{,}261 \text{ m}^3 + 298{,}070 \text{ m}^3 \leq 108 \text{ m}^3$$
$$726{,}331 \text{ m}^3 \leq 108 \text{ m}^3$$

Based on the calculations above, the total new storage (warehouse) space is 726,331 m^3. These results are still not optimal because the order placed exceeds the warehouse capacity owned by PT XYZ, which is 108 m^3, so the settlement will continue using the Lagrange Multiplier method.

Inventory calculations using the Lagrange Multiplier method can calculate the optimal production volume (Q_{Li}*) using equation 8 as follows:

a) Mindi Wood $= \left(\frac{108}{726{,}331}\right) \text{ x } 250 = 37 \text{ m}^3$

b) Mahogany Wood $= \left(\frac{108}{726{,}331}\right) \text{ x } 174 = 26 \text{ m}^3$

Based on the results of inventory calculations using the Lagrange Multiplier (Q_{Li}*) method above and warehouse capacity data, the total new warehouse inventory can be calculated Q_{Li}* using equation 8 as follows:

$$7{,}88 \text{ x } \frac{37}{4{,}6} + 7{,}88 \text{ x } \frac{26}{4{,}6} \leq 108 \text{ m}^3$$

$$63{,}383 \text{ m}^3 + 44{,}539 \text{ m}^3 \leq 108 \text{ m}^3$$

$$107{,}922 \text{ m}^3 \leq 108 \text{ m}^3$$

Based on the calculations above, the total new storage (warehouse) space obtained using the Lagrange Multiplier method is 107,922 m^3. These results show optimal values because the orders made do not exceed the warehouse capacity owned by PT XYZ, which is 108 m^3, so there is no excess capacity in the mindi wood and mahogany wood material warehouses.

1. Calculation of Total Cost Using the Lagrange Multiplier Method

Total cost from the Lagrange Multiplier method (TC_2) using equation 10.

$$= \left(\begin{array}{l} \left(\frac{\text{IDR } 5.000.000 \text{ x } 1232{,}673}{37}\right) + \left(\frac{37 \text{ x IDR } 2.806.504 \text{ x } 0.07}{2}\right) \\ + \left(\frac{\text{IDR } 5.000.000 \text{ x } 477{,}521}{26}\right) + \left(\frac{26 \text{ x IDR } 2.253.690 \text{ x } 0.07}{2}\right) \end{array} \right)$$

= (IDR 166.577.432) + (IDR 3.634.423) + (IDR 91.830.962) + (IDR 2.050.858)

= IDR 264.093.675

Based on the results of the calculation above, namely calculating the total cost (total inventory costs), which was calculated using the Lagrange Multiplier method, the result was IDR 264.093.675.

D. Conclusion

The calculation of storage space using the Lagrange Multiplier method resulted in a result of 107,922 m^3. These results show the optimal value because the orders made do not exceed the warehouse capacity of PT XYZ, which is 108 m^3. The total cost (total inventory costs) calculated using the Lagrange Multiplier method resulted in IDR 253.488.426 with an order size for mindi wood of 37 m^3 and mahogany wood of 26 m^3.

The total cost (total inventory costs) calculated using the Lagrange Multiplier method produces a result of IDR 253.488.426. Compared to the company method with a total cost of IDR 270.707.599, the Lagrange Multiplier method can provide the best solution, and the total inventory costs obtained are smaller than the company's total costs, namely IDR 17.219.173 or a savings of 6,36%.

E. References

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