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Analysis of Carpet Orders to Suppliers at PT Distributor Karpel Bandung (dkb) Using Probabilistic Economic Order Quantity

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Abstract: PT Distributor Karpel Bandung (DKB) is a distribution services company that sells Eva Carpets in the city of Bandung. DKB purchased Eva Carpets from Suppliers in Jakarta. The number of Eva Carpet purchases in 2023 will be as much as Eva Carpet sales in 2023 will be 106,614 units, 107,000 units. The initial inventory in 2023 will be 500 units. There is excess inventory of 886 units. The author conducted research with the title "Analysis of Carpet Orders to Suppliers at PT Distributor Kartpet Bandung (DKB) Using the Probabilistic EOQ Method". The author analyzed Eva Carpet purchase orders using the Probabilistic EOQ Method by forecasting sales numbers from January 2024 to December 2024 using the linear regression method. The research results explain that the number of Eva Carpet sales calculated using the linear regression method for 2024 is 106,617 units. 3 more units than actual sales in 2023. The calculation result of the number of units purchased for each order using the Economic Order Quantity method is 38,727 units. Inventory costs before using EOQ are IDR 177,263,700. Costs after using EOQ are IDR 63,032,850. Inventory Cost Savings amounting to IDR 114,230,858. It is best for DKB to plan Eva Carpet purchase orders using the Probabilistic EOQ method.

Keyword: Eva plastics carpet, Probabilistic EOQ, Linear Regression

INTRODUCTION

Carpet Distributor (DKB) is one of the distributor companies selling Eva brand plastic carpets in the city of Bandung. The number of Eva brand carpet sales in DKB is presented in Table 1.

Table 1. Eva Carpet Sales in 2023

No	Month	Initial Inventory	Purchase Supplier	Sales To Customers	Ending Inventory
1	Jan-23	500	11.000	10.500	1.000
2	Feb-23	1.000	7.500	8.100	400

3	Mar-23	400	10.000	10.062	338
4	Apr-23	338	9.000	8.950	388
5	May-23	388	10.000	9.800	588
6	Jun-23	588	5.000	5.000	588
7	Jul-23	588	11.000	10.900	688
8	Aug-23	688	6.000	6.100	588
9	Sep-23	588	7.000	6.900	688
10	Oct-23	688	10.000	9.930	758
11	Nov-23	758	9.000	8.300	1.458
12	Dec-23	1.458	11.500	12.072	886
Jumlah			107.000	106.614	886

Source : DKB (2023)

At the end of December 2023, the number of Eva carpets at DKB should be at least nil, the amount of inventory is the same as at the beginning of the year. In reality, the amount of inventory at the end of 2023 will be 886 units. The excess inventory is 336 units from the end of 2022 inventory. This information shows that there is a problem related to the Eva carpet purchase order from DKB to the Carpet Supplier. The price of 1 (one) carpet is IDR 50,000. Excess inventory of 886 units results in a waste of money purchasing inventory of 886 units x IDR 50,000 equals IDR 44,300,000. The problem of excess inventory gives rise to wasted costs. Wasted costs give rise to the problem of reduced DKB profits. In connection with DKB, it is necessary to look for a carpet purchase ordering method that can appropriately reduce the amount of inventory purchases, reduce purchasing costs, increase DKB profits. DKB leadership is having difficulty determining what method to assign the number of carpet orders to suppliers that reduces costs. The EOQ Probability can be used to determine the amount of rice ordered at Bulog Solok provided that the amount of rice ordered by the public is not fixed (the amount changes). (Akbar,2023)¹. The EOQ method can be used to determine the optimal number of soybean orders at XYZ MSMEs provided that the amount of soybeans purchased by XYZ MSME customers changes(Wildan,2023)²

. Paying attention to the changing number of Eva carpets purchased by customers, and referring to the opinions of Weno Akbar (2023) and Wildan (2023), the author conducted research with the title "

"ANALYSIS OF CARPET ORDERS TO SUPPLIERS AT PT DISTRIBUTOR CARPET BANDUNG (DKB) USING PROBABILISTIC EOQ".

Research determines the problem formulation:

- What are the steps for determining the optimal number of Eva carpet orders by DKB using the Probabilistic EOQ method?
- How many carpets are ordered per order using the Probabilistic EOQ method?

¹ .Akbar, (2023),Penerapan Metode EOQ Probabilistik Dalam Pengendalian Persediaan Beras Perum Bulog Kantor Cabang Solok, Jurnal Pendidikan Tambusi,Vol 7 No 3,2023. <https://jptam.org/index.php/jptam/10912>.

² . Wildan, (2023),Penerapan Metode EOQ Probabilistik Untuk Pengendalian Persediaan Biji Kedelai di UMKM XYZ, GTech : Jurnal Teknologi Terapan, Vol 7 no 3 ,2023. <https://ejournal.uniramalang.ac.id/index.php/g-tech/article/view/2895/1943>

- c. How much inventory cost reduction can DKB save if using the Probabilistic EOQ method?

The author conducted research with the aim of finding out and analyzing:

- a. Stages of determining the optimal number of Eva carpet orders by DKB using the Probabilistic EOQ method.
- b. The number of carpets ordered in each order uses the Probabilistic EOQ method
- c. How much inventory cost reduction can DKB save if using the Probabilistic EOQ method.

METHOD

This research uses quantitative methods because the data collected is in the form of numbers. The author conducted research on the Probabilistic EOQ method. The Economic Order Quantity (EOQ) probabilistic model is a method of determining the number of orders for purchasing goods from factories to suppliers, the amount of which is determined based on the number of customer requests which vary from one time to another (Susanto,2023)³. The Probabilistic EOQ with research stages of data collection, data processing, discussion. Data collection begins with collecting product sales data in 2023. Data processing starts from forecasting sales of Eva carpet products from January 2024 to December 2024 using Multiple Linear Regression, determining the number of Eva carpet sales in 2024. Determining the number of Eva carpet orders using the EOQ method, number of uses during lead time, Probability during lead time, Safety Stock, Reorder Point, Probabilistic EOQ, Frequency, Inventory Costs After Using the Probabilistic EOQ Method.

The discussion is carried out by comparing inventory costs before using EOQ and after using EOQ.

RESULTS AND DISCUSSION

The author has conducted research on the use of the Probabilistic EOQ method in determining the number of Eva carpet products in DKB in 2024 using the Probabilistic EOQ method, the results of which are presented in the subject of data collection, data processing, discussion. The information in table 1 explains that the number of Eva carpet sales during 2023 will be 106,614 units. The cost of ordering to purchase Eva carpets at DKB consists of the cost of buying credit for communication of IDR 1,000, and the cost of transporting Eva carpets from the Supplier to DKB is IDR 1,000,000 per delivery. So the ordering fee is IDR 1,000 + IDR 1,000,000 = IDR 1,001,000. Eva Carpet Storage costs consist of the cost of paying the guard IDR 3,750,000 per month, building rental costs IDR 10,000,000 per month. Total Carpet Storage Costs for 1 month = IDR 3,750,000 + IDR 10,000,000 = IDR 13,750,000 per month. Carpet storage costs for 1 year = 12 x IDR 13,750,000 = IDR 165,000,000. Number of Carpets stored in 2023 = 106,614 units. Storage Costs for 1 Unit of Carpet = IDR 165,000,000 : 106,614 = IDR 1,547.63. Rounded up to IDR 1,550. The price of Eva Carpet from the Supplier is IDR 50,000. DKB bought Eva Carpet from another supplier for IDR 51,000. There is a difference of IDR 51,000 - IDR 50,000 = IDR 1,000. The lead time required from ordering goods until the goods arrive is 3 (three) days. The number of working days determined by the DKB for one year is 300 working days.

Table 2. Sales During Lead Time

No	Month	Sales Customers	To	Working Days	Sales Per Day	Lead Time	Number of Sales During Lead Time
1	Jan-23	10.500		25	420	3	1.260

³ . Susanto (2023), Perencanaan dan Pengendalian Produksi, Bandung, Alfabeta

2	Feb-23	8.100	25	324	3	972
3	Mar-23	10.062	25	402	3	1.207
4	Apr-23	8.950	25	358	3	1.074
5	May-23	9.800	25	392	3	1.176
6	Jun-23	5.000	25	200	3	600
7	Jul-23	10.900	25	436	3	1.308
8	Aug-23	6.100	25	244	3	732
9	Sep-23	6.900	25	276	3	828
10	Oct-23	9.930	25	397	3	1.192
11	Nov-23	8.300	25	332	3	996
12	Dec-23	12.072	25	483	3	1.449
Jumlah		106.614	886	4.265	3	12.794

Source : DKB (2024)

Forecasting the number of Eva Carpet Sales in 2024 using the Linear Regression method.

Table 3. Linier Regression Equation

No	Month	X	Penjualan (Y)	X Kuadrat	XY
1	Jan-23	1	10.500	1	10.500
2	Feb-23	2	8.100	4	16.200
3	Mar-23	3	10.062	9	30.186
4	Apr-23	4	8.950	16	35.800
5	May-23	5	9.800	25	49.000
6	Jun-23	6	5.000	36	30.000
7	Jul-23	7	10.900	49	76.300
8	Aug-23	8	6.100	64	48.800
9	Sep-23	9	6.900	81	62.100
10	Oct-23	10	9.930	100	99.300
11	Nov-23	11	8.300	121	91.300
12	Dec-23	12	12.072	144	144.864
Jumlah		78	106.614	650	694.350

Source: Author's Calculation (2024).

Eva Carpet Sales Forecasting uses the formula:

$$Y = a + bX$$

Information :

Y= Number of Sales in the 3rd Month....

a = Constant .

b = Regression Coefficient.

The b value is obtained by calculating:

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum X^2) - (\sum x)^2}$$

$$b = \frac{[12(694,350) - (78)(106,614)]}{[12(650) - (78 \times 78)]}$$

$$b = (8,332,200-8,315,892) : (7,800-6,084)$$

$$b = 16.308 : 1.716$$

$$b = 9.50$$

The value of a is obtained by calculating:

$$(\sum y - b\sum x) : n$$

$$a = [106.614 - (9.50 \times 78)] : 12$$

$$a = (106.614 - 741.) : 12$$

$$a = 105.873 : 12$$

$$a = 8,822.75 \text{ rounded to } 8,823 \text{ units}$$

The linear regression equation for forecasting Eva Carpet products for February 2022 to February 2023 is as follows:

$$Y = a + bX$$

$$Y = 8.823 + 9.50$$

The forecasting results for 2023 are presented in Table 4. With a detailed explanation of the sales numbers for January 2023 – December 2023 as follows: January 2023 was 8,833, February 2023 8,842, March 2023 was 8,852, April 2023 was 8,861. May 2023 amounting to 8,871. June 2023 amounting to 8,886. July 2023 amounting to 8,890. August 2023 amounting to 8,899. September 2023 is 8,909. October 2023 8,918. November 2023 8,928. December as many as 8,913. The total forecast sales for Eva Carpets from January 2023 to December 2023 is 106,617 units. The predicted number of Eva carpet sales in 2023 is 3 units more than the actual number of Eva carpet sales in 2023.

Eva product sales forecasting results from January 2023 to December 2023 are presented in Table 4.

Table 4 Sales Forecasting 2023

No	Month	Sales	a	b	X	Sales Forecasting
1	Jan-23	10.500	8.823	9,5	1	8.833
2	Feb-23	8.100	8.823	9,5	2	8.842
3	Mar-23	10.062	8.823	9,5	3	8.852
4	Apr-23	8.950	8.823	9,5	4	8.861
5	May-23	9.800	8.823	9,5	5	8.871
6	Jun-23	5.000	8.823	9,5	6	8.880
7	Jul-23	10.900	8.823	9,5	7	8.890
8	Aug-23	6.100	8.823	9,5	8	8.899
9	Sep-23	6.900	8.823	9,5	9	8.909
10	Oct-23	9.930	8.823	9,5	10	8.918
11	Nov-23	8.300	8.823	9,5	11	8.928
12	Dec-23	12.072	8.823	9,5	12	8.937
Jumlah		106.614				106.617

Source : Author’s Calculation Results(2024)

The number of Eva Carpets estimated to be sold during January 2023 to December 2023 is 106,617 units, while the actual sales data from January 2023 to December 2023 is 106,014. This forecast is only 3 units more than actual sales.

The author continues forecasting Eva Carpet sales from January 2024 to December 2024. The results are presented in Table 5.

Table 5.Sales Forecasting 2024

No	Month	Sales	a	b	X	Sales Forecasting
1	Jan-24		8.823	9,5	13	8.947
2	Feb-24		8.823	9,5	14	8.956
3	Mar-24		8.823	9,5	15	8.966
4	Apr-24		8.823	9,5	16	8.975
5	May-24		8.823	9,5	17	8.985
6	Jun-24		8.823	9,5	18	8.994
7	Jul-24		8.823	9,5	19	9.004
8	Aug-24		8.823	9,5	20	9.013
9	Sep-24		8.823	9,5	21	9.023
10	Oct-24		8.823	9,5	22	9.032
11	Nov-24		8.823	9,5	23	9.042
12	Dec-24		8.823	9,5	24	9.051
Jumlah						107.985

Source : Results Of The Author’s Calculations (2024)

The author sets the number of Eva Carpet sales in 2024 at 107,985 units

The author determines the most economical order for Eva Carpets using the EOQ (Economic Order Quantity) method without probabilistics. Eva Carpet's Probabilistic Non-Probabilistic EOQ Formula is: $\sqrt{(2 DS): H}$

Information :

EOQ = Most Economical Number of Orders.

D = Total demand = 107,985 units

S = Order Cost = IDR 1,001,000

H = Storage Cost = IDR 1,550

EOQ = $\sqrt{(2 \times 107,985 \times \text{IDR } 1,001,000): \text{IDR } 1,550}$

EOQ = $\sqrt{139,474,819}$

EOQ = 11,810.unit.

Number of Eva carpet sales during lead time shows in Table 6.

Table 6.Sales During LeadTime

No	Month	Sales Customers	To Working Days	Sales Per Day	Lead Time	Number of Sales During Lead Time
1	Jan-23	10.500	25	420	3	1.260
2	Feb-23	8.100	25	324	3	972
3	Mar-23	10.062	25	402	3	1.207
4	Apr-23	8.950	25	358	3	1.074
5	May-23	9.800	25	392	3	1.176
6	Jun-23	5.000	25	200	3	600
7	Jul-23	10.900	25	436	3	1.308
8	Aug-23	6.100	25	244	3	732
9	Sep-23	6.900	25	276	3	828
10	Oct-23	9.930	25	397	3	1.192
11	Nov-23	8.300	25	332	3	996
12	Dec-23	12.072	25	483	3	1.449

Jumlah	106.614	886	4.265	3	12.794
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Source : Results Of The Author’s Calculations (2024)

The number of Eva Carpet sales during the 12 (twelve) lead times was 12,794. The average sales of Eva Carpets during 1 (one) lead time is = $12,794 : 12 = 1,066.16$ rounded . Probability of Eva Carpet Sales During Lead Time is explained as follow

Number of Classes (K) = $1 + 3.3 \log n$

Number of Classes (K) = $1 + 3.3 \log 12 = 1 + 3.56 = 4.56$ rounded to 5 Classes.

Range (R) is calculated from the highest value – the lowest value.

Range (R) = $1,440 - 600 = 849$.

Interval = R : K = $849 : 5 = 169.8$ rounded to 170

Sales Probability During Lead Time is explained in Table 7

Table 7.Sales Probability During Lead Time

Sales During Lead Time	Frequency	Probability
600- 770	2	0,17
771- 940	1	0,08
941-1.110	2	0,17
1.111-1.280	4	0,33
1.280-1.450	3	0,25
Total	12	1,00

Source : Results Of The Author’s Calculations (2024)

Average number of Eva Carpet sales during lead time = 1,067. Average sales of 1,067 are between 941-1,110 with sales frequency = 2 times. The probability of sales during the lead time of 23 units with a frequency of 5 times is 0.17 or 17%.The author calculates the Safety Stock (SS) value using the formula:

$SS = Stdev \times Z$

Information :

SS = Safety Stock.

Stdev = Standard Deviation.

Z = Confidence Value

The author uses the Excel application to determine the standard deviation of total sales during 2023. The method is =STDEV.P(first row: twelfth row). The result is the Standard Deviation value = 1.998.The Z value for a 5% error rate or 95% confidence value is 1.65. The total Safety Stock value is equal to the standard deviation value multiplied by Z. Z is the confidence value.

$SS = Stdev \times Z$

$SS = 1.998 \times 1.65$

$SS = 3.29$ rounded to 3.

Total sales from January 2023- December 2023 = 106,617 units. Number of working days = 300 working days. Average sales amount per day = $106.617 \text{ units} : 300 \text{ working days} = 355.39 \text{ units/working day}$. Lead time = 3 working days. Sales during lead time were = $3 \times 1,066 = 3,198.51 \text{ units}$ rounded up to 3.199 units.

Reorder Point is 3.199 unit

The Economical Order Quantity can be calculated using the formula: Optimal Q : $\sqrt{2 [D (S+BK) X (SP-Ki) X Ki] : [H]}$.

Information :

D= needs January 2024- December 2024= 106,617 S=Order Cost = Rp. 1.001.000 H= Holding Cost = 1.550, BK = Running out Cost = Rp. 1.000, Lead Time = 1.066. Sp (Reorder Point) = 3.199. H = Storage Cost = IDR 1.550

The Economical Order Quantity can be calculated using the formula: Optimal Q : $\sqrt{2[D (S+BK) X (SP-Ki) X Ki] : [H]}$ = 38.727 units. The number of Eva Carpets estimated to be sold in 2024 is 106,617 units. The number of Eva Carpet Purchases from Suppliers per order is 38,727 units. So the frequency of orders in 1 year is 106,617: 38,727 = 2.75 times rounded up to 3 (three) orders. Total ordering costs = IDR 1,002,000 x 3 = IDR 3,006,000. Storage costs = IDR 38,727 x IDR 1,550 = IDR 60,020,000. Inventory Costs = IDR 3,006,000+ IDR 60,020,000 = IDR 63,026,000. Inventory costs before using EOQ consist of ordering costs of 12 x IDR 1,001,000 = IDR 12,012,000. Storage costs = 106,614 x IDR 1,550 = IDR 165,251,700. Total Inventory Costs = IDR 12,012,000 + IDR 165,251,700 = IDR 177,263,700. Inventory costs after using the EOQ method are ordering costs of 3 X IDR 1,002,000 = IDR 3,006,000. Storage costs of 38,727 x Rp 1550= Rp 60.0. 26,850. Inventory Costs = IDR 3,006,000 + IDR 60,026,850 = IDR 63,032,850. The author provides recommendations that it is best to plan the number of Eva carpet orders in one order using the probabilistic EOQ method because it has been proven to provide cost savings of IDR 177,263,700 - IDR 63,032,850 = IDR 114,230,858

CONCLUSION

The author determines the following conclusions:

- a. Probabilistic EOQ with research stages of data collection, data processing, discussion. Data collection begins with collecting product sales data in 2023. Data processing starts from forecasting sales of Eva carpet products from January 2024 to December 2024 using Multiple Linear Regression, determining the number of Eva carpet sales in 2024. Determining the number of Eva carpet orders using the EOQ method, number of uses during lead time, Probability during lead time, Safety Stock, Reorder Point, Probabilistic EOQ, Frequency, Inventory Costs After Using the Probabilistic EOQ Method. The discussion is carried out by comparing inventory costs before using EOQ and after using EOQ.
- b. The optimal number of carpets purchased per order according to the Probabilistic EOQ method is 38,727 units
- c. Inventory Costs before using Probabilistic EOQ = IDR R 177,263,700. Inventory costs after using the Probabilistic EOQ method are IDR 63,032,850. the probabilistic EOQ method provide cost savings of IDR 177,263,700 - IDR 63,032,850 = IDR 114,230,858

The author recommends that when ordering Eva carpets, DKB recommends that in every time you order an Eva carpet purchase, the number of Eva carpets to be purchased is determined using Probabilistic EOQ because it provides benefits in the form of reduced inventory costs.

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