Optimization Of Bread Distribution Transportation Costs At Ud Bakery Garden Using The Mdma Method (Maximum Divide Minimum Alloment)

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A B S T R A C T

This study aims to optimize distribution transportation costs using a transportation model. The transportation model is a model that aims to determine the number of goods that must be sent from source to destination so that total transportation costs can be optimized. The transportation model used in this study is the Maximum Divide Minimum Aloment (MDMA) method. Data collection is in progress using Maximum Divide Minimum Aloment (MDMA), namely data on fixed costs, variable costs, demand and capacity of goods. The results of optimization research using the Maximum Divide Minimum Aloment (MDMA) method were obtained at Rp. 24,541,890 and has a difference with the costs incurred by the company of Rp. 3,449,660. Therefore, the MDMA (Maximum Divide Minimum Aloment) method can solve problems or can be used to minimize transportation costs.

Keywords:

Distribution, Transportation, Maximum Divide Minimum Aloment (MDMA)

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1. INTRODUCTION

Operational Research or often abbreviated as Operations Research is an English language, namely "Operation Research" which has various meanings for people with different interests and scientific backgrounds. According to Dedy in [1] the science of operations research is widely used and determined by humans in everyday life, especially in the economic field, namely in the business field. In business activities, production must continue in order to meet market demand. While the definition of Operations Research (Management Science) is the application of scientific methods, techniques and equipment in dealing with problems that arise in the company's operations with the aim of finding alternative solutions to optimal problems. The value of optimization in operations research that functions for the purpose of minimizing and maximizing a problem. One of the discussions that covers the issue is linear programming.

Linear Programming (LP) or linear programming is one of the techniques that can assist in making optimal decisions on the allocation of scarce and limited resources. The mathematical model used to solve optimization problems, namely maximizing or minimizing the objective function that depends on a number of decision variables is called a linear program [1], [2]Linear programming can be applied in real life, namely in the field of production and distribution of goods.[3]

Distribution is a process of delivering goods or services from producers to consumers and users, when and where the goods or services are needed,[4]. In today's era, the implementation of the right strategy is an important part of maintaining an increasingly fierce and broad competition. When distributing products, there are many aspects that must be considered, including transportation facilities, employees, transportation costs. Distribution problems are often related to transportation problems, therefore the company must further improve the strategy to minimize the transportation costs used in order to avoid losses to the company. This can be overcome by applying a transportation model method.[5]

The transportation model is a variation of the linear program. This model is specifically designed to solve problems related to the distribution of a commodity or resource originating from production centers to various specific destinations. In calculating the distribution optimization of the transportation method, several methods can be used, including the simplex method, Stepping Stone, Vogel's Approximation Method (VAM), Least Cost Method (LCM), North West Corner (NWC).[6] In the development of science, he saw the emergence of various new methods with new algorithms in solving transportation problems. One of them is the emergence proposed by Amaravathy et al [7] namely the Maximum Divide Minimum Allotment (MDMA) method. This method uses an

algorithm that is easy and unique in achieving optimal or feasible solutions. The application using the MDMA method provides optimization results with fewer iterations than simplex so that it is more effectively used to calculate transportation models. These methods are generally used in solving problems in the company's distribution transportation model.
UD. Bakery Garden is a business that produces various types of bread located on Jalan Catur, Kec. West Siantar, Pematangsiantar City. One of its products is packaged bread.[8] Packaged bread products are marketed in several districts of Siantar-Simalungun. The vehicles used in this distribution are motorcycles, goods tricycles and box cars. Marketing in some areas makes distribution transportation costs incurred even greater and the costs incurred make the company get a small profit. The expenses incurred by UD bakery garden are Rp. 27,991,550.00 per month. This problem can be handled by controlling distribution transportation costs incurred by the company, to get maximum profit by minimizing distribution transportation costs. For that we need a method in solving problems in the field of distribution in minimizing transportation costs

According to Soekartawi in Supratman (2016) optimization is the achievement of the best condition, namely the achievement of problem solutions directed at the maximum and minimum limits. Optimization in this study is a way to find the efficient value of the objective function to maximize or minimize. In this study using the type of optimization with constraints. In determining the solution in this distribution research can be achieved by using the distribution optimization method using the minimum objective function in order to obtain minimum transportation costs so that the distribution system within the company becomes efficient.[9]

The transportation model is a special case of a linear programming problem. According to Taha, this transportation model is concerned with determining the lowest-cost plan to send one item from a number of sources (eg factories) to a number of destinations. The purpose of this model is to determine the number of goods that must be sent from each source to each destination in such a way that the total transportation costs can be minimized. [10][9]

Then the formulation of the linear program in Muhtarulloh et al (2022)[11] is as follows:
Minimize :

$$z = \sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}x_{ij} \qquad (2.4)$$

With Limitations :

$$\sum_{i=1}^{m} x_{ij} \leq a_i\,, \qquad i = 1,2,\dots,m \qquad (2.5)$$

$$\sum_{j=1}^{n} x_{ij} \geq b_j, \qquad j = 1,2,\dots,n \qquad (2.6)$$

$$x_{ij} \geq 0, \quad For\ all\ \ i\ and\ j$$

This transportation is generally known as follows :

Z = total transportation costs
X_{ij} = The number of commodities distributed from source *i* to destination *j*
A_i = Source location *i*
B_j = Source location *j*
ai = Amount *supply* at source i
bj = Amount *demand* at destination j
cij = Transportation costs between source i to destination j

According to Tjiptono "Distribution channels (marketing channels, trade channels, distribution channels) are routes or a series of intermediaries, both managed by marketers and independent in delivering goods from producers to consumers". [5]

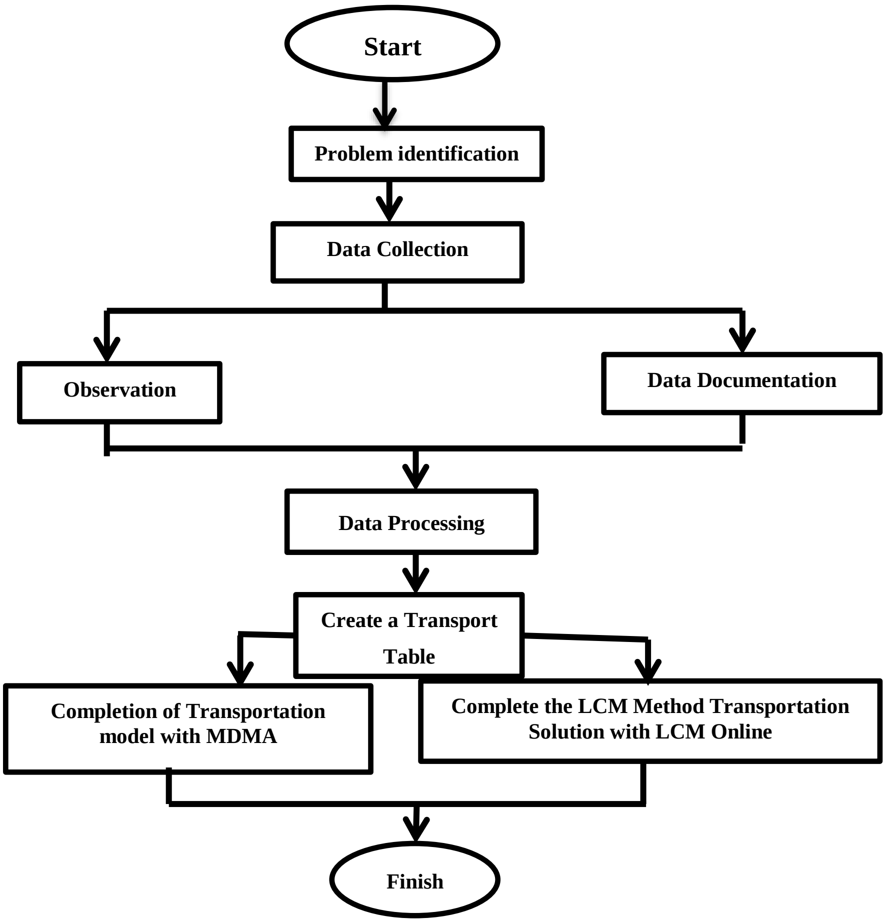
The distribution strategies that must be carried out by the company include: incentive distribution strategy, selective distribution strategy, exclusive distribution strategy. [4]

The MDMA (Maximum Divide Minimum Alloment) method is a proposal from Amaravathy et al (2016)[7] which is a method applied in determining a feasible solution to transportation problems. There are several stages in the completion of the MDMA method, namely :[12]
Tahap 1 : Create a Transport Tabel (TT) for *Pay Off Matrix* (POM);
Tahap 2 : Choose *Maximum Element* (ME) from POM and divide all elements by ME at *Constructed Transportation Table* (CTT);
Tahap 3 : supply or demand is given for the smallest element in more than one CTT, then choose the element that has the smallest demand or supply value;
Tahap 4 : select the next maximum element in the CTT, the ME value selected in the new CTT cannot be equal to 1, if ME = 1 then the CTT that is formed will remain the same, because the division is 1;

Then repeat the same steps for the remaining elements.
The MDMA (Maximum Divide Minimum Allowance) method is a development of the Least Cost method which is often used to seek optimization of transportation models with easy-to-understand algorithm steps.

2. RESEARCH METHOD

The stages carried out in this study are shown in Figure 1 :



Ficture 1. Research Flow Chart

3.1 Research Procedure

The procedure to be carried out in this study is as follows:

1. Start

a. Study of literature

This research starts from a literature study, namely collecting reference materials as sources in the material to be studied in the form of articles, journals, paper books and so on related to case studies and the Maximum Divide Minimum Allowance method.

b. Field Observations

In this activity the aim is to synchronize the data that has been obtained from the factory (Secondary) by carrying out field observations to ensure that the data that has been obtained is valid.

2. Problem identification

The problem in this study is how to optimize the transportation costs for UD Bakery Garden distribution using the MDMA (Maximum Divide Minimum Allowance) method.

3. Data collection

In collecting data, the authors made observations and data documentation to UD Bakery Garden.

4. Data Processing

The steps taken in data processing are:

a. Arranging data into the form of a transportation table

b. Completion of the transportation model is completed using the MDMA (Maximum Divide Minimum Allowance) method, an updated method in seeking optimization solutions for transportation models that require data on demand, product capacity, and matters related to the distribution process.
c. Completing transportation solutions is also calculated using the lcm method, namely Lcm Online.
d. Analyzing data between data issued by transportation costs from companies, the MDMA (Maximum Divide Minimum Allowance) method and the online Lcm method.
5. Done

From data processing using the MDMA (Maximum Divide Minimum Allowance) method and the Lcm method, the results of Transportation Costs will be obtained

3. RESULT AND DISCUSSION

Based on the results of data collection by observing the owner and data documentation to obtain data on fixed costs, variable costs and the number of requests. The results of these data are used to enter the sum of the transportation tables, which can be seen in table 1 below:

Table 1. Calculation of transportation costs per carton of packaged bread

Destination	**Source**		
	Motorcycle	**Goods Rickshaw**	**Van**
Siantar Barat	$\frac{198.750+2.550.000}{200} = 13743$	$\frac{206.700+2.550.000}{680} = 4054$	$\frac{127.200+2.650.000}{280} = 9919$
Siantar Marihat	$\frac{365.700+2.550.000}{230} = 12677$	$\frac{413.400+2.550.000}{580} = 5109$	$\frac{238.500+2.650.000}{470} = 6146$
Siantar Marimbun	$\frac{119.250+2.550.000}{300} = 8898$	$\frac{516.750+2.550.000}{350} = 8762$	$\frac{318.000+2.650.000}{800} = 3710$
Siantar Martoba	$\frac{333.900+2.550.000}{410} = 6302$	$\frac{333.900+2.550.000}{410} = 6302$	$\frac{333.900+2.650.000}{410} = 6546$
Siantar Sitalasari	$\frac{135.150+2.550.000}{550} = 4882$	$\frac{135.150+2.550.000}{550} = 4882$	$\frac{135.150+2.650.000}{550} = 5064$
Siantar Utara	$\frac{310.050+2.550.000}{230} = 12435$	$\frac{310.000+2.550.000}{520} = 5500$	$\frac{190.800+2.650.000}{520} = 5463$

3.1 Maximum Divide Minimum Allotment (MDMA)

The Maximum Divide Minimum Allowance (MDMA) method can be used to solve the problem of the transportation distribution model of packaged bread at UD Bakery Garden. The stages of completing the transportation model using the MDMA method are as follows :

a. The transportation distribution table for packaged bread at UD Bakery Garden can be seen in Table 1.

Table 2 Table Transportation

Source	Destination	Supply

	B1	B2	B3	B4	B5	B6	
A1	13743	12677	**8898**	**6302**	**4882**	**12435**	**1920**
A2	4054	5190	**6862**	**6302**	**4882**	**5500**	**3490**
A3	9919	**6146**	**3710**	**6546**	**5064**	5463	**3030**
Demand	1160	980	1450	410	550	750	**8440** **5300**

On Table 4.1 shows transportation problems in the company because the amount of capacity is greater than the number of requests which means it is not balanced. How to calculate in the completion of an unbalanced transport table by adding a dummy column. The transportation table added with this dummy aims to create a balanced transportation table, the dummy column also serves to make an additional difference between capacity (supply) and demand (demand). The total capacity is 8,440 boxes and the number of requests is 5,300 boxes, to find the dummy column, which is to reduce the capacity with the number of requests, which is 3,140 boxes. So that the total difference of 3,140 boxes is an additional request for packaged bread that is not supplied, but will be allocated to the dummy column. In the cells of the dummy column the transportation cost is zero because the amount allocated to those cells is the number of unfulfilled requests.

The balanced transportation table can be seen in Table 4.2.

Table 4.3 Balanced Transportation Table

Source	**Destination**							**Supply**
	B1	**B2**	**B3**	**B4**	**B5**	**B6**	**Dummy**	
A1	13743	12677	8898	6302	4882	12435	**0**	**1920**
A2	4054	5190	6862	6302	4882	5500	**0**	**3490**
A3	9919	6146	3710	6546	5064	5463	**0**	**3030**
Demand	1160	980	1450	410	550	750	3140	

a. Selecting the maximum cost element (ME) from table 4.2 of balanced transportation, namely 13743 is in cell (1,1) and dividing all cost elements by ME, because in the transportation table there is a dummy to solve using the MDMA method, the dummy column is ignored first. The request in the dummy column is supplied last.
b. Choose the smallest element that has been divided by ME in table 4.3 of the MDMA iteration 1 method, namely 3710/13743 contained in cell (3,3), then the smallest capacity or demand [K(3030), P(1450)] = 1450 units supplied to the cell (3,3), so that column B3 has been fulfilled, causing the total capacity in A3 to decrease, namely 3030 – 1450 = 1580.
c. Do these stages over and over again until each one is filled with its minimum elements and its capacity is fulfilled, as shown in Table 4.4.

Tabel 4.4 Solution Table with MDMA

Source	Destination							Supply
	B1	**B2**	**B3**	**B4**	**B5**	**B6**	**Dummy**	
A1	**13743**	**12677**	**8898**	**6320** **410**	**4882** **550**	**12435**	**0** **960**	**1920**
A2	**4054** **1160**	**5190** **980**	**8762**	**6320**	**4882**	**5500**	**0** **1350**	**3490**
A3	**9919**	**6146**	**3710** **1450**	**6546**	**5064**	**5463** **750**	**0** **830**	**3030**
Demand	**1160**	**980**	**1450**	**410**	**550**	**750**	3140	8440 5300

Based on Table 4.4, it can be calculated into the total transportation cost formula using the MDMA method of transportation model by multiplying the demand and capacity that has been supplied in each sub-district by the cost of each means of transportation when carrying out the distribution process as follows.

$$z = \sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}x_{ij} \tag{4.2}$$

$= 6320(410) + 4882(550) + 0(960) + 4054(1160) + 5190(980) + 0(1350) + 3710(1450) +$

$5463(750) + 0(830)$

$= 24541890$

Based on the calculation, the total cost of using the MDMA method is IDR 24.541,890.00

4. CONCLUSION

The problem of packaging bread distribution transportation at UD Bakery garden can be solved by applying the Maximum Divide Minimum Allowance (MDMA) method to minimize the cost of packaging bread distribution transportation at UD Bakery Garden which is supplied to several Siantar sub-districts. It can be concluded that the cost optimization is Rp. 24,541,890.00. The difference in costs incurred by the company and using the MDMA method is IDR 3,449,660.00. Distribution costs at UD Bakery garden are more optimal using the Maximum Divide Minimum Allowance (MDMA) method when compared to the costs incurred by the company. Therefore the MDMA (Maximum Divide Minimum Allowance) method can solve the problem or can be used to minimize transportation costs

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