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Russel Approximation Method And Vogel's Approximation Method In Solving Transport Problem

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Abstract - Transportation problems can be regarded as one of the problems that occur routinely in a company in the process of distributing products from several sources to certain places. Transportation issues are included in one of the optimization issues in operations research aimed at minimizing transportation costs. Differences in transportation costs can be due to several factors such as distance gap, type of transport used and other things. The optimization of transportation cost can be done by using Vogel Approximation method and Russel Approximation Method. Method. To see the effectiveness of optimization conducted by the two methods is needed a comparison process.

Keywords - Transport Problem, Russel Approximation, Vogel's Approximation

1 INTRODUCTION

Distribution in a company is one of the routine operational activities carried out for the sustainability of the company. Generally, every company performs the distribution process for example companies engaged in the field of production, construction services, expedition, suppliers, distributors and other companies. Distribution also can be said part of marketing where in distribution marketing processes delivery of product or service from company to consumer.

Distributing products or services, the company must issue distribution costs such as transportation costs. The size of transportation costs in the distribution process is influenced by several factors, among others. The distance from one source to the intended locations, the type of transportation used and so forth. Transportation costs can be minimized using optimization techniques contained in operations research.

Operational research became known in World War 2 where war strategists were required to consider how to win with limited resources such as limited troop numbers or limited ammunition. War strategy experts must be able to generate strategies to optimize these resources by performing calculations that produce a formula or formula. Until now the strategy was developed and adopted for the optimization of various fields such as cost optimization in the company's operations.

Operations of the company certainly require big cost, for that the application of operations research is necessary for the optimization of these costs. It seems like the optimization of transportation costs in the distribution process that occurred in the company. Optimization of transportation costs can be done using transportation optimization methods such as Vogels Approximation Method (VAM) and Russel Approximation Method (RAM).

Therefore, necessary to conduct a study that describes the problem solving of transportation using 2 methods where the 2 methods solve the same case. The comparison is done to see the effectiveness and efficiency of both methods. Effectiveness is assessed by which method obtains a more optimum completion result. While the efficiency is judged by the process of workmanship including how many iterations to get optimization results.

2 THEORY

2.1 Transportation Problem

The problem of transportation in a company occurs due to limited resources or limited capacity of a company in the process of distribution from several places of origin to several destinations. Settlement of transportation problems is intended to optimize transportation costs[1].

Optimization Transportation costs can be done by allocating the number of products/goods using the method of the settlement include:

1. NWC Method (North West Corner)
   The transportation method that allocates products/goods starts from the top left corner of the table or starts from the cell located in the first column and the first row. The optimization result of the method is not maximal because the allocation does not pay attention to transportation cost.
2. C Method (Least Cost)

The transportation method that allocates products/goods starts from the cell with the smallest transportation cost. The results of allocations using the least cost method will generally be more efficient and effective when compared with the North West Corner method.

3. VAM Method (Vogel's Approximation Method)
   The optimization method is done by finding the difference of 2 (two) smallest cost.
4. RAM Method (Russel Approximation Method)
   Optimization begins by finding the highest cost for each row and column in the transport table.
5. MODI Method (Modified Distribution)
   Perform optimization by modifying the result of North West Corner method with Least Cost method.
6. Stepping Stone Method
   Performs optimizations by filling empty cells generated from previous methods.

Each of the above methods has their own weaknesses and advantages.

2.2 Vogel's Approximation Method (VAM)

Resolving transportation problems using the Vogel Approximation Method (Vogel's Approximation Method) will result in an optimum solution when compared to the North West Corner method or by the Least Cost method.

The completion steps Vogel's Approximation Method is as follows:

1. Arrange the value matrix of transport costs and the value of the capacity of each source into columns and rows.
2. Find the two smallest cost of each row and column then calculate the difference of 2 the smallest cost.
3. Finding 1 (one) largest difference value of the difference between row and column.
4. Selecting the cell with the lowest transportation cost that is in the column or row that has the smallest value of the difference then allocate products/goods on the cell.
5. Repeat step 2 until step 4 until all products are distributed.
6. If the allocation has been completed then calculate the distribution cost.

Vogels Approximation Method can be regarded as a method of solving transportation problems that are heuristic where problem-solving will give a better result when compared with Nort West Corner method and Least Cost method[3].

2.3 Russel's Aproximation Method (RAM)

Solving the problem of transportation cost optimization using Russel's approximation method can be said to have the same logic or working method using the Vogels approximation method.

The steps of Russell's Approximation Method are described as follows:

1. Arrange the value matrix of transport costs and value of the capacity of each source into columns and rows
2. Find the highest cost value for each row and column
3. Subtract each cost value on the columns and rows at their highest cost.
4. Selecting the cell that has the greatest negative value from the calculation of step 2 (two) and then allocates goods or products on the cell
5. Repeat step 2 until step 4 until all products are distributed.
6. If the allocation has been completed then calculate the distribution cost [4].

Russell's Approximation Method (Russell's Approximation Method) is an initial optimization method whose results are also better compared to the Nort West Corner method and the Least Cost method.

3 RESULT AND DISCUSSION

Characteristics of transportation problems include the presence of the number of sources with the number of objectives in which the quantity of sources and quantity of objectives has been determined, the cost of transport from each source to each destination has been determined.

Problems example:
A company has 3 factories for production process with 3 warehouses for storage of goods. Production results should be distributed from the factory to be stored in the storage. Differences in distance cause the cost of shipping

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goods from each factory to different warehouses. How to optimize the cost of shipping goods to the company if the shipping cost and capacity (quantity) of each factory and warehouse are determined as follows:

Table 1. Production Table

Factory/ Warehouse	Factory 1	Factory 2	Factory 3	Warehouse Capacity
Warehouse A	13	20	23	**250**
Warehouse B	17	16	22	**300**
Warehouse C	21	10	14	**150**
Factory Capacity	**150**	**250**	**300**	**700**

A. Completion with Vogel's Approximation Method

Optimization is done by continuing step 2 (two) because the value of transportation cost and quantity of factory and warehouse have been arranged.
Following completion steps.

1. Search for the two smallest cost of each row and column then calculate the difference of 2 smallest cost
   Column 1 => 17 – 13 = 4
   Column 2 => 16 – 10 = 6
   Column 3 => 22 – 14 = 8
   Row 1 => 23 – 13 = 10
   Row 2 => 17 – 16 = 1
   Row 3 => 14 – 10 = 4
2. Search for 1 (one) largest difference value of the difference between row and column.
   The largest difference value = 10 (Line 1)
3. Selecting the cell with the lowest transportation cost that is in the column or row that has the smallest value of the difference then allocate products / goods on the cell.

Table 2. The Difference Table

Factory/ Warehouse	Factory 1	Factory 2	Factory 3	Warehouse Capacity	Difference
Warehouse A	13 **150**	20	23	**250-150 = 100**	**10**
Warehouse B	17	16	22	**300**	**1**
Warehouse C	21	10	14	**150**	**4**
Factory Capacity	**150**	**250**	**300**	**700**	
Difference	**4**	**6**	**8**		

4. Repeat step 2 until step 4 until all products are distributed.

Table 3. VAM Result 1

Factory/ Warehouse	Factory 2	Factory 3	Warehouse Capacity
Warehouse A	20	23	**100**
Warehouse B	16	22	**300**
Warehouse C	10	14	**150**
Factory Capacity	**250**	**300**	**550**

Search for 1 (one) largest difference value of difference between row and column.
   Column 1 => 16 – 10 = 6
   Column 2 => 22 – 14 = 8
   Row 1 => 20 – 23 = 3
   Row 2 => 22 – 16 = 6
   Row 3 => 14 – 10 = 4
Search for 1 (one) largest difference value of difference between row and column
The largest difference value = 8 (Column 2)

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Selecting the cell with the lowest transportation cost that is in the column or row that has the smallest value of the difference then allocate products/goods on the cell.

Table 4. The Difference Table

Factory/ Warehouse	Factory 2	Factory 3	Warehouse Capacity	Difference
Warehouse A	20	23	**100**	**3**
Warehouse B	16	22	**300**	**6**
Warehouse C	10	14 **150**	**150**	**4**
Factory Capacity	**250**	**300-150 = 150**	**550**	
Difference	**6**	**8**		

Repeat step 2 until step 4 until all products are distributed.

Table 5. VAM Result 2

Factory/ Warehouse	Factory 2	Factory 3	Warehouse Capacity
Warehouse A	20	23	**100**
Warehouse B	16	22	**300**
Warehouse C	**250**	**150**	**400**
Factory Capacity			

Search for 1 (one) largest difference value of the difference between row and column.

Column 1 => 20 – 16 = 4
Column 2 => 23 – 22 = 1

Row 1 => 20 – 23 = 3
Row 2 => 22 – 16 = 6

Search for 1 (one) largest difference value of difference between row and column.
The largest difference value = 6 (Line 2)
Selecting the cell with the lowest transport cost that is in the column or row that has the least value of the difference then allocate the product/goods on the cell

Table 6. The Difference Table

Factory/Warehouse	Factory 2	Factory 3	Warehouse Capacity	Difference
Warehouse A	20	23	**100**	**3**
Warehouse B	16 **250**	22	**300 - 250 = 50**	**6**
Factory Capacity	**250**	**150**	**400**	
Difference	**4**	**1**		

Repeat step 2 until step 4 until all products are distributed.

Table 7. VAM Result 3

Factory/ Warehouse	Factory 3	Warehouse Capacity
Warehouse A	23 **100**	**100**

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Factory/ Warehouse	Factory 3	Warehouse Capacity
Warehouse B	22 **50**	**50**
Factory Capacity	**150**	**150**

5. If the allocation has been completed then calculate the distribution cost.
   Cost = (13*150) + (14*150) + (16*250) + (23*100) + (22*50)
   = 1950 + 2100 + 4000 + 2300 + 1100
   = 11450

B. Completion With Russel's Approximation Method

The steps of optimization of transportation costs are described as follows:

1. Find the highest cost value for each row and column

Table 8. The First Stage of RAM

Factory/Warehouse	Factory 1	Factory 2	Factory 3	Warehouse Capacity
Warehouse A	13	**20**	**23**	**250**
Warehouse B	17	16	**22**	**300**
Warehouse C	**21**	10	14	**150**
Factory Capacity	**150**	**250**	**300**	**700**

1. Subtract each cost value on the columns and rows at their highest cost.
   A1 => 13 – 23 – 21 = -31
   B1 => 17 – 22 – 21 = -26
   C1 => 21 – 21 – 21 = -21
   A2 => 20 – 20 – 23 = -23
   B2 => 16 – 20 – 22 = -26
   C2 => 10 – 20 – 21 = -31
   A3 => 23 – 23 – 23 = -23
   B3 => 22 – 23 – 22 = -23
   C3 => 14 – 23 – 21 = -30

2. Selecting the cell that has the greatest negative value from the calculation of step 2 (two) and then allocate goods or products on the cell.

Table 9. The Second Stage of RAM

Factory/Warehouse	Factory 1	Factory 2	Factory 3	Warehouse Capacity
Warehouse A	13 **150**	**20**	**23**	**250 – 150 = 100**
Warehouse B	17	16	**22**	**300**
Warehouse C	**21**	10 **150**	14	**150**
Factory Capacity	**150**	**250 – 150 = 100**	**300**	**700**

3. Repeat step 2 until step 4 until all products are distributed.

Table 10. The Third Stage of RAM

Factory/Warehouse	Factory 2	Factory 3	Warehouse Capacity
Warehouse A	20	23	**100**
Warehouse B	16	22	**300**
Factory Capacity	**100**	**300**	**400**

Subtract each cost value on the columns and rows at their highest cost.

A2 => 20 – 23 – 20 = -23
B2 => 16 – 22 – 20 = -26
A3 => 23 – 22 – 23 = -24
B3 => 22 – 22 – 23 = -23

Selecting the cell that has the greatest negative value from the calculation of step 2 (two) and then allocate goods or products on the cell.

Table 11. The Last Stage of RAM

Factory/Warehouse	Factory 2	Factory 3	Warehouse Capacity
Warehouse A	20	23	**100**
Warehouse B	16 **100**	22	**300 - 100 = 200**
Factory Capacity	**100**	**300**	**400**

From the repetition of the above steps only 1 column and 2 rows are factory column 3 and warehouse A and warehouse B, therefore for the next allocation can be directly completed as follows:

Table 12. The Final Result of RAM

Factory/ Warehouse	Factory 3	Warehouse Capacity
Warehouse A	23 **100**	**100 – 100 = 0**
Warehouse B	22 **200**	**200 – 200 = 0**
Factory Capacity	**300**	**300**

4. If the allocation has been completed then calculate the distribution cost.
   Biaya = (13*150) + (10*150) + (23*100) + (22*200) + (16*100)
   = 1950 + 1500 + 2300 + 4400 + 1600
   = 11.750

The result of completion of transportation cost optimization using Vogel approximation method (VAM) and Russel approximation method (RAM) can be seen in the following table:

Table 13. The Completion of VAM and RAM

Method \ Result	Optimation	Iteration Result
VAM	11450	4 Kali
RAM	11750	3 Kali

Based on the above table it can be seen the results obtained by using the approximation Vogel more optimum although the process of completion longer.

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4 CONCLUSION

From the analysis d above it can be concluded that:

1. Optimization of transportation costs in the distribution process can be done if the cost of delivery from each source to each destination has been obtained.
2. In terms of effectiveness, the settlement result using the Vogel approximation method is more optimum when compared with the results obtained from the Russel approximation method.

REFERENCES

[1] Aminudin, Prinsip Prinsip Riset Operasi, ST Lemeda Simarmata, Ed. Jakarta, Indonesia: Erlangga, 2005.

[2] Henry Bustani, Fundamental Operation Research. Jakarta, Indonesia: PT. Gramedia Pustaka Utama, 2005.

[3] Er. Prem Kumar Gupta, Operation Research. New Delhi, India: S.Chand & Company PVT. LTD, 2008.

[4] N. Guruprasad, "Modified Approximation Methods for Finding an Optimal Solution for the Transportation Problem," International Journal Of Mathematical And Computational Sciences, vol. 1, January 2015.