JINAV: Journal of Information and Visualization *ISSN: 2746-1440 (online)*
Vol. 4 No. 1 (2023)
https://doi.org/10.35877/454RI.jinav2125

SolutionOptimal Transportation Problems Using The Sirisha Viola Modification Method Python Assisted Programming

Fahrudin Muhtarulloh*, Aisyah Maulidina, & Arief Fatchul Huda

UIN Sunan Gunung Djati , Jl. AH. Nasution No. 105 , Bandung 40614 , Indonesia

Abstract

One of the problems that exist in operations research is the problem of transportation. This study proposes the completion of the optimal solution in the transportation problem using the Modified Method of the Sirisha Viola method. The method proposed hereinafter is called the Sirisha Viola Modified Method . The algorithm in this method is the same as in the Sirisha Viola method but differs in the allocation step, where the allocation is made to the minimum demand first, then compared with the corresponding supply value. The data used in this study consisted of secondary data and simulated data (random data). The results of numerical calculations or using the help of the Python program for secondary data obtained an optimal solution of 12,100 cost units. Whereas for random data consisting of 4 0 balanced data and 40 unbalanced data with sizes 10 x 10, 13 x 17, 25 x 27, and 50 x 50 the optimal solution results are obtained. It is concluded that the Sirisha Viol a Modification Method in solving transportation problems can produce optimal solutions directly without the need to determine the initial feasible solution.

Keywords: Transportation Problems ; Sirisha Viola Modification Method ; Python Programming ; Optimal Solution

1. Introduction

The British Operational Research Society (1970) in (Brookes, 1970; Jardine, 1970; Kirby, 2003; Merigó & Yang, 2017) states that operations research is the application of scientific methods that are used to solve complex problems that appear when implementing large-scale management systems like man, machine, material, Money, on field industry, sectortrading, sector Country And defense. According to (Jek Siang , 2014) research operation naturally related tightly with principle optimization, WhereThis principle aims to optimize the results of the use of resources such as time, effort, cost, etc. Optimized results can be done with method minimize loss or maximizing profit. In research operation there are several problems, one of the problems included into operations research that is transportation problem.

The transportation problem is a linear programming problem, which is related to determining the optimal distribution plan for an item. The distribution of goods in transportation problems is carried out from several sources to several destinations with a certain capacity, by applying the minimum cost principle. The main objective of the transportation problem is to obtain an optimal solution for the cost of distributing goods from a certain source to a destination (Patel & Bhathawala, 2015) .

In the real world this transportation problem is commonly applied to a company. In distributing products to several regions, it is part of a company's operations, where transportation costs are certainly not insignificant. Therefore, in-depth planning is needed so that the transportation costs that will be incurred can be as efficient as possible and do not require large costs. The right method is certainly needed to minimize transportation costs (Muhtarulloh et al., nd; Sari et al., 2013) .

Along with the development of the times, new methods were discovered. One of them is the Sirisha Viola method, where this method is included in the direct method because it can produce optimal values in solving transportation problems. The Sirisha Viola Modification Method is a modified method from the previous discussion, where this method is easier to apply in solving transportation problems with the allocation target determined based on the zero value in the cell by looking at the minimum value of demand which will then be compared with the corresponding

* Corresponding author.
E-mail address: fahrudin.math@uinsgd.ac.id

supply value, then the value which will then be allocated to the zero-valued cell, when the remaining cells do not include a zero value, then the row and column reduction is repeated so that the cell can produce a zero value, then the remaining allocation can be made (Muhtarulloh & Maulidina, nd; Sirisha & Viola, 2018) .

In this study, the authors proposed modifications to the Sirisha Viola Method algorithm, especially in the allocation step. In the Sirisha Viola method, allocation is done by comparing all requests and the minimum supply. Whereas in the method proposed in the allocation step, it is done by selecting the minimum value from all existing requests, then comparing it with the appropriate supply, then selecting the minimum. In other words, the proposed method simply prioritizes requests first. Based on description the writer interested For propose problem transportation with Sirisha Viola's Modified Method.

2. Methods

Method Modified Sirisha Viola is A development of the method proposed by J. Sirisha and A. Viola forsolve transportation problems. The modification lies in the allocation determination algorithm, where in this method the first time the allocation is considered is the minimum demand and then compared with the appropriate supply. Whereas in the predecessor method (Sirisha Viola) at the time of allocation the minimum value between demand and supply is sought (Sirisha & Viola, 2018) .

The algorithm of the Sirisha Viola Modification Method is as follows: (1) Check whether the total supply equals the total demand, if notadd row/column *dummy* ; (2) Mutual exchange line odd And even Which appropriate with supply(*supplies*) ; (3) Mutual exchange column odd And even Which appropriate withrequest (*demand*) ; (4) Identification element smallest And do subtraction in every row ; (5) Identification element smallest And do subtraction d every column ; (6) Select a zero-value cell in each row with minimum *demand* , then compare with the supply (*supply*) accordingly, then allocate the minimum demand or supply to the zero-value cell. If the allocation has not been fulfilled, review the non-zero cells, and then go back to step 4 to step 6; (7) The optimal solution is obtained.

3. Result and Discussion

The data used in this article are secondary data and simulation data (random data). Secondary data was obtained from the Journal of Physical Sciences entitled "An Innovative Approach to Obtain an Initial Basic Feasible Solution for the Transportation Problems" writtenby Mollah Mesbahuddin Ahmed, Nahid Sultana, Aminur Rahman Khan, and Sharif Uddin (Ahmed et al., 2017) . In addition to the secondary data, random data is also used with larger and more numerous data sizes. It is used to evaluate the proposed research method. The random data used is 40 data for balanced cases and 40 data for unbalanced cases. The data tested was 20 data in 10x10 size, 20 data in 13x17 size, 20 data in 25x27 size, and 20 data in 50x50 size.

3.1. Case Study of Secondary Data

A company A which produces musical instruments has four production sources, namely the first source (S1), the second source (S2), the third source (S3), and the fourth source (S4). Where each source has a different production capacity, namely the first source (S1) produces 300 units, the second source (S2) produces 500 units, the third source (S3) produces 825 units, and the fourth source (S4) produces 375 units. The company distributes these musical instruments to five music stores, where demand from each store is the first store (T1) for 350 units, the second store (T2) for 400 units, the third store (T3) for 250 units, the fourth store (T4) 150 units, and the fifth store (T5) 400 units. The transportation model can be seen as follows (Ahmed et al., 2017) .

Step 1: Create a transportation table of the problem to be solved. Check whether the amount of supply is equal to the number of requests, if not then add a dummy.

From table 1 it is obtained that the total supply is 2000 units, and the number of requests is 1550 units. Because the amount of inventory is not the same as the amount of demand, a dummy column (T6) must be added to the demand, as shown in table 2.

Table 1. Table Beginning Cost Transportation Secondary Data

	T1	T2	T3	T4	T5	Supply
S1	10	2	16	14	10	300
S2	6	18	12	13	16	500
S3	8	4	14	12	10	825
S4	14	22	20	8	18	375
Request	350	400	250	150	400	

Analysis of completion of case two data is as follows:

Table 2. Table of Secondary Data Balanced Transport Problems with Dummy

	T1	T2	T3	T4	T5	T6	Supply
S1	10	2	16	14	10	0	300
S2	6	18	12	13	16	0	500
S3	8	4	14	12	10	0	825
S4	14	22	20	8	18	0	375
Request	350	400	250	150	400	450	2000

Step 2: Make exchanges on odd and even rows along with their supplies.

Odd row swapping is done by swapping the first row with third row, for exchange on even rows is done by swapping rows second with line fourth especially formerly, Then swap line fourth with line sixth , as shown in table 3.

Table 3. Redemption Table Line Odd and Even

	T1	T2	T3	T4	T5	T6	Supply
S3	8	4	14	12	10	0	825
S4	14	22	20	8	18	0	375
S1	10	2	16	14	10	0	300
S2	6	18	12	13	16	0	500
Request	350	400	250	150	400	450	2000

Step 3: Make an exchange in the odd and even columns along with the request.

The odd column swap is done by swapping the first column with the third column first, then swapping the third column with the fifth column. After that the even column exchange is done by exchanging the second column with the fourth column first, then swapping the fourth column with the sixth column, as shown in table 4.

Table 4. Table Exchange Column Odd And Even

	T3	T4	T5	T6	T1	T2	Supply
S3	14	12	10	0	8	4	825
S4	20	8	18	0	14	22	375
S1	16	14	10	0	10	2	300
S2	12	13	16	0	6	18	500
Request	250	150	400	450	350	40	2000

Step 4: Identify the smallest element in each row and subtract each row with the smallest element , as shown in table 5.

Table 5 . Row Smallest Element Table Secondary Data

	T3	T4	T5	T6	T1	T2	Supply
S3	14	12	10	0	8	4	825
S4	20	8	18	0	14	22	375
S1	16	14	10	0	10	2	300
S2	12	13	16	0	6	18	500
Request	250	150	400	450	350	400	2000

= Element Minimum Line

Because element minimum every the line is zero, so results reduction remains the same.

Step 5: Identification element smallest in every column And do subtraction in each column with the smallest element, as shown in table 6 and table 7 .

Table 6 . Table Element smallest Column Secondary Data

	T3	T4	T5	T6	T1	T2	Supply
S3	14	12	10	0	8	4	825
S4	20	8	18	0	14	22	375
S1	16	14	10	0	10	2	300
S2	12	13	16	0	6	18	500
Request	250	150	400	450	350	400	2000

Information:

= Element Minimum Column

Step 6: Allocation done by pick one zero on last row see the minimum request value then compare it withmark supply which appropriate. Allocate request or supply with mark which more minimum. So reduction matrix in accordance with amount request or supply which allocated.

Table 7. Table Results Subtraction with Element smallest Column

	T3	T4	T5	T6	T1	T2	Supply
S3	2	4	0	0	2	2	825
S4	8	0	8	0	8	20	375
S1	4	6	0	0	4	0	300
S2	0	5	6	0	0	16	500
Request	250	150	400	450	350	400	2000

Information:

= Element the result of subtraction with the smallest column element

- Allocation First

Choose zero with minimum demand or supply, i.e. at request in column second (T4) as big 150, Look supply Which corresponds to zero, which is equal to 375. Because the demand value is more minimum supply, then allocate a demand of 150 at zero in the second row of the second column. Then reduce the inventory accordingly with the number of requests that have been allocated as shown in table 8 and table 9.

Table 8. Table Allocation-1 Case Data Secondary

	T3	T4	T5	T6	T1	T2	Supply
S3	2	4	0	0	2	2	825
S4	8	0 (150)	8	0	8	20	375-150
S1	4	6	0	0	4	0	300
S2	0	5	6	0	0	16	500
Request	250	0	400	450	350	400	

Table 9 . Table Reduction

	T3	T5	T6	T1	T2	Supply
S3	2	0	0	2	2	825
S4	8	8	0	8	20	225
S1	4	0	0	4	0	300
S2	0	6	0	0	16	500
Request	250	400	450	350	400	

In the same way the second, third and so on allocations are carried out until the allocation table is obtained as shown in step 7 below.

Step 7: For table results For supply And request Which Alreadyallocated , as in table 10.

Inventory at source 1 is allocated as many as 300 units to destination 5. Inventory at source 2 is allocated 250 units to destination 1. Inventory at source 2 is allocated 250 units to destination 3. Inventory at source 3 is allocated 100 units to destination 1. Inventory at source 3 is allocated 400 units to destination 2. Supply on source 3 allocated as much 100 units to destination 5. Supply on source 3 allocated as much 225 units to objective 6 (*dummy*). Inventory on source 4 allocated as much 150 units to objective 4. Supply on source 4 allocated as much 225 units to objective 6(*dummy*).

Table 10. Table Allocation Case Data Secondary

	T1	T2	T3	T4	T5	T6	Supply
S1	10	2	16	14	10 (300)	0	300
S2	6 (250)	18	12 (250)	13	16	0	500
S3	8 (100)	4 (400)	14	12	10 (100)	0 (225)	825
S4	14	22	20	8 (150)	18	0 (225)	375
Request	350	400	250	150	400	450	2000

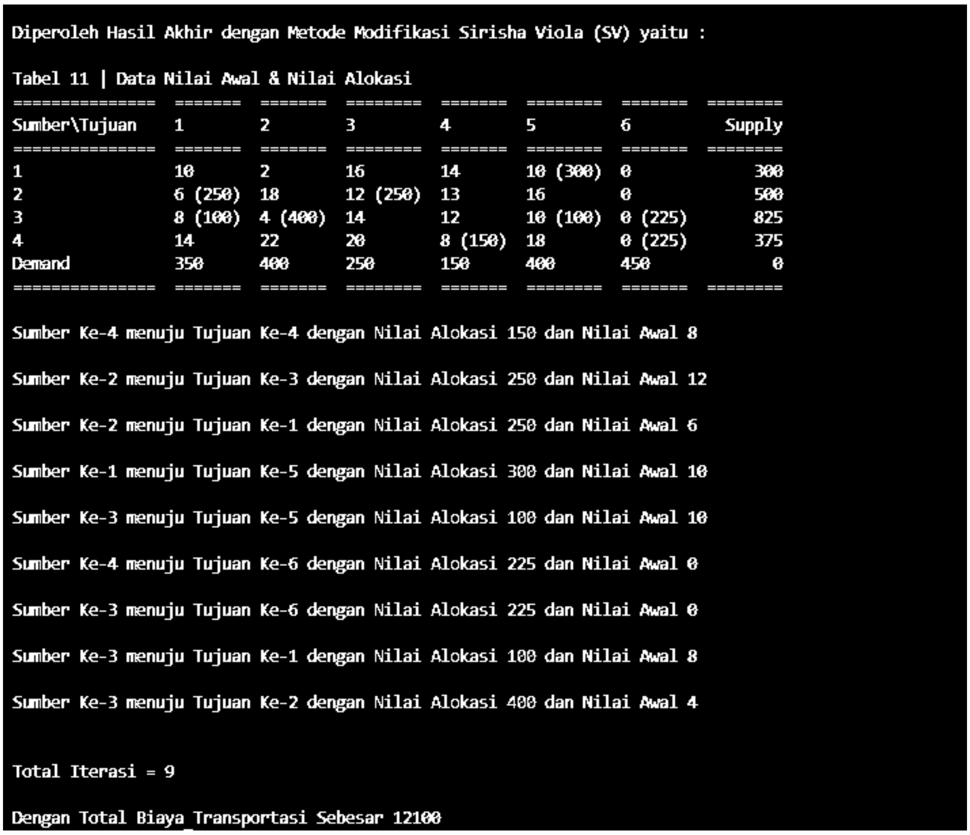
Step 8 : Count cost transportation Which generated from allocation Which Already determined.

$$Z = \sum_{i=1}^{4} \sum_{j=1}^{5} c_{ij} x_{ij}$$

= (10×300) + (6×250) + (12×250) + (8×100) + (4×400) + (10×100) + (0×225) +(8×150) + (0×225)

= 12,100 unit costs.

So that the optimum solution to the problem in the secondary data case study is 12,100 cost units.


```
Diperoleh Hasil Akhir dengan Metode Modifikasi Sirisha Viola (SV) yaitu :

Tabel 11 | Data Nilai Awal & Nilai Alokasi
============== ======= ======= ======== ======= ======== ======= ========
Sumber\Tujuan   1       2       3        4       5        6         Supply
============== ======= ======= ======== ======= ======== ======= ========
1               10      2       16       14      10 (300) 0            300
2               6 (250) 18      12 (250) 13      16       0            500
3               8 (100) 4 (400) 14       12      10 (100) 0 (225)      825
4               14      22      20       8 (150) 18       0 (225)      375
Demand          350     400     250      150     400      450            0
============== ======= ======= ======== ======= ======== ======= ========

Sumber Ke-4 menuju Tujuan Ke-4 dengan Nilai Alokasi 150 dan Nilai Awal 8

Sumber Ke-2 menuju Tujuan Ke-3 dengan Nilai Alokasi 250 dan Nilai Awal 12

Sumber Ke-2 menuju Tujuan Ke-1 dengan Nilai Alokasi 250 dan Nilai Awal 6

Sumber Ke-1 menuju Tujuan Ke-5 dengan Nilai Alokasi 300 dan Nilai Awal 10

Sumber Ke-3 menuju Tujuan Ke-5 dengan Nilai Alokasi 100 dan Nilai Awal 10

Sumber Ke-4 menuju Tujuan Ke-6 dengan Nilai Alokasi 225 dan Nilai Awal 0

Sumber Ke-3 menuju Tujuan Ke-6 dengan Nilai Alokasi 225 dan Nilai Awal 0

Sumber Ke-3 menuju Tujuan Ke-1 dengan Nilai Alokasi 100 dan Nilai Awal 8

Sumber Ke-3 menuju Tujuan Ke-2 dengan Nilai Alokasi 400 dan Nilai Awal 4


Total Iterasi = 9

Dengan Total Biaya Transportasi Sebesar 12100
```

Figure 1 Results Allocation and Total Cost Transportation Data Case Secondary Data

Furthermore, for the same case, we will find the minimum cost using the Sirisha Viola Modification Method with the help of *Python Programming* . The calculation results are shown in Figure 1.

Based on figure 1, the following results are obtained, inventory tool music from source 1 (S1) allocated only on One objective that is to shop 5(T5) as much 300 units, Then from source 2 (S2) allocated on two objectiveWhich different, that is to shop 1 (T1) as much 250 units, And to shop 3 (T3) as many as 250 units, then from source 3 allocated to four different destinations different, that is to shop 1 (T1) as much 100 units, to shop 2 (T2) as much 400units, to shop 5 (T5) as many as 100 units, and because shop 6 is *a dummy* so neither supply nor demand can be allocated, then for source 4 (S4)allocated to two different destinations, namely to store 4 (T4) of 150 units, whereas allocation to shop 6 No can done Because is*dummy* . The resulting total minimum shipping cost is 12,100 unit cost.

3.2. Case Study of Simulation Data (Random Data)

Besides that, we do test try success For Method Modification of Sirisha Viola using Python Programming, namely with data random for balanced and unbalanced minimization problems respectively as many as 100 data with different matrix sizes for tens of data ranges.Results test try will shown on table 11, table 12, and table 13.

Table 11. Results of Trial Cases Balanced Minimization Data Random Size10x10

Size Data	Data nth	Optimal Solution
10x10	1	22580
	2	12892
	3	21489
	4	10333
	5	19030
	6	19609
	7	17422
	8	17851
	9	13262
	10	24982
	11	19441
	12	18299
	13	19812
	14	16440
	15	16936
	16	19189
	17	11511
	18	17940
	19	13042
	20	21380

Table 12. Results Test Try Case Minimize No Balanced Data RandomSize 25x27

Size Data	Data nth	Optimal Solution
25x27	1	26560
	2	26444
	3	28195
	4	25387
	5	25012
	6	26303
	7	29263

Size Data	**Data nth**	**Optimal Solution**
	8	30817
	9	31547
	10	30176
	11	27023
	12	30304
	13	34884
	14	34573
	15	24974
	16	29411
	17	26747
	18	25573
	19	26514
	20	29218

Table 13. Results Test Try Case Minimize No Balanced Data RandomSize 50x50

Size Data	Data nth	Optimal Solution
50x50	1	39234
	2	49896
	3	38687
	4	47936
	5	47877
	6	44546
	7	43510
	8	43446
	9	44654
	10	45164
	11	45106
	12	45692
	13	43534
	14	44277
	15	41295
	16	43081
	17	39341
	18	43067
	19	42106
	20	47482

4. Conclusion

Based on the analysis that has been done, it can be concluded that the Sirisha Viola Modification Method can solve transportation problems. In this case the proposed method can directly produce optimal solutions without having to find an initial feasible solution first. The proposed method can find the optimal solution for balanced and unbalanced minimization cases, such as in the case of secondary data and random data. The optimal solution obtained for secondary case data is 12,100 cost units. While the optimal solution from random data is shown in table 11 to table 14.

References

Ahmed, MM, Sultana, N., Khan, AR, & Uddin, M. (2017). *An innovative approach to obtain an initial basic feasible solution for the transportation problems* .

Brookes, JE (1970). Operational Research in Education Administration. *Education and Urban Society* , *3* (1), 7–40.

Jardine, AKS (1970). *Operational research in maintenance* . Manchester UniversityPress.

Jek Siang, J. (2014). Operations Research on an Algorithmic Approach. *Yogyakarta: Publisher Andi* .

Kirby, MW (2003). *Operational research in war and peace: the British experience from the 1930s to 1970* . Imperial College Press.

Merigó, JM, & Yang, J. -B. (2017). A bibliometric analysis of operations research and management science. *Omega* , *73* , 37–48.

Muhtarulloh, F., & Maulidina, A. (nd). The Sirisha-Viola Method For Finding Optimal Solutions To Transportation Problems. *Journal of Mathematical Science and Statistics* , *8* (1), 19–26.

Muhtarulloh, F., Meirista, M., & Cahyandari, R. (nd). Solving Transportation Problems Using the Sumathi-Sathiya Method and the Karagul-Sahin Approach (KSAM). *EurekaMatika Journal* , *10* (1), 51–62.

Patel, RG, & Bhathawala, PH (2015). The Advance method for the optimum solution of a transportation problem. *International Journal of Science and Research* , *6* (14), 703–705.

Sari, DP, Bu'ulolo, F., & Ariswoyo, S. (2013). Optimization of Transportation Problems Using Potential Methods in the Distribution System of PT. XYZ. *Saintia Mathematics* , *1* (5), 406–418.

Sirisha, J., & Viola, A. (2018). A Novel Method to Find an Optimal Solution for Transportation Problems an Experiment. *International Journal of Pure and Applied Mathematics* , *118* (24), 1–7.