Ceiling Component Analogous Least Appears In Row Or Column Distribution Method To Evaluate Enriched Network Design

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Abstract: In this research article, suggested methodology namely Ceiling Component Analogous Least Appears in Row Or Column Distribution Method is warranted to decide the feasible solution with respect to minimize the cost from the necessary reasonable elucidation set for the shipping tribulations. The recommended methodology is a unique way to achieve the practicable (or) may be best possible elucidation without disturbing the degeneracy condition for the unbalanced networks.

Keywords: Assignment problem, Column, Degeneracy, Maximum, Minimum, Optimizing cost, Pay Off Matrix (POM), Pivot element, Row, Transportation problem

1. Introduction

The transportation problem is a special type of linear programming problem where the objective consists in minimizing transportation cost of a given commodity from a number of sources (e.g. factory, manufacturing facility) to a number of destinations (e.g. warehouse, store) [1] [2]. Each source has a limited supply (i.e. maximum number of products that can be sent from it) while each destination has a demand to be satisfied (i.e. minimum number of products that need to be shipped to it) [3]. The cost of shipping from a source to a destination is directly proportional to the number of units shipped [1] [8], [9].

Now a days transportation problem have been broadly studied in Electronics and Communication branches along with Operations Research methods. It is one of the essential problems of network flow problem which is usually use to reduce the transportation cost for communication outlets with number of sources and number of destination while satisfying the supply and demand constraints [5].

Early days onwards transportation models play an important role in shipping and delivery management for minimizing the cost and maturing the services in communication and control engineering. Some former processes have been formulated solution system for the transportation problem with precise supply and demand constraints [6], [7]. Optimized methods have been established for solving the transportation problems and assignment problems when the costs for the supply and demand quantities are known accurately [2], [4]. In real situations, the supply and demand quantities in the transportation problem are sometimes hardly specified exactly because of varying the present scenario of their economic position [10].

2. Algorithm:

Ceiling Component Analogous Least Appears in Row Or Column Distribution Method (CeCALAiROCD)

Step 1 : Construct the (TT) Transportation Table for the given (POM) pay off matrix.

Step 2 : Choose the maximum component from given POM.

Step 3 : Supply the demand for the minimum component which lies in the corresponding row or column of the selected maximum component in the (CTT) Constructed TT.

Step 4 : Select the next maximum component in (NCTT) Newly CTT and do again the steps 2 & 3 until degeneracy condition satisfied.

Pivot element cell is shaded.

Example 1: Consider the following unbalanced POM, cost for the transportation to be minimized.

	D_1	D_2	D_3	D_4	D_5	Supply
S_1	10	2	16	14	10	**300**
S_2	6	18	12	13	16	**500**
S_3	8	4	14	12	10	**825**
S_4	14	22	20	8	18	**375**
Demand	**350**	**400**	**250**	**150**	**400**	

Table: 1

By using the proposed methodology, we get

Step 1: Here the maximum cost is 22 in TT (4, 2) (is a Pivot element for the POM which is shaded in the following Table: 2) in POM, by applying the above said methodology, the minimum cost is 2 in TT (1, 2) which appears in the corresponding column of the selected maximum cost and allocate the maximum possible demand 300 units for TT (1, 2) and delete the same row S_1. Remaining rows will be considered as NCTT.

	D_1	D_2	D_3	D_4	D_5	D_6	Supply
S_1	10	2 $\boxed{300}$	16	14	10	0	**0**
S_2	6	18	12	13	16	0	**500**
S_3	8	4	14	12	10	0	**825**
S_4	14	22	20	8	18	0	**375**
Demand	**350**	**100**	**250**	**150**	**400**	**450**	**1700**

Table: 2

Step 2: Here the maximum cost is 22 in TT (3, 2) (is a Pivot element for the POM which is shaded in the following Table: 3) in POM, by applying the above discussed methodology, the minimum cost 4 in TT (2, 2) which appears in the corresponding column of the selected maximum cost and allocate the maximum possible demand 100 units for TT (2, 2) and delete the same column D_2. Remaining columns will be considered as NCTT.

	D_1	D_2	D_3	D_4	D_5	D_6	Supply
S_2	6	18	12	13	16	0	**500**
S_3	8	4 $\boxed{100}$	14	12	10	0	**725**
S_4	14	22	20	8	18	0	**375**
Demand	**350**	**0**	**250**	**150**	**400**	**450**	**1600**

Table: 3

Step 3: Here the maximum cost is 20 in TT (3, 2) (is a Pivot element for the POM which is shaded in the following Table: 4) in POM, by applying the above proposed methodology, the minimum cost is 8 in TT (3, 3) which appears in the corresponding row of the selected maximum cost and allocate the maximum possible demand 150 units for TT (3, 3) and delete the same column D_4. Remaining columns will be considered as NCTT.

	D_1	D_3	D_4	D_5	D_6	**Supply**
S_2	6	12	13	16	0	**500**
S_3	8	14	12	10	0	**725**
S_4	14	20	8 $\boxed{150}$	18	0	**225**
Demand	**350**	**250**	**0**	**400**	**450**	**1450**

Table: 4

Step 4: Here the maximum cost is 20 in TT (3, 2) (is a Pivot element for the POM which is shaded in the following Table: 5) in POM, by applying the above discussed methodology, the minimum cost is 12 in TT (1, 2) which appears in the corresponding column of the selected maximum cost and allocate the maximum possible demand 250 units for TT (1, 2) and delete the same column D_3. Remaining columns will be considered as NCTT.

	D_1	D_3	D_5	D_6	**Supply**
S_2	6	12 $\boxed{250}$	16	0	**250**
S_3	8	14	10	0	**725**
S_4	14	20	18	0	**225**
Demand	**350**	**0**	**400**	**450**	**1200**

Table: 5

Step 5: Here the maximum cost is 18 in TT (3, 2) (is a Pivot element for the POM which is shaded in the following Table: 6) in POM, by applying the above said methodology, the minimum cost is 10 in TT (2, 2) which appears in the corresponding column of the selected maximum cost and allocate the maximum possible demand 400 units for TT (2, 2) and delete the same column D_5. Remaining columns will be considered as NCTT.

	D_1	D_5	D_6	**Supply**
S_2	6	16	0	**250**
S_3	8	10 $\boxed{400}$	0	**325**
S_4	14	18	0	**225**
Demand	**350**	**0**	**450**	**800**

Table: 6

Step 6: Here the maximum cost is 14 in TT (3, 1) (is a Pivot element for the POM which is shaded in the following Table: 7) in POM, by applying the above proposed methodology, the minimum cost is 6 in TT (1, 1) which appears in the corresponding column of the selected maximum cost and allocate the maximum possible demand 250 units for TT (1, 1) and delete the same row S_2. Remaining rows will be considered as NCTT.

	D_1	D_6	**Supply**
S_2	6 $\boxed{250}$	0	**0**
S_3	8	0	**325**
S_4	14	0	**225**
Demand	**100**	**450**	**550**

Table: 7

Step 7: Here the maximum cost is 14 in TT (2, 1) (is a Pivot element for the POM which is shaded in the following Table: 8) in POM, by applying the above discussed methodology, the minimum cost is 8 in TT (1, 1) which appears in the corresponding column of the selected maximum cost and allocate the maximum possible demand 100 units for TT (1, 1) and delete the same column D1. Remaining columns will be considered as NCTT.

	D_1	D_6	Supply
S_3	8 100	0	**225**
S_4	14	0	**225**
Demand	**0**	**450**	**450**

Table: 8

Step 8: Supply the maximum possible demand 225 units in TT (1, 1) and TT (2, 1) which leads to the solution satisfying all the conditions.

	D_6	Supply
S_3	0 225	**0**
S_4	0 225	**0**
Demand	**0**	**0**

Table: 9

Step 9: The resulting basic feasible solution is

	D_1	D_2	D_3	D_4	D_5	D_6	Supply
S_1	10	2 300	16	14	10	0	**300**
S_2	6 250	18	12 250	13	16	0	**500**
S_3	8 100	4 100	14	12	10 400	0 225	**825**
S_4	14	22	20	8 150	18	0 225	**375**
Demand	**350**	**400**	**250**	**150**	**400**	**450**	**2000**

Table: 10

Optimum Cost:

Supply	1	2	2	3	3	3	3	4	4
Demand	2	1	3	1	2	5	6	4	6
Cost	600	1500	3000	800	400	4000	0	1200	0
Optimum Cost									11,500

Table: 11

Example 2: Consider the following unbalanced POM, cost for the transportation to be minimized.

	D_1	**D_2**	**D_3**	**Supply**
S_1	2	7	4	**5**
S_2	3	3	1	**8**
S_3	5	4	7	**7**
S_4	1	6	2	**14**
Demand	**2**	**9**	**18**	

Table: 12

By using the proposed methodology, the resulting basic feasible solution is

	D_1	**D_2**	**D_3**	**D_4**	**Supply**
S_1	2 $\boxed{2}$	7	4	0 $\boxed{3}$	**5**
S_2	3	3	1 $\boxed{8}$	0	**8**
S_3	5	4 $\boxed{7}$	7	0	**7**
S_4	1	6 $\boxed{2}$	2 $\boxed{10}$	0 $\boxed{2}$	**14**
Demand	**2**	**9**	**18**	**5**	**34**

Table: 13

Optimum Cost:

Supply	1	1	2	3	4	4	4
Demand	1	4	3	2	2	3	4
Cost	4	0	8	28	12	20	0
Optimum Cost							72

Table: 14

Example 3: Consider the following unbalanced POM, cost for the transportation to be minimized.

	D_1	**D_2**	**D_3**	**D_4**	**Supply**
S_1	4	6	8	13	**500**
S_2	13	11	10	8	**700**
S_3	14	4	10	13	**300**
S_4	9	11	13	3	**500**
Demand	**250**	**350**	**1050**	**200**	

Table: 15

By using the proposed methodology, the resulting basic feasible solution is

	D_1	D_2	D_3	D_4	D_5	Supply
S_1	4	6	8 500	13	0	500
S_2	13	11 50	10 550	8	0 100	700
S_3	14	4 300	10	13	0	300
S_4	9 250	11	13	3 200	0 50	500
Demand	250	350	1050	200	150	2000

Table: 16

Optimum Cost:

Supply	1	2	2	2	3	4	4	4
Demand	3	2	3	5	2	1	4	5
Cost	4000	550	5500	0	1200	2250	600	0
Optimum Cost								14,100

Table: 17

3. Comparison with existed methods:

Comparison with North West Corner method (NWC) :

Example	NWC	CeCALAiROCD	Accuracy in %
1	19700	11500	171.30
2	112	72	155.56
3	15150	14100	107.45
Average Accuracy with NWC			144.77

Table: 18

Comparison with Vogal's Approximation method (VAM):

Example	VAM	CeCALAiROCD	Accuracy in %
1	12250	11500	106.52
2	74	72	102.78
3	14100	14100	100.00
Average Accuracy with VAM			103.10

Table: 19

Comparison with Least Cost method (LCM) :

Example	LCM	CeCALAiROCD	Accuracy in %
1	11500	11500	100.00
2	70	72	97.22
3	13650	14100	96.81
Average Accuracy with LCM			98.01

Table: 20

4. Results and Discussion:

Average Accuracy	
With NWC	144.77
With VAM	103.10
With LCM	98.01
Overall Accuracy	115.29

Table: 21

The optimal feasible solution of the proposed methodology is **115.29%**, which is **15.29%** more accurate than the existing optimization methods..

References

1. Amaravathy, V. Seerengasamy, S. Vimala, Comparative study on MDMA Method with OFSTF Method in Transportation Problem, International Journal of Computer & Organization Trends(IJCOT) – Volume 38 Number 1 - December 2016, ISSN 2249-2593.
2. Amaravathy, K. Thiagarajan , S. Vimala, Cost Analysis – Non linear Programming Optimization Approach , International Journal of pure and applied mathematics Volume 118 No.10 2018, 235-245 ISSN:1311-8080(printed version), ISSN:1314-3395(on –line version)
3. Amaravathy, K. Thiagarajan, S. Vimala, MDMA Method –An Optimal Solution for Transportation Problem, Middle – East Journal of Scientific Research 24(12):3706-63710,2016 ISSN 1990-9233
4. Amaravathy, K. Thiagarajan , S. Vimala, Optimal Solution of OFSTF, MDMA Methods with Existing Methods Comparison, International Journal of pure and applied mathematics Volume 119 No.10 2018, 989-1000 ISSN:1311-8080(printed version), ISSN:1314-3395(on –line version)
5. Gass, SI (1990). On solving the transportation problem. Journal of Operational Research Society, 41(4), 291-297.
6. Goyal, SK (1984). Improving VAM for unbalanced transportation problems. Journal of Operational Research Society, 35(12), 1113-1114.
7. K. Thiagarajan, A. Amaravathy, S. Vimala, K. Saranya (2016). OFSTF with Non linear to Linear Equation Method – An Optimal Solution for Transportation Problem, Australian Journal of Basic and Applied Sciences, ISSN – 1991-8178 Anna University-Annexure II, SI No. 2095.
8. Reinfeld, NV and WR Vogel (1958). Mathematical Programming. Englewood Gliffs, New Jersey: Prentice-Hall.
9. Shih, W (1987). Modified Stepping-Stone method as a teaching aid for capacitated transportation problems. Decision Sciences, 18, 662-676.
10. S. Vimala, K. Thiagarajan, A. Amaravathy, OFSTF Method –An Optimal Solution for Transportation Problem, Indian Journal of Science and Technology, Vol 9(48), DOI:17485/ijst/2016/v9i48/97801, December 2016. ISSN (Print) : 0974-6846 ,ISSN (Online) : 0974-5645..