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A Little Modification in Least Cost Method for Unbalanced Transportation Problem

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Abstract

Operation research is a branch of mathematics whereas Transportation problem is sub-branch of operation research. Transportation Problem can be solved by many methods such as North West Corner Rule (NWC), Least Cost Method (LCM), and Vogel's Approximation Method (VAM) etc. In this paper we are discussing Least Cost Method for unbalanced transportation problem and way of allocations to dummy row/column. We have made a few modifications in our proposed algorithm which gives minimum cost or nearer to optimal cost.

Terms used: Transportation Problem, LCM, VAM, unbalanced transportation problem, Feasible Solution, Optimal Solution.

Existing Methods: Initially we mention that there are several algorithms exists for finding feasible solution of Transportation Problem such as North West Corner Rule (NWC), Least Cost Method (LCM), Vogel's Approximation Method (VAM) etc.

Existing algorithm of LCM is given below:

Step-1: Find the minimum/smallest cost element in the cost matrix.

Step-2: Allocate to the least/smallest element as per demand and supply. Allocate min (Supply, Demand).

Step-3: If minimum cost appear in two or more times in a cost matrix allocate as much as possible to the variable with the least cost in the selected row or column.

Step-4: Give the supply and demand and cross the satisfied row or column.

Step-5: For second allocation find the next least element and allocate according demand and supply.

Step-6: Continue the process until all demands and supply exhausted .

Step-7: For total cost multiply allocations to initial costs and add

This existing method has confusion for a unbalanced transportation problem regarding allocation to zero in dummy row. So I have suggested a method for unbalanced problem which will remove the discrepancy of allocation to zero.

Proposed: LCM method for Unbalanced Transportation Problem.

Unbalanced Transportation Problem: The transportation problem in which sum of demand is not equal to sum of supply is called unbalanced transportation problem. To solve UBTP first we make it balance by adding Dummy row/Column having cost zero.

Step-1: If the transportation is unbalanced add dummy Row/column with zero cost.
(i) If sum of demand is less than sum of supply then add Dummy column with Demand=(Sum of supply-Sum of demand)
(ii) If sum of supply is less than sum of demand then add Dummy row with Supply=(Sum of demand-Sum of supply)

Step-2: Now in balanced transportation problem find the minimum/smallest element.

Step-3: In all zeros of dummy row/column to which zero we have to allocate is confusion

Step-4: Firstly allocate that zero which is in the last row & in RHS of table which will

break the tie and will give least cost as compared with other than last row zero allocations.

Step-5: Give the supply and demand and cross the satisfied row or column.

Step-6: For second allocation find the next least element and allocate according demand and supply

Step-7: Continue the process until all demands and supply exhausted.

Step-8: For total cost multiply allocations to initial costs and add.

We are discussing here some examples for verification of method:-

Examples of unbalanced transportation problem

Example 1: Solve the following Transportation problem by LCM.

Source	**Destinations**					**Supply**
	F1	**F2**	**F3**	**F4**	**F5**	
M1	5	4	8	6	**5**	**600**
M2	4	5	4	3	**2**	**400**
M3	3	6	5	8	**4**	**1000**
Demand	**450**	**400**	**200**	**250**	**300**	

Solution: Since the given problem is unbalanced Transportation Problem so we will add dummy row to make it balance.

Source	**Destinations**					**Dummy**	**Supply**
	F1	**F2**	**F3**	**F4**	**F5**		
M1	5	4	8	6	**5**	**0**	**600**
M2	4	5	4	3	**2**	**0**	**400**
M3	3	6	5	8	**4**	**0**	**1000**
Demand	**450**	**400**	**200**	**250**	300	400	2000/2000

Method 1

In table 1 we are allocating to zero of first row as minimum element

Table 1

Source	Destinations						
	F1	**F2**	**F3**	**F4**	**F5**	**Dummy**	**Supply**
M1	5	4^{200}	8	6	**5**	$\mathbf{0^{400}}$	**600**
M2	4	5	4	3^{100}	$\mathbf{2^{300}}$	**0**	**400**
M3	3^{450}	6^{200}	5_{200}	8^{150}	**4**	**0**	**1000**
Demand	**450**	**400**	**200**	**250**	300		

Total cost = 4x200 +0x400 +3x100+ 2x300 + 6x200 +5x200 +8x150 + 3x450=**6450**

In table 2 we are allocating to zero of second row as minimum element

Table 2

Source	Destinations						
	F1	**F2**	**F3**	**F4**	**F5**	**Dummy**	**Supply**
M1	5	4^{400}	8	6^{200}	**5**	**0**	**600**
M2	4	5	4	3	**2**	$\mathbf{0^{400}}$	**400**
M3	3^{450}	6	5^{200}	8^{50}	$\mathbf{4^{300}}$	**0**	**1000**
Demand	**450**	**400**	**200**	**250**	300		

. Total cost = 4x400 +0x400 + 4x300 + 6x200 +5x200 +8x50 + 3x450=**6750**

In table 3 we are allocating to zero of third row as minimum element

Table 3

Source	Destinations						
	F1	**F2**	**F3**	**F4**	**F5**	**Dummy**	**Supply**
M1	5	4^{400}	8^{50}	6^{150}	**5**	**0**	**600**
M2	4	5	4	3^{100}	$\mathbf{2^{300}}$	**0**	**400**
M3	3^{450}	6	5^{150}	8	**4**	$\mathbf{0^{400}}$	**1000**
Demand	**450**	**400**	**200**	**250**	300		

Total cost : 4x400+ 8x50 +6x150+ 3x100+ 2x300 +3x450 + 5x150 +0x400=**5900**

Example 2 : Solve transportation problem by LCM

DESTINATION / WAREHOUSE	**A**	**B**	**C**	**Supply**
X	11	21	16	14
Y	7	17	13	26
Z	11	23	21	36
Demand	18	28	25	71/76

Solution:

Since the given problem is unbalanced Transportation Problem so we will add dummy row to make it balance.

Table 1

DESTINATION / WAREHOUSE	**A**	**B**	**C**	**DUMMY**	**Supply**
X	11	21	16^{9}	0^{5}	14
Y	7^{18}	17	13^{8}	0	26
Z	11	23^{28}	21^{8}	0	36
Demand	18	28	25	05	76/76

Total cost = 7x18+23x28+16x9+13x8+21x8+0x5=**1186**

Table 2

DESTINATION / WAREHOUSE	**A**	**B**	**C**	**DUMMY**	**Supply**
X	**11**	**21**	**16^{14}**	**0**	**14**
Y	**7^{18}**	**17**	**13^{3}**	**0^{5}**	**26**
Z	**11**	**23^{28}**	**21^{8}**	**0**	**36**
Demand	**18**	**28**	**25**	**05**	**76/76**

Total cost=7x18+23x28+16x14+13x3+21x8+0x5=**1201**

Table 3

DESTINATION / WAREHOUSE	**A**	**B**	**C**	**DUMMY**	**Supply**
X	**11**	**21**	**16^{14}**	**0**	**14**
Y	**7^{18}**	**17^{8}**	**13**	**0**	**26**

Z	**11**	**23 ^{20}**	**21 ^{11}**	**0^{5}**	**36**
Demand	**18**	**28**	**25**	**05**	**76/76**

Total cost=7x18+17x8+23x20+16x14+21x11+0x5=**1177**

Observation: in above Example-1 least cost method gives the feasible solution

Table 1	**6450**	5600	Assigned zero of first row
Table 2	**6750**	5600	Assigned zero of second row
Table 3	**5900**	5600	Assigned zero of third row

In Example 2

Table 1	**1186**	1119	Assigned zero of first row
Table 2	**1201**	1119	Assigned zero of second row
Table 3	**1177**	1119	Assigned zero of third row

Result Analysis: In above two examples we observed that by assigning to zero of last row it provides the better solution than other zeros (except the zero of last row). We also tried it for another unbalanced problems and found the same observation.

Conclusion: In this paper we observed that unbalanced transportation problem solved by Least Cost Method gives the minimum cost when zero in the last row allocated first. The solution/cost given by this method is not optimal but it removes the discrepancy of allocation of zeros in dummy row. Allocations made by this criterion may give minimum solution as compared with another but not guaranteed for all problems of different kinds.

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