International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-2 Issue-5, June 2013

# A New Method for Obtaining an Optimal Solution for Transportation Problems

**S. Ezhil Vannan, S. Rekha**

***Abstract— In this paper a new method is proposed for finding an optimal solution for a wide range of transportation. This method is easy to understand and use compared to other methods. The main feature of this method is that it requires very simple arithmetical and logical calculations and avoids large number of iterations. This method is very efficient for those decision makers who are dealing with logistics and supply chain related issues. This method can easily adopt among the existing method.***

***Key words: Transportation problem, Exponential approach, cost matrix, optimal solution.***

## I. INTRODUCTION

Transportation problem is a special variety of classical linear-programming problem. The objective of the transportation problem is to provide the following information to the decision makers: what quality should be transported from a manufacturing unit to all possible destinations? And what would be the cost for this allocation? Transportation problem is a particular class of linear programming, which is associated with day-to-day activities in our real life and mainly deals with logistics. It helps in solving problems on distribution and transportation of resources from place to another. Transportation problems deal with transportation of a single product manufactured at different plants (supply origins) to a number of different warehouses (demand destination). The objective is to satisfy the demand at destination from the supply constraint at the minimum transportation cost possible.
The objective of the transportation model is to determine the amount to be shipped from each source to each destination so as to maintain the supply and demand requirements at the lowest transportation cost.

## II. PROPOSED METHOD (EXPONENTIAL APPROACH)

**Step 1: Formulation**
Construct the transportation model (Table) from the given transportation problem.
**Step 2: Row & Column reduction**
Subtract each row entries of the transportation table from the respective row minimum and then subtract each column entries of the transportation table from the respective column minimum, so that each row and column will have least one zero.
**Step 3: Assigning Exponential penalties**

**Manuscript published on 30 June 2013.**
***** Correspondence Author (s)
**Prof. S. EZHIL VANNAN***, Mechanical Engineering Dept, VTU Belgaum / Engineering college/ HKCKCE/, Bangalore, India ,
**Prof. S.REKHA**, Electronics & Communication VTU Belgaum / Engineering college/ EPWCE/, Bangalore, India.



Now there will be at least one zero in each row and column in the reduced cost matrix. Select the first zero (row wise) occurring in the cost matrix.
Count the total number of zeros excluding the selected one in the corresponding row and column. And then assign exponential penalties (sum of zeros in respective row and column). Repeat the procedure for all zeros in the matrix.
**Step 4: Optimality Test**
Now choose a zero for which the minimum exponential penalty is assigned from step 3 and allocate the respective cell value with maximum possible amount.
If tie occurs for any cell in the penalty values then first check for the corresponding value in demand and supply, find its average value and assign the allocation for least average value. And if again tie occurs then check the corresponding value in the rows and column and select the minimum.
**Step 5:**
After performing step 4 delete the row or column (where supply or demand becomes zero) for further calculation.
**Step 6:**
Check whether the resultant matrix possesses at least one zero in each column and in each row. If not repeat step2, otherwise go to step 7.
**Step 7:**
Repeat step 3 to step 6 untill and unless all the demands are satisfied and all the supplies are exhausted.
**Step 8:**
For the allocated values calculate the optimal cost.

## III. NUMERICAL EXAMPLE

Consider the following cost minimizing transportation problem with the three origins and four destinations.

**Step1: Mathematical Formulation:**
Construct the transportation table from the given transportation problem

| To / From | D1 | D2 | D3 | D4 | Supply |
|---|---|---|---|---|---|
| S1 | 13 | 20 | 25 | 8 | 8 |
| S2 | 50 | 20 | 25 | 45 | 10 |
| S3 | 25 | 6 | 55 | 10 | 11 |
| Demand | 4 | 7 | 6 | 12 | 29 / 29 |


Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

**Step 2: Row reduction & Column reduction:**
Subtract each row entries of the transportation table from the respective row minimum and then subtract each column entries of the transportation table from the respective column minimum.

(i) Subtracting row minimum:

| To / From | D1 | D2 | D3 | D4 | Supply |
|---|---|---|---|---|---|
| S1 | 5 | 12 | 17 | 0 | 8 |
| S2 | 30 | 0 | 5 | 25 | 10 |
| S3 | 19 | 0 | 49 | 4 | 11 |
| Demand | 4 | 7 | 6 | 12 | 29 |

(ii)Subtracting column minimum:

| To / From | D1 | D2 | D3 | D4 | Supply |
|---|---|---|---|---|---|
| S1 | 0 | 12 | 17 | 0 | 8 |
| S2 | 30 | 0 | 0 | 25 | 10 |
| S3 | 19 | 0 | 49 | 4 | 11 |
| Demand | 4 | 7 | 6 | 12 | 29 |

**Step 3:**
Now there will be at least one zero in each row and column in the reduced cost matrix. Select the first zero (row wise) occurring in the cost matrix. Count the total number of zeros excluding the selected one in the corresponding row and column. And then assign exponential penalties (sum of zeros in respective row and column). Repeat the procedure for all zeros in the matrix.

| Position | No.of zeros |
|---|---|
| (1,1) | 1 |
| (1,4) | 1 |
| (2,2) | 2 |
| (2,3) | 1 |
| (3,2) | 1 |

**Step4:**
Now choose a zero for which the minimum exponential penalty is assigned from step 3 and allocate the respective cell value with maximum possible amount.
If tie occurs for any cell in the penalty values then first check for the corresponding value in demand and supply, find its average value and assign the allocation for least average value. And if again tie occurs then check the corresponding value in the rows and column and select the minimum.
The tie occurs at position (1,1),(1,4),(2,3) &(3,2) then check the values in demand and supply and find the respective average value
1. (8, 4) =8+4/2=6
2. (8, 12) =8+12/2=10
3. (10, 12) =10+12/2=11
4. (11,6 ) =11+6/2=8.5
Hence select the minimum average value of cell (1,1) and allocate the respective cell as shown below

| To / From | D1 | D2 | D3 | D4 | Supply |
|---|---|---|---|---|---|
| S1 | $0^1$ | 12 | 17 | $0^1$ | ~~8~~ 4 |
| S2 | (4) | $0^2$ | $0^1$ | 25 | 10 |
| S3 | 19 | $0^1$ | 49 | 4 | 11 |
| Demand | 4 | 7 | 6 | 12 | 25 |

(8,4) √ ,(8,12), (10,12), (11,6)

**Step 5:**
After performing step 4, demand of D1 is zero. Hence delete the column D1

**Step 6:**
Check whether the resultant matrix possesses at least one zero in each column and each row, if not repeat step2. Otherwise go to step7.

(4,12) √
(10,6)
(7,11)

| To / From | D2 | D3 | D4 | Supply |
|---|---|---|---|---|
| S1 | 12 | 17 | $0^1$ | 0 |
| | | | | |
| S2 | $0^2$ | $0^1$ | (4) | 10 |
| S3 | $0^1$ | 49 | 4 | 11 |
| Demand | 7 | 6 | ~~12~~ 8 | 21 |

Next position is (1,4), again tie exist for cell values (1,4),(2,3) & (3,2) then check the values in demand and supply and find the respective average value
1. (4, 12) =4+12/2=8
2. (10, 6) =10+6/2=8
3. (7, 11) =7+11/2=9


Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Supply of S1 is zero. Hence delete row S1

| To / From | D2 | D3 | D4 | Supply |
|---|---|---|---|---|
| S2 | $0^2$ | $0^1$ | 21 | 10 |
| S3 | $0^2$ | 49 | $0^1$ | 11 |
| Demand | 7 | 6 | 8 | 21 |

(10,6)
(11,8)
√

Next position is (2, 3), again tie exist for cell values (2,3) & (3,4) then check the values in demand and supply and find the respective average value.

1. (10, 6) =10+6/2=8
2. (11,8) =11+8/2=9.5

Demand of D3 is zero. Hence delete the column D3

| To / From | D2 | D4 | Supply |
|---|---|---|---|
| S2 | $0^1$ (4) | 21 | 0 |
| S3 | $0^2$ | $0^1$ | 11 |
| Demand | ~~7~~ 3 | 8 | 11 |

(4,7) √
(11,8)

Next position is (2, 2), again tie exist for cell values (2,2) & (3,4) then check the values in demand and supply and find the respective average value

1. (4, 7) =4+7/2=5.5
2. (11, 8) =11+8/2=9.5

Supply of S2 is zero. Hence delete row S2

Delete the row minimum from the cell and the column minimum from that cell.

| To / From | D2 | D4 | Supply |
|---|---|---|---|
| S3 | 0 | 0 | 11 |
| Demand | (3) | (8) | 29 (Total) |

**Step7:**

Repeat step 3 to step 6 until and unless all the demands are satisfied and all the supplies are exhausted.

**Optimum solution:**

| To / From | D1 | D2 | D3 | D4 | Supply |
|---|---|---|---|---|---|
| S1 | 13 | 20 (4) | 25 | 18 (4) | 8 |
| S2 | 50 | 20 (4) | 25 (6) | 45 | 10 |
| S3 | 25 | 6 (3) | 55 | 10 (8) | 11 |
| Demand | 4 | 7 | 6 | 12 | 29 |

**Step8:** The total cost associated with these allocations is (4*13+8*4+20*4+25*6+3*6+10*8)= 52+32+80+150+18+80= **Rs. 412**

## IV. CONCLUSIONS

Thus it can be concluded that the proposed method provides an optimal solution in less number of iterations, directly for the given transportation problem. As this method required less number of time and is very easy to understand and apply. So it will be very helpful for decision makers who are dealing with logistic and supply chain problem.

## REFERENCES

[1] G.B. Dantzig, Linear programming and extensions, Princeton University Press, Princeton, NJ 1963.
[2] Taha. H.A., Operations Research- Introduction, Prentice Hall of India (PVT), New Delhi, 2004.
[3] Sharma . J.K., Operations Research- Theory and applications, Macmillan India (LTD), New Delhi, 2005.
[4] V.J.Sudhakar, N. Arunsankar and T. Karpagam, A New approach for finding an Optimal solution for transportation Problems. *European journal of scientific Research, vol 68, pp.254-257,2012.*
[5] Chandrasekhar Putcha, Aditya K. Putcha, MD Rohul Amin Bhuiysn and Nasima Farzana Hoque, Development of New Optimal Method for solution of Transportation portation Problems Preceding of world Congress on Engineering 2010.
[6] H.Arsham, Post optimality analyses of the transportation problem, Journal of the Optimal Research Society, vol 43, pp. 121-139, 1992.
[7] A. Henderson and R. Schlaifer Mathematical programming: Better information for better decision making, *Harvard Buisness Review*, vol 32, pp.73-100, 1954.
[8] Koopmans T. C., Optimum Utilization of Transportation System, *Econometrica*, Supplement vol 17, 1949.

**S.EZHIL VANNAN,** obtained B.E, in Mech. Engg.,, ME in Manufacturing Science, and c pursuing Ph.D under Bangalore University in Composites Materials. His research interest include Natural fiber Reinforced MMC,optimization and Mathematical Modeling etc

**Rekha.S,** obtained B.E in Medical Electronics Engg.., ME in Control& Instrumentation. Having teaching experience of 7years. Reasearch intrest Biomedical signal processing, Image processing and Optimization


*Published By:*
*Blue Eyes Intelligence Engineering*
*and Sciences Publication (BEIESP)*