International Journal of Research in Advent Technology, Vol.6, No.10, October 2018
E-ISSN: 2321-9637
Available online at www.ijrat.org

A Zero suffix algorithm to solve Interval Integer Transportation Problem

M.K.Purushothkumar[1], M.Ananathanarayanan[2], S.Dhanasekar[3]
[1]*Dr.Ambedkar Govt Arts College, Chennai-39, mkpurushoth2004@gmail.com*
[2]*A.M.Jain College,Chennai-114, ananthanarayanan47@yahoo.com*
[3]*VIT , Chennai Campus .dhanasekar.sundaram@vit.ac.in*

Abstract-In this paper we used Fuzzified version of zero suffix algorithm for solving Interval Integer Transportation problem. To explain the algorithm an example is solved .

Keywords- Interval Fuzzy number; Interval arithmeticoperations,;Interval ranking techniques; Interval Integer Transportation problems,;Zero suffix algorithm..

1. INTRODUCTION

In an industry transporting goods from various sources to various sinks with the minimum cost is a vital part of their minimizing cost of production. Plenty of algorithms were developed to solve transportation problems with certain parameters. In practical situations it is difficult to determine those parameters in precise. To overcome these vagueness various researchers [1-3,5 -8,12] proposed various techniques like fuzzy and interval numbers. Very few researchers worked in interval integer transportation problems. Juman et al., [6] proposed a heuristic technique for solving transportation problems with interval numbers. Das et al. [3] solved interval transportation problem using the right bound and the midpoint of the interval. Sengupta et al., [11] developed a method to solve interval transportation problems by considering the midpoint and width of the interval in the objective function. Safi et al.,[10] solved a fixed charge transportation problems by converting the interval fuzzy constraints into multi-objective fuzzy constraints,.Pandian et al.,[9] applied separation method for solving fully interval integer transportation problems. Purushothkumar et al.. [13] developed diagonal optimal algorithm to solve interval integer transportation problems. In this article we proposed zero suffix algorithm to solve interval integer transportation problem. The midpoint ranking technique was used to rank the fuzzy numbers in this article. The algorithm is illustrated through an example. This algorithm may useful for the decision makers to solve interval integer transportation problems. The organization of this article is given as follows:In section 1relevant definition are given. Section 2 deals with the proposed new algorithm. An example is given in Section 3. Conclusion is given in Section 4.

2. BASIC DEFINITIONS

2.1 Definition:

An interval number A is defined as $A = [a_1, a_2] = \{x: a_1 \le x \le a_2, x \in \mathbb{R}\}$. Here $a_1, a_2 \in \mathbb{R}$ are the lower and upper bound of the intervals [4].

2.2 Definition:

Interval Numbers Arithmetic [4]

Let $A = [a_1, a_2]$and $B = [b_1, b_2]$ are two interval numbers.

Addition:$A + B = [a_1, a_2] + [b_1, b_2] = [a_1 + b_1, a_2 + b_2]$.

Subtraction $A - B = [a_1, a_2] - [b_1, b_2] = [a_1 - b_2,\ a_2 - b_1]$.

Multiplication: $A * B = [x, y]$where $x = \min\ \{a_1b_1, a_1b_2, a_2b_1, a_2b_2\}$and $y = \max\ \{a_1b_1, a_1b_2, a_2b_1, a_2b_2\}$.

2.3 Definition:

Let $A = [a_1, a_2]$and $B = [b_1, b_2]$ are two interval numbers. Let $\alpha = \frac{a_1+a_2}{2}$and $\beta = \frac{b_1+b_2}{2}$.

If $\alpha \le \beta$ then $A \preccurlyeq B$. If $\alpha \ge \beta$ then$A \succcurlyeq B$.

2.4 Definition

Equivalent Interval number: Two interval numbers$A = [a_1, a_2]$and $B = [b_1, b_2]$ are said to be equivalent if their crisp values $[R(A) = R(B)]$ are equal.

2.5Interval Integer Transportation problems

Minimize$[z_1, z_2]$=$\sum_{i=1}^{m}\sum_{j=1}^{n}[\mathrm{C_{ij}}, \mathrm{D_{ij}}] * [x_{ij}, y_{ij}]$

Subject to$\sum_{i=1}^{m}[\mathrm{x_{ij}} y_{ij}]$,=$[s_i, s_j]$,$\sum_{j=1}^{n}[\mathrm{x_{ij}} y_{ij}]$=$[d_i, d_j]$, $i = 1,2, \dots m$ $j = 1,2 \dots n$.

$[z_1, z_2]$=$\sum_{i=1}^{m}\sum_{j=1}^{n}[\mathrm{C_{ij}}, \mathrm{D_{ij}}] * [x_{ij}, y_{ij}]$	total interval transportation cost
$[s_i, s_j]$	the total fuzzy availability of the product at i^{th} source

$[d_i, d_j]$	the total fuzzy demand of the product at j^{th} destination
$[C_{ij}, D_{ij}]$	unit fuzzy transportation cost from the i^{th} source to the j^{th} destination
$[x_{ij} y_{ij}]$	the number of approximate units of the product that should be transported from the i^{th} source to j^{th} destination or fuzzy decision variables

3. PROPOSED ALGORITHM

The new algorithm is as follow:

Step 1.

Construct the Interval fuzzy transportation table for the given Interval Integer transportation problem and then, convert it into a balanced one, if it is not. Subtract each row entries of the interval transportation table from the row minimum. Do the same for columns also.

Step 2.

In the reduced cost matrix there will be at least one interval fuzzy zero in each row and column. Find interval fuzzy suffix value$\tilde{S}$ of all theInterval fuzzy zeros in the reduced cost matrix by the ratio of addition interval fuzzy costs of nearest adjacent sides of interval fuzzy zeros which are greater than interval fuzzy zero to the number of interval fuzzy values added. Here we should take the denominator as interval fuzzy values. i.e., if the number of values is 3, we should take that as fuzzy number [3,3].

$\tilde{S}$= Addition of the fuzzy costs of adjacent sides of fuzzy zero which are greater than fuzzy zero/number of fuzzy values added.

Step 3.

Choose the maximum of$\tilde{S}$, if it has one maximum value then first supply to that interval fuzzy demand corresponding to that cell. If it has more equal interval fuzzy values then select any one and supply to that interval fuzzy demand maximum possible.

Step 4.

After the above step, the exhausted interval fuzzy demands or interval fuzzy supplies to be trimmed. The resultant interval fuzzy matrix possess at least one interval fuzzy zero in each row and column else repeat Step 1.

Step 5.

Repeat Step 3 to Step 4 until the optimal solution is obtained.

Section-3

Example 1

Consider the following interval integer transportation problem

$$\begin{array}{c} \\ S_1 \\ S_2 \\ S_3 \\ Demand \end{array}\begin{array}{c} \begin{array}{cccc} D_1 & D_2 & D_3 & D_4 \end{array} \\ \begin{pmatrix} [3,5] & [2,6] & [2,4] & [1,5] \\ [4,6] & [7,9] & [7,10] & [9,11] \\ [4,8] & [1,3] & [3,6] & [1,2] \\ [10,12] & [2,4] & [13,15] & [15,17] \end{pmatrix} \end{array}\begin{array}{c} Supply \\ [7,9] \\ [17,21] \\ [16,18] \\ [40,48] \end{array}$$

Applying the proposed algorithm

$$\begin{pmatrix} [-1,3] & [-4,5] & [-2,2] & [-3,3] \\ [-2,2] & [-1,6] & [1,6] & [3,7] \\ [2,7] & [-3,3] & [1,5] & [-1,1] \end{pmatrix}$$

The interval fuzzy zeros are in the position (1,3), (1,4),(2,1),(3,2),(3,4) of the reduced matrix. If we take the fuzzy zero in the (1,3), the adjacent values [-4,5], [1,6]which are greater than fuzzy zero. So the interval fuzzy suffix value for that position (1,3) is given by$\frac{[-4,5]+[1,6]}{[2,2]}$, where the interval fuzzy number [-1.5,5.5] is the interval fuzzy value of the number of adjacent values which are greater than fuzzy zero added. Similarly find the fuzzy suffix value for all other fuzzy zeros. The values are given below : for the position(1,4)is [3,7], for the position (2,1) is[0,5.33], for the position (3,2) is [0.66,6] and for the position(3,4) is [2,6]. Out of all these interval fuzzy suffix value, the interval fuzzy suffix value of fuzzy zero in the position (1,4) is maximum. Therefore allocate the corresponding fuzzy supply or fuzzy demand whichever is less to that (1,4) position. From the problem it is noted that in that position the corresponding fuzzy supply [7,9] is minimum. So allocate the corresponding fuzzy supply [7,9] to that position and delete the corresponding row. Do these steps repetitively until all the requirements are satisfied.

The optimal solution is given by

$$\begin{pmatrix} [3,5] & [2,6] & [2,4] & [1,5]^{[7,9]} \\ [4,6]^{[10,12]} & [7,9]^{[2,4]} & [7,10]^{[1,9]} & [9,11] \\ [4,8] & [1,3] & [3,6]^{[6,12]} & [1,2]^{[6,10]} \\ [10,12] & [2,4] & [13,15] & [15,17] \end{pmatrix}\begin{array}{c} [7,9] \\ [17,21] \\ [16,18] \\ [40,48] \end{array}$$

The transportation cost is given by $[1,5]*[7,9]+[4,6]*[10,12]+[7,10]*[1,9]+[7,9]*[2,4]+[3,6]*[6,12]+[1,2]*[6,10]=[7,45]+[40,72]+[7,90]+[14,36]+[18,72]+[6,20]=[92,335]$.

4. CONCLUSION

An algorithm is proposed for solving interval integer transportation problem by using zero suffix algorithm. This algorithm is effective and easy to understand. This method can be used for solving special kind of interval integer transportation problems like unbalanced, prohibited routes and maximization problems.

REFERENCES

[1]S. Chanas and D. Kuchta, A concept of solution of the transportation problem with fuzzy cost co-efficient, Fuzzy Sets and Systems, volume 82 , pages 299 – 305, 1996.

[2] J.W. Chinneck and K. Ramadan , Linear programming with interval coefficients, Journal of the Operational Research Society, volume 51 , pages 209 – 220, 2000.

[3] S.K. Das, A. Goswami and S.S. Alam ,Multiobjective transportation problem with interval cost, source and destination parameters, European Journal of Operational Research, volume 117 , pages 100 – 112,1999.

[4] George J.Klir and Bo Yuan, Fuzzy sets and fuzzy logic: Theory and Applications , Prentice-Hall, 2008.

[5] Ishibuchi, H., Tanaka, H., Multiobjective programming in optimization of the interval objective function. European Journal of Operational Research, volume 48 , pages 219–225,1990.

[6] Juman, Z. A. M. S., and M. A. Hoque. A Heuristic Solution Technique to Attain theMinimal Total Cost Bounds of Transporting a Homogeneous Product with Varying Demands and Supplies,European Journal of Operational Research , volume 239 , pages 146–156,2014.

[6] R.E. Moore, Method and applications of interval analysis, SLAM, Philadelphia, PA, 1979.

[7] C. Oliveira and C.H. Antunes, Multiple objective linear programming models with interval coefficients – an illustrated overview, European Journal of Operational Research, volume 181, pages 1434–1463,2007.

[8] P.Pandian and G.Natarajan, A new algorithm for finding a fuzzy optimal solution for fuzzy transportation problems, Applied Mathematical Sciences, volume 4 , pages 79 – 90,2010.

[9] P.Pandian and G.Natarajan, A New method for finding an optimal solution of fully interval integer transportation problems, Applied Mathematical Sciences, volume 4(37) , pages 1819-1830,2010.

[10] Safi, M. R., and A. Razmjoo. Solving Fixed Charge Transportation Problem with Interval Parameters, AppliedMathematicalModelling, volume 37 (18–19), pages 8341–8347, 2013

[11] A. Sengupta and T.K. Pal , Interval-valued transportation problem with multiple penalty factors, VU Journal of Physical Sciences , volume 9, pages 71 – 81,2003.

[12] S.Tong, Interval number and fuzzy number linear programming, Fuzzy sets and systems, volume 66 , pages 301-306,1994.

[13] M.K.Purushothkumar, M.Ananathanarayanan and S.Dhanasekar, A Diagonal optimal algorithm to solve Interval Integer Transportation problems, International Journal of Applied Engineering Research, volume 13(18) , pages 13702-13704,2018.