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# To solve via best candidate method balanced and unbalanced dodecagonal transhipment problem

**S Vimala**
Assistant Professor, Department of Mathematics, Mother Teresa Women's University, Kodaikanal, Tamil Nadu, India

Corresponding Author: **S Vimala**

**Abstract**
Fuzzy transshipment refers to the fuzzy transportation dilemma in which an available commodity frequently moves from one source to another before arriving at its final destination. We determine the fuzzy optimal solution for the following transshipments throughout this paper: from a destination to any source, from a source to any other source, and from a destination to any source. Most widely utilized approaches for solving transportation problems are attempting to find the ideal answer; as a result, most of these methods are deemed complex and time-consuming to execute. In this work, we employ the best candidate method (BCM), whose central principle is to reduce the number of possible solutions by selecting the best candidates. This method is simple to learn and apply for determining the fuzzy optimal solution to fuzzy transportation problems involving transshipment in real-world settings.

**Keywords:** method balanced, candidate, dodecagonal, transhipment

## Introduction

The challenge is to determine the shortest route that visits each city precisely once and loops back to the starting point, given a collection of cities and the distances between each pair of cities. Be aware of the variations between TSP and the Hamiltonian Cycle. The Hamiltonian cycle problem aims to determine if there is a tour that stops in each city precisely once. Because the graph is complete in this instance, we know that a Hamiltonian Tour exists. In fact, there are many such tours; the challenge is identifying the Hamiltonian Cycle with the lowest weight.

The fuzzy travelling salesman problem aims to find the order or sequence that the salesman should visit each city, so that the total distance travelled or cost or time of travelling is minimum, with the constraint that the salesman should visit each city once and return to the starting point. In 2016, Dr. AbhaSinghaland Priyanka Pandey [1] gave an approach to solve the travelling salesman problems by dynamic programming algorithm. In 2011,2012,Khurana A, Verma T,Amitkumar and Anila Gupta has worked on some fuzzy assignment problems and fuzzy travelling salesman problems were solved by using classical assignment method and Yager's ranking method [2] Assignment and Travelling Salesman Problems with Coefficients as LR Fuzzy Parameters [3]. In 2019 Fuzzy Travelling Salesman Problem Using Fuzzy Number was solved by Dr. Amit Kumar Rana using triangular fuzzy number [23, 24]. Zadeh found a new approach for travelling salesman problems in crisp and fuzzy environment have received great attention in recent years [5]. In 2004 alabelling algorithm for the fuzzy assignment problem, Fuzzy Sets and Systems, has proposed by Chi Jen Lin and UePyng Wen, [6]. Dhanasekar. S, Hariharan .S and Sekar.P found a new approach for Classical Travelling Salesman Problem based approach to solve fuzzy TSP using Yager's ranking [7] in 2013.

An Approach for Solving Fuzzy Transportation Problem and One's Assignment method for solving Travelling Salesman Problem", has proposed by HadiBasirzadeh [29, 30] in 2011and 2016."Hungarian method to solve Travelling Salesman Problem with fuzzy cost" has developed by JagunathNayak, Sudharsan Nanda and Srikumar Acharya [29] in 2017. "A new approach for solving Travelling Salesman Problem with fuzzy numbers using dynamic programming" was urbanized by Mythili.V, Kaliyappan. M, Hariharan .S and Dhanasekar, in 2018.

In this paper, we proposed a two ranking technique for ranking the Dodecagonal fuzzy numbers. The idea is to transform a problem with fuzzy parameters to a crisp version in the TSP form and to solve it by Best candidate method. Other than the fuzzy assignment problem other applications of this method can be tried in project scheduling, sequencing, replacement problem, etc. Using this ranking the fuzzy assignment problem or fuzzy travelling salesman problem is converted to a crisp valued problem. The optimal solution can be got either as a fuzzy number or as a crisp number. In section 2 consists of preliminaries and definition of a fuzzy set and fuzzy numbers. In section 3, we present some results on using fuzzy Dodecagonal number and find the transportation cost.

## 2 Preliminaries

**Definition 2.1:** fuzzy set A fuzzy set $\tilde{A}$ is defined by $\tilde{A}$ = {(x, $\mu\tilde{A}$ $(x)$) /$x \in X$} Where $\mu\tilde{A}$ $(x)$ is called membership function of $x$ in $\tilde{A}$ which maps $X \rightarrow [0, 1]$.

**Definition 2.2:** Membership function A membership function for a fuzzy set A on the universe of discourse X is defined as $\mu AX \rightarrow [0,1]$ There each element of X is mapped to a value between 0 and 1. This value called as membership value or degree of membership, quantifies the grade of membership of the element in $X$ to the fuzzy set $A$.

**Definition 2.3:** A fuzzy number is generalization of a regular real number and which does not refer to a single value but rather to a connected a set of possible values, where each possible value has its weight between 0 and 1. This weight is called the membership function [9, 10]. A fuzzy number is a convex normalized fuzzy set on the real line R such that:

1) There exist at least one x$\epsilon$X, with $\mu_A(x) = 1$
2) $\mu_A(x)$ is piecewise continuous.

Generalized Fuzzy Number: A fuzzy set is defined on universal set of real numbers is said to be generalized fuzzy number if its membership function has the following attributes:

1. μA(x): R→ [0, 1] is continuous
2. μA(x): 0 for all x ϵA (-∞, A] U [d, ∞)
3. μA(x) is strictly increasing on [a, b] and strictly decreasing on [c, d]
4. μA(x) = w for all x ϵ [b, c], where 0 < w ≤ 1.

## 3. Dodecagonal Fuzzy Number

The membership function of dodecagonal fuzzy number $\tilde{A}$ = ($a$1,2, $a$3, $a$4, $a$5, $a$6, $a$7, $a$8, $a$9 , $a$10, $a$11, $a$12, ) Where ($a$1,$a$2, $a$3, $a$4, $a$5, $a$6, $a$7, $a$8, $a$9 , $a$10, $a$11, $a$12 ,$a$13, $a$14)are real numbers, is given by

### 3.1. Algorithm for balanced generalized dodecagonal Transhipment problem

Step 1: Find the cell shaving smallest and next to smallest cost in each row and write the difference (called penalty) along the side of the table in row penalty.

Step 2: Find the cell shaving smallest and next to smallest cost in each column and write the difference (called penalty) along the side of the table in column penalty.

Step 3: Select the row or column with the maximum penalty and find cell that has least cost in selected row or column. Allocate as much as possible in this cell.

If there is a tie in the values of penalties then select the cell where maximum allocation can be possible.

Step 4: Adjust the supply and demand and cross out (strike out) the satisfied row or column.

Step 5: Repeat this steps until all supply and demand values are 0.

### 3.2. Solving balanced generalized dodecagonal transhipment problem

| | $\widetilde{D_1}$ | $\widetilde{D_2}$ |
|---|---|---|
| $\widetilde{D_1}$ | (0,0,0,0,0,0,0,0,0,0,0,0) | (1,4,6,3,8,12,15,14,13,11,9,10) |
| $\widetilde{D_2}$ | (14,30,8,5,3,2,7,12,13,11,9,5) | (0,0,0,0,0,0,0,0,0,0,0,0) |

….

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ |
|---|---|---|
| $\widetilde{S_1}$ | (0,0,0,0,0,0,0,0,0,0,0,0) | (15,13,8,7,5,4,21,31,28,18,22,3) |
| $\widetilde{S_2}$ | (5,4,3,8,9,7,12,16,19,21,25,23) | (0,0,0,0,0,0,0,0,0,0,0,0) |

……

| | $\widetilde{D_1}$ | $\widetilde{D_2}$ | Supply |
|---|---|---|---|
| $\widetilde{S_1}$ | (7,8,12,15,13,11,5,21,25,29,31,1) | (9,8,5,7,21,22,1,3,31,35,12,13) | (21,18,13,1,8,9,31,12,3,4,6,1) |
| $\widetilde{S_2}$ | (15,21,23,9,8,6,3,4,12,15,31,35) | (14,11,8,3,5,7,21,19,31,18,13,2) | (2,3,8,9,12,15,21,11,3,31,25,2) |
| Demand | (4,8,12,3,5,1,12,21,25,31,24,18) | (21,18,15,14,13,12,11,9,25,2,3,1) | |

……..

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | Supply |
|---|---|---|---|
| $\widetilde{D_1}$ | (35,12,3,4,8,1,21,15,18,25,4,6) | (8,10,15,13,12,9,5,10,20,25,3,2) | (1,3,5,7,9,11,15,13,17,19,21,2) |
| $\widetilde{D_2}$ | (4,8,12,3,7,1,12,21,18,25,4,5) | (5,6,7,10,11,9,17,15,13,21,25,23) | (4,8,9,13,11,1,15,21,18,17,3,4) |
| Demand | (5,7,11,15,3,1,12,13,4,3,31,35) | (17,18,11,9,5,3,4,21,25,1513,4) | |

…….

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | $\widetilde{D_1}$ | $\widetilde{D_2}$ | Supply |
|---|---|---|---|---|---|
| $\widetilde{S_1}$ | (0,0,0,0,0, 0,0,0,0,0,0,0) | (15,13,8,7,5,4,21,31,28,18, 22,3) | (7,8,12,15,13,11,5,21,25,1 0,31,1) | (9,8,5,7,21,22,1,3,31,35,12 ,15) | (21,18,13,1,8,9,31,12,3,4 ,6,1) |
| $\widetilde{S_2}$ | (5,4,3,8,9,7,12,16,19,21, 25,23) | (0,0,0,0,0, 0,0,0,0,0,0,0) | (15,21,23,9,8,6,3,4,12,15,3 1,35) | (14,11,8,3,5,7,21,19,31,18, 13,2) | (2,3,8,9,12,15,21,11,3,31 ,25,2) |
| $\widetilde{D_1}$ | (35,12,3,4,8,1,21,15,18,2 5,4,6) | (8,10,15,13,12,9,5,10,20,2 5,3,2) | (0,0,0,0,0, 0,0,0,0,0,0,0) | (1,4,6,3,8,12,15,14,13,11,9 ,10) | (1,3,5,7,9,11,15,13,17,19 ,21,2) |
| $\widetilde{D_2}$ | (4,8,12,3,7,1,12,21,18,25 ,4,5) | (5,6,7,10,11,9,17,15,13,21, 25,23) | (14,30,8,5,3,2,7,12,13,11,9 ,5) | (0,0,0,0,0, 0,0,0,0,0,0,0) | (4,8,9,13,11,1,15,21,18,1 7,3,4) |
| Demand | (5,7,11,15,3,1,12,13,4,3, 31,35) | (17,18,11,9,5,3,4,21,25,15, 13,14) | (4,8,12,3,5,1,12,21,25,31,2 4,18) | (21,18,15,14,13,12,11,9,25 ,2,3,1) | |

Using ranking function (1) we get,
Decagonal Ranking formula:

$$M_{\circ}^{DECFN}(\tilde{A}) = \frac{1}{4}\{(a_1 + a_2 + a_{11} + a_{12})k_1 + (a_3 + a_4 + a_9 + a_{10})(k_2 - k_1) + (a_5 + a_6 + a_7 + a_8)(1 - k_2)\}, \quad where\ 0 < k_1 < k_2 < 1$$

*K=0.4, K=0.8*

$(2,4,8,6,10,7,9,3,5,11) = \frac{1}{4}\{(2+4+5+11)(0.4) + (8+6+9+3)(0.8-0.4) + (10+7)(1-0.8)\}$

$= \frac{1}{4}(22\times 0.4 + 26 \times 0.4 + 17 \times 0.2)$

$= \frac{1}{4}(6.184)$

$= 1.5$

| | $\tilde{S_1}$ | $\tilde{S_2}$ | $\tilde{D_1}$ | $\tilde{D_2}$ | Supply |
|---|---|---|---|---|---|
| $\tilde{S_1}$ | 0 | 5.83 | 1.69 | 1.64 | 2.19 |
| $\tilde{S_2}$ | 0.98 | 0 | 2.40 | 1.39 | 2.12 |
| $\tilde{D_1}$ | 1.01 | 1.38 | 0 | 1.29 | 1.49 |
| $\tilde{D_2}$ | 2.15 | 1.29 | 1.17 | 0 | 1.66 |
| Demand | 1.51 | 1.13 | 2.59 | 2.22 | |

By using best candidate method the allocations are obtained as follows,

Step 1:

| | $\tilde{S_1}$ | $\tilde{S_2}$ | $\tilde{D_1}$ | $\tilde{D_2}$ | Supply | |
|---|---|---|---|---|---|---|
| $\tilde{S_1}$ | 0.51 0 | 5.83 | 1.69 | 1.64 | 2.19 0.68 | 1.64 |
| $\tilde{S_2}$ | 0.98 | 0 | 2.40 | 1.39 | 2.12 | 0.98 |
| $\tilde{D_1}$ | 1.01 | 1.38 | 0 | 1.29 | 1.49 | 1.01 |
| $\tilde{D_2}$ | 2.15 | 1.29 | 1.17 | 0 | 1.66 | 1.17 |
| Demand | 1.51 0 | 1.13 | 2.59 | 2.22 | | |
| | 0.98 | 1.29 | 1.17 | 1.29 | | |

Step 2:

| | $\tilde{S_2}$ | $\tilde{D_1}$ | $\tilde{D_2}$ | Supply | |
|---|---|---|---|---|---|
| $\tilde{S_1}$ | 5.83 | 1.69 | 1.64 | 0.68 | 0.05 |
| $\tilde{S_2}$ | 1.13 0 | 2.40 | 1.39 | 2.12 0.99 | 1.39 |
| $\tilde{D_1}$ | 1.38 | 0 | 1.29 | 1.49 | 1.29 |
| $\tilde{D_2}$ | 1.29 | 1.17 | 0 | 1.66 | 1.17 |
| Demand | 1.13 0 | 2.59 | 2.22 | | |
| | 1.29 | 1.17 | 1.29 | | |

Step 3:

| | $\tilde{D_1}$ | $\tilde{D_2}$ | Supply | |
|---|---|---|---|---|
| $\tilde{S_1}$ | 1.69 | 1.64 | 0.68 | 0.05 |
| $\tilde{S_2}$ | 2.40 | 1.39 | 0.99 | 1.01 |
| $\tilde{D_1}$ | 0 | 1.29 | 1.49 | 1.29 |
| $\tilde{D_2}$ | 1.17 | 1.66 0 | 1.66 | 1.17 |
| Demand | 2.59 | 2.22 0.56 | | |
| | 1.17 | 1.29 | | |

Step 4:

| | $\tilde{D_1}$ | $\tilde{D_2}$ | Supply | |
|---|---|---|---|---|
| $\tilde{S_1}$ | 1.69 | 1.64 | 0.68 | 0.05 |
| $\tilde{S_2}$ | 2.40 | 1.39 | 0.99 | 1.01 |
| $\tilde{D_1}$ | 1.49 0 | 1.29 | 1.49 0 | 1.29 |
| Demand | 2.59 1.1 | 0.56 | | |
| | 1.69 | 0.1 | | |

Step 5:

| | $\tilde{D_1}$ | $\tilde{D_2}$ | Supply | |
|---|---|---|---|---|
| $\tilde{S_1}$ | 1.69 | 1.64 | 0.68 | 0.05 |
| $\tilde{S_2}$ | 2.40 | 0.56 1.39 | 0.99 0.43 | 1.01 |
| Demand | 1.1 | 0.56 0 | | |
| | 0.71 | 0.25 | | |

Transportation cost by using best candidate method is given by,

$0.68\times 1.69 + 0.43 \times 2.40 = 1.1492+1.032$

$= 2.18$

**4. Algorithm for unbalanced generalized octagonal transhipment problem**

Step 1**:** The total supply is not equal to the total demand. Thus, the transportation problem with unequal supply and demand is said to be unbalanced transportation problem.

Step 2: If the total supply is more than the total demand, we introduce and additional column, which will indicate the surplus supply with transportation cost zero.

Step 3: Similarly, if the total demand is more than the total supply, an additional row is introduced in the table which represent unsatisfied demand with transportation cost zero.

Step 4: Find the cellshaving smallest and next to smallest cost in each row and write the difference (called penalty) along the side of the table in row penalty.

Step 5: Find the cellshaving smallest and next to smallest cost in each column and write the difference (called penalty) along the side of the table in column penalty.

Step 6: Select the row or column with the maximum penalty and find cell that has least cost in selected row or column. Allocate as much as possible in this cell.

If there is a tie in the values of penalties then select the cell where maximum allocation can be possible.

Step 7: Adjust the supply and demand and cross out (strike out) the satisfied row or column

Step 8: Repeat this steps until all supply and demand values are 0.

**4.1. Solving unbalanced generalized decagonal transhipment problem**

| | $\tilde{D_1}$ | $\tilde{D_2}$ |
|---|---|---|
| $\tilde{D_1}$ | (0,0,0,0,0,0,0,0,0,0) | (9,7,5,3,1,17,15,13,11,0) |
| $\tilde{D_2}$ | (3,2,4,6,8,5,3,1,4,7) | (0,0,0,0,0,0,0,0,0,0) |

….

| | $\tilde{S_1}$ | $\tilde{S_2}$ |
|---|---|---|
| $\tilde{S_1}$ | (0,0,0,0,0,0,0,0,0,0) | (2,4,8,6,10,7,9,3,5, 11) |
| $\tilde{S_2}$ | (4,5,6,7,8,9,10,11,12,13) | (0,0,0,0,0,0,0,0,0,0) |

| | $\widetilde{D_1}$ | $\widetilde{D_2}$ | **Supply** |
|---|---|---|---|
| $\widetilde{S_1}$ | (2,4,6,8,10,11,12,13,14,15) | (3,4,5,6,7,8,9,10,11,12) | (2,1,3,6,7,9,5,8,10,0) |
| $\widetilde{S_2}$ | (4,6,8,10,12,14,16,18,20, 23) | (1,3,5,7,9,13,12,11,8,7) | (4,10,1,8,3,6,5,7,2,9) |
| Demand | (3,6,5,9,4,6,6,8,11,8) | (5,4,2,11,8,3,8,6,9,1) | |

....

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | Supply |
|---|---|---|---|
| $\widetilde{D_1}$ | (8,6,2,4,10,3,7,5,9,19) | (1,2,4,5,3,10,12,14,13,17) | (9,3,4,2,7,2,6,5,10,13) |
| $\widetilde{D_2}$ | (4,8,12,16,18,24,30,32,13,15) | (1,2,4,6,7,3,9,12,15,18) | (8,16,12,14,17,13,18,15,11,10) |
| Demand | (7,12,3,2,4,11,10,4,7,13) | (5,7,8,4,6,9,8,7,3,5,) | |

…

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | $\widetilde{D_1}$ | $\widetilde{D_2}$ | **Supply** |
|---|---|---|---|---|---|
| $\widetilde{S_1}$ | (0,0,0,0,0, 0,0,0,0,0) | (2,4,8,6,10, 7,9,3,5,11) | (2,4,6,8,10,11,12,13,14,15) | (3,4,5,6,7, 8,9,10,11,12) | (2,1,3,6,7, 9,5,8,10,0) |
| $\widetilde{S_2}$ | (4,5,6,7,8,9,10,11,12,13) | (0,0,0,0,0, 0,0,0,0,0) | (4,6,8,10,12,14,16,18,20, 23) | (1,3,5,7,9, 13,12,11,8,7) | (4,10,1,8,3,6,5,7,2,9) |
| $\widetilde{D_1}$ | (8,6,2,4,10,3,7,5,9,19) | (1,2,4,5,3, 10,12,14,13,17) | (0,0,0,0,0, 0,0,0,0,0) | (9,7,5,3,1, 17,15,13,11,0) | (9,3,4,2,7,2,6,5,10,13) |
| $\widetilde{D_2}$ | (4,8,12,16,18,24,30,32,13,15) | (1,2,4,6,7, 3,9,12,15,18) | (3,2,4,6,8, 5,3,1,4,7) | (0,0,0,0,0, 0,0,0,0,0) | (8,16,12,14,17,13,18,15,11,10) |
| Demand | (7,12,3,2,4,11,10,4,7,13) | (5,7,8,4,6, 9,8,7,3,5,) | (7,12,3,2,4, 11,10,4,7,13) | (5,7,8,4,6, 9,8,7,3,5,) | |

It is unbalanced transshipment problem. So, we take dummy column in given table,

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | $\widetilde{D_1}$ | $\widetilde{D_2}$ | **Dummy** | **Supply** |
|---|---|---|---|---|---|---|
| $\widetilde{S_1}$ | (0,0,0,0,0, 0,0,0,0,0) | (2,4,8,6,10, 7,9,3,5,11) | (2,4,6,8,10,11 ,12,13,14,15) | (3,4,5,6,7, 8,9,10,11,12) | (0,0,0,0,0, 0,0,0,0,0) | (2,1,3,6,7, 9,5,8,10,0) |
| $\widetilde{S_2}$ | (4,5,6,7,8,9,10,11,12,13) | (0,0,0,0,0, 0,0,0,0,0) | (4,6,8,10,12,1 4,16,18,20, 23) | (1,3,5,7,9, 13,12,11,8,7) | (0,0,0,0,0, 0,0,0,0,0) | (4,10,1,8,3,6,5,7,2,9) |
| $\widetilde{D_1}$ | (8,6,2,4,10,3,7,5,9,19) | (1,2,4,5,3, 10,12,14,13,17) | (0,0,0,0,0, 0,0,0,0,0) | (9,7,5,3,1, 17,15,13,11,0) | (0,0,0,0,0, 0,0,0,0,0) | (9,3,4,2,7,2,6,5,10,13) |
| $\widetilde{D_2}$ | (4,8,12,16,18,24,30,32,13, 15) | (1,2,4,6,7, 3,9,12,15,18) | (3,2,4,6,8, 5,3,1,4,7) | (0,0,0,0,0, 0,0,0,0,0) | (0,0,0,0,0, 0,0,0,0,0) | (8,16,12,14,17,13,18, 15,11,10) |
| Deman d | (7,12,3,2,4,11,10,4,7,13) | (5,7,8,4,6, 9,8,7,3,5,) | (3,6,5,9,4, 6,6,8,11,8) | (5,4,2,11,8, 3,8,6,9,1,) | (3,1,2,4,2, 1,2,3,3,2) | |

Using ranking function (1) we get,
Decagonal Ranking formula:

$M_{\circ}^{DECFN}(\tilde{A}) = \frac{1}{4}\{(a_1 + a_2 + a_9 + a_{10})k_1 + (a_3 + a_4 + a_7 + a_8)(k_2 - k_1) + (a_5 + a_6)(1 - k_2)\}$, $where\ 0 < k_1 < k_2 < 1$, K=0.4 , K=0.8

$(2,4,8,6,10,7,9,3,5,11) = \frac{1}{4}\{(2 + 4 + 5 + 11)(0.4) + (0.8 - 0.4) + (10 + 7)(1 - 0.8)\}$

$= \frac{1}{4}(22 \times 0.4 + 26 \times 0.4 + 17 \times 0.2)$

$= \frac{1}{4}(6.184)$

$= 1.55$

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | $\widetilde{D_1}$ | $\widetilde{D_2}$ | **Dummy** | **Supply** |
|---|---|---|---|---|---|---|
| $\widetilde{S_1}$ | 0 | 1.55 | 2.11 | 1.59 | 0 | 1.34 |
| $\widetilde{S_2}$ | 1.80 | 0 | 2.76 | 1.95 | 0 | 1.07 |
| $\widetilde{D_1}$ | 1.35 | 1.61 | 0 | 1.84 | 0 | 1.07 |
| $\widetilde{D_2}$ | 4.22 | 1.41 | 1.06 | 0 | 0 | 3.04 |
| Demand | 1.44 | 1.45 | 1.28 | 1.24 | 0.44 | |

By applying best candidate method the allocations are obtained as follows,

Step 1:

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | $\widetilde{D_1}$ | $\widetilde{D_2}$ | **Dummy** | **Supply** | |
|---|---|---|---|---|---|---|---|
| $\widetilde{S_1}$ | 0 | 1.55 | 2.11 | 1.59 | 0 | 1.34 | 1.55 |
| $\widetilde{S_2}$ | 1.80 | 1.07 0 | 2.76 | 1.95 | 0 | 1.07 0 | 1.80 |
| $\widetilde{D_1}$ | 1.35 | 1.61 | 0 | 1.84 | 0 | 1.07 | 1.35 |
| $\widetilde{D_2}$ | 4.22 | 1.41 | 1.06 | 0 | 0 | 3.04 | 1.06 |
| Demand | 1.44 | 1.45 0.38 | 1.28 | 1.24 | 0.44 | | |
| | 1.35 | 1.41 | 1.06 | 1.59 | 0 | | |

Step 2:

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | $\widetilde{D_1}$ | $\widetilde{D_2}$ | **Dummy** | **Supply** | |
|---|---|---|---|---|---|---|---|
| $\widetilde{S_1}$ | 0 | 1.55 | 2.11 | 1.59 | 0 | 1.34 | 1.55 |
| $\widetilde{D_1}$ | 1.35 | 1.61 | 0 | 1.84 | 0 | 1.07 | 1.35 |
| $\widetilde{D_2}$ | 4.22 | 1.41 | 1.06 | 1.24 0 | 0 | 3.04 1.8 | 1.06 |
| Demand | 1.44 | 0.38 | 1.28 | 1.20 | 0.44 | | |
| | 1.35 | 0.14 | 1.06 | 1.59 | 0 | | |

Step 3:

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | $\widetilde{D_1}$ | Dummy | Supply | |
|---|---|---|---|---|---|---|
| $\widetilde{S_1}$ | 1.340 | 1.55 | 2.11 | 0 | 1.34 0 | 1.55 |
| $\widetilde{D_1}$ | 1.35 | 1.61 | 0 | 0 | 1.07 | 1.35 |
| $\widetilde{D_2}$ | 4.22 | 1.41 | 1.06 | 0 | 1.8 | 1.06 |
| Demand | 1.44 0.1 | 0.38 | 1.28 | 0.44 | | |
| | 1.35 | 0.14 | 1.06 | 0 | | |

Step 4:

| | $\widetilde{S_1}$ | $\widetilde{S_2}$ | $\widetilde{D_1}$ | Dummy | Supply | |
|---|---|---|---|---|---|---|
| $\widetilde{D_1}$ | 0.1 1.35 | 1.61 | 0 | 0 | 1.07 0.97 | 1.35 |
| $\widetilde{D_2}$ | 4.22 | 1.41 | 1.06 | 0 | 1.8 | 1.06 |
| Demand | 0.10 | 0.38 | 1.28 | 0.44 | | |
| | 2.87 | 0.2 | 1.06 | 0 | | |

Step 5:

| | $\widetilde{S_2}$ | $\widetilde{D_1}$ | Dummy | Supply | |
|---|---|---|---|---|---|
| $\widetilde{D_1}$ | 1.61 | 0.97 0 | 0 | 0.970 | 1.61 |
| $\widetilde{D_2}$ | 1.41 | 1.06 | 0 | 1.8 | 1.06 |
| Demand | 0.38 | 1.28 0.31 | 0.44 | | |
| | 0.2 | 1.06 | 0 | | |

Transportation cost by using best candidate method is given by,

$0.38\times 1.41 + 0.31 \times 1.06$ = 0.5358+0.3286
= 0.86

## 5. Conclusion

In decision-making situations, fuzzy number ranking is crucial. Decisions in decision-making difficulties are decided by the decision-makers using a fuzzy number ranking system. In this work, we have used the Best Candidate Method to solve the generalized fuzzy Decagonal transshipment issues for both balanced and unbalanced scenarios. We discover that the Best Candidate approach minimizes iterations, requires less computational time, and is simple to solve. It is therefore preferable to use alternative techniques.

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