Solving Transportation Problem using Decagonal Neutrosophic Numbers

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Abstract:
This paper deals with the Decagonal Neutrosophic Sets and its terminologies and it introduced the basic operation of single-valued Decagonal Neutrosophic Number. The formation of Transportation Problem with Decagonal Neutrosophic Numbers which the supply, demand and transportation cost value is vagueness. Our new idea is easy to handle the issue and can rank various types of decagonal Neutrosophic Numbers. To introduce the proposed technique, some numerical examples are given to show the suitable of the new model.

Keywords: Transportation Problem, Decagonal Numbers, Neutrosophic Numbers.
DOI Number: 10.14704/NQ.2022.20.15.NQ88475 **NeuroQuantology2022;20(15): 4690-4696**

1.Introduction

[7]Due to mass population, there is a huge challenging to company, how to deliver the commodity to numbers of consumer or sources to a numbers of destinations in a minimizing cost value. This kind of thought is called Transportation Problem (TP) and it is a special case of Linear Programming Problem(LPP) where the company'sobjective is to decrease the expenses.Basic transportation problem was introduced by Hitchcock.This kind of knowledge can be direct programming technique and then tackled easiest strategy.Dantzig developed a primal simplex technique to transportation problem. Transportation Problem is a different type of content therefore simplex method is not capable for deriving the objectives. [8] Due to some lackness in simplex method for solving TP, a new Initial Basic Feasible Solution (IBFS) method was developed like North-west corner, Least-cost method, and Vogel's approximation method. In classical TP the decision makers gets the values of capacity, requirement and transportation cost value i.e. the decision makers possess the defuzzified numbers. Even though, in our day to day life implementations, the decision makers may not be gotclearly to all the parameters of transportation problem due to some uncontrolled factors. To overcome these uncontrolled factors, fuzzy decision making method has introduced by Prof.Zadeh in 1965. Since, many of the researchers have put investigation on Fuzzy Transportation Problem.All the parameters are trapezoidal fuzzy numbers and that method extent to solve Fully Fuzzy TP has created by Das.G

Charles Rabinson and Chandrasekarn have givenPentagonal fuzzy numbers inFuzzy transportation problem.We experienced with inefficient and uncertain data where it isn't valuablethought to the data just by the methodsfor membership function and non-membership function. In 1988, Smarandache has introduced the structure of Neutrosophic Set (NS) which is the most efficient tool of both fuzzy and intuitionistic fuzzy. Neutrosophic Set be considered by three degrees, i.e. (i) Truth-MembershipDegree (TMD), (ii) Indeterminacy Membership Degree (IMD), and(iii) Falsity Membership Degree (FMD). Lately, Wang introduced a Single Value Neutrosophic Set (SVNS) problem for solving some problem. Ye created the Trapezoidal Neutrosophic Set (TrNS) by collecting the thought of Trapezoidal Fuzzy Numbers (TrFN) and Single Value Neutrosophic Set. To take the benefit of NS, several researchers proposed different method for solving LP problem under Neutrosophic environment. Recently, Charles Rabinson G and Pachamuthu have given a Neutrosophic Fuzzy Transportation Problem for Finding Optimal Solution Using Nanogonal Number.

FavourableAction:[12]Neutrosophic sets always provide anawesome role in unclearsituation. Before going to discuss the development of our research paper, we highlighted the many of the author's research work towards the TP with mixed constraints.

In this way, there is to setup another idea for Decagonal Neutrosophic transportation problem. This total situation has induced us to build up another strategy for involves TP with Decagonal Neutrosophic numbers.We characterize Neutrosophic Transportation Problem (NTP) issue in which the source, requirement and transportation cost is taken as Decagonal Neutrosophic numbers.

- This model consists with settling alternate arrangement of issue with Decagonal Neutrosophic numbers.
- In this paper involvesDecagonal Neutrosophic numbers, we will in general present a recently applied scoring function.
- By applying our recently scoring function, the Decagonal Neutrosophic TP is modifying over into its defuzzified TP.
- To best our insight, it would be the initiallevel to unravel the DeNTP.

2 Basic Terminologies

2.1:Neutrosophic Set (NS)[11]

Let X be a non-empty set with an element in x denoted by A^N. A non-empty Neutrosophic set A^N in X is formulated by a Truth membership function T_A (x), an Indeterminacy membership function I_A (x) , and a Falsity membership function F_A (x) and is denoted by A^N = {[x, T_A (x), I_A (x), F_A (x) / x∈ X]}. Here T_A (x), I_A (x), and F_A (x) are real subsets of [0, 1] that is T_A (x): X →[0,1] , I_A (x) : X →[0,1] and F_A (x) : X → [0,1] . The sum of T_A (x), I_A(x) and F_A (x) lies in [0, 3]. i.e) $0 \leq \sup T_A (x) + \sup I_A (x) + \sup F_A (x) \leq 3$.

2.2: Single valued Neutrosophic Set (SVNS) [11]

Let X be a non-empty elements with an element in x denoted by A^N. A Single valued Neutrosophic set (SVNS) in X is formulated by Truth-membership function T_A, Indeterminacy-membership function I_A and Falsity-membership function F_A. For each point x in X, $T_A(x)$, $I_A(x)$, $F_A(x) \in [0,1]$.

2.3: Single valued Decagonal Neutrosophic Number (DeSVNN)[12]

A SDeNN ($\breve{D}$) is defined as SDeNN=⟨[(k_1, l_1, m_1, n_1, o_1, p_1, q_1, r_1, s_1, t_1) ;μ], [(k_2, l_2, m_2, n_2, o_2, p_2, q_2, r_2, s_2, t_2); δ], [(k_3, l_3, m_3, n_3, o_3, p_3, q_3, r_3, s_3, t_3) ; ϑ]⟩, where $\mu,\delta,\vartheta \in [0,1]$. The truly membership function($\mu_{SDe\ NN}$):Ȓ→ [0, μ], the non- membership function($\delta_{SDe\ NN}$):Ȓ→ [0,1], and the falsity membership function($\vartheta_{SDe\ NN}$):Ȓ→ [ϑ,1], are given as:

$$(\mu_{\text{SDe NN}}) = \begin{cases} 0 & , \ x < k_1 \\ c\left(\frac{x-k_1}{l_1-k_1}\right) & , k_1 \le x \le l_1 \\ c\left(\frac{x-l_1}{m_1-l_1}\right) & , l_1 \le x \le m_1 \\ c & , m_1 \le x \le n_1 \\ c+(1-c)\left(\frac{x-n_1}{0_1-n_1}\right) & , n_1 \le x \le o_1 \\ 1 & , \ 0_1 \le x \le p_1 \\ c+(1-c)\left(\frac{q_1-x}{q_1-p_1}\right) & , p_1 \le x \le q_1 \\ c & , q_1 \le x \le r_1 \\ c\left(\frac{s_1-x}{s_1-r_1}\right) & , r_1 \le x \le s_1 \\ c\left(\frac{t_1-x}{s_1-t_1}\right) & , s_1 \le x \le t_1 \\ 0 & , x > t_1 \end{cases}$$

$$(\delta_{\text{SDe NN}}) = \begin{cases} 0 & , \ x < k_2 \\ c\left(\frac{x-k_2}{l_2-k_2}\right) & , k_2 \le x \le l_2 \\ c\left(\frac{x-l_2}{m_2-l_2}\right) & , l_2 \le x \le m_2 \\ c & , m_2 \le x \le n_2 \\ c+(1-c)\left(\frac{x-n_2}{0_2-n_2}\right) & , n_2 \le x \le o_2 \\ 1 & , \ 0_2 \le x \le p_2 \\ c+(1-c)\left(\frac{q_2-x}{q_2-p_2}\right) & , p_2 \le x \le q_2 \\ c & , q_2 \le x \le r_2 \\ c\left(\frac{s_2-x}{s_2-r_2}\right) & , r_2 \le x \le s_2 \\ c\left(\frac{t_2-x}{s_2-t_2}\right) & , s_2 \le x \le t_2 \\ 0 & , x > t_2 \end{cases}$$

$$(\vartheta_{\text{SDe NN}}) = \begin{cases} 0 & , x < k_3 \\ c\left(\frac{x-k_3}{l_3-k_3}\right) & , k_3 \le x \le l_3 \\ c\left(\frac{x-l_3}{m_3-l_3}\right) & , l_3 \le x \le m_3 \\ c & , m_3 \le x \le n_3 \\ c+(1-c)\left(\frac{x-n_3}{0_3-n_3}\right) & , n_3 \le x \le o_3 \\ 1 & , 0_3 \le x \le p_3 \\ c+(1-c)\left(\frac{q_3-x}{q_3-p_3}\right) & , p_3 \le x \le q_3 \\ c & , q_3 \le x \le r_3 \\ c\left(\frac{s_3-x}{s_3-r_3}\right) & , r_3 \le x \le s_3 \\ c\left(\frac{t_3-x}{s_3-t_3}\right) & , s_3 \le x \le t_3 \\ 0 & , x > t_3 \end{cases}$$

2.4: Score and Accuracy Function[11]

Let us consider a single valued Decagonal Neutrosophic Numbers (SDeNN) as SDeNN= $(S_1,S_2,S_3,S_4,S_5,S_6,S_7,S_8,S_9,S_{10};\mu,\delta,\vartheta)$. The Initial application of score valueis to get the judgment of conversion of SDeNN to crisp number. Also, the mean of the SDeNN components is $(\frac{S_1+S_2+S_3+S_4+S_5+S_6+S_7+S_8+S_9+S_{10}}{10})$ and score value of the membership parts is $\{\frac{2+\pi-\rho-\sigma}{3}\}$.

2.5 Ranking technique based on Centroid of Centroid Method [11]

RCCDe = $[\frac{2(k+t)+6(l+m+n+q+r+s)+7(o+p)}{54} \times \frac{19}{18}]$

3 Neutrosophic Transportation Problem[16]

Assume that there are m number of sources and n destinations. Mathematically, the DeNTP may be stated as:

Min Z = $\sum_{i=1}^{m}\sum_{j=1}^{n} {C_{ij}}^{DeN} X_{ij}$

Subject to

$\sum_{i=1}^{m} X_{ij} = a_j$, j = 1 to n.

$\sum_{j=1}^{n} X_{ij} = b_i$, i = 1 to m.

$X_{ij} \ge 0, \forall$ i,j

Numerical Example:

In Tamilnadu a company named GJC Private Ltd. and the organization has three plants for delivering Tiles. The Tiles ought to be transport to three destinations under decagonal Neutrosophic numbers.

	KL	**KA**	**MP**	**Capacity**
A	**T**(0.69,0.59,0.21,0.35, 0.47,0.85,0.32,0,13,0. 48,0.64),**I**(0.65,0.87,0. 33,0.29,0.31,0.48,0.67 ,0.45,0.63,0.21),**F**(0.28 ,0.58,0.88,0.38,0.55,0.	**T**(0.21,0.31,0.41,0.51,0. 61,0.71,0.76,0.52,0.36, 0.46),**I**(0.79,0.87,0.67,0. 98,0.78,0.58,0.48,0.69, 0.24,0.62),**F**(0.98,0.95,0 .94,0.93,0.90,0.92,0.99,	**T**(0.21,0.31,0.41,0.51 ,0.61,0.72,0.84,0.33, 0.30,0.24),**I** ((0.25,0.41,0.67,0.75, 0.85,0.47,0.67,0.41,0 .31,0.49),**F**((0.98,0.97	**30**

	36,0.78,0.24,0.36,0.95)	0.88,0.78,0.58)	,0.96,0.94,0.87,0.81, 0.89,0.48,0.61,0.13)	
B	**T**(0.11,0.21,0.19,0.28,0.52 ,0.36,0.57.0.36,0.38,0.25) ,**I**(0.74,0.24,0.34,0.21,0.98,0.75,0.41,0.58,0.32,0.27),**F**(0.33,0.44,0.55,0.66,0.45,0.87,0.88,0.97,0.23,0.45)	**T**(0.41,0.51,0.13,0.23,0.43,0.33,0.17,0.58,0.21, 0.67),**I**(0.25,0.35,0.45,0.55,0.65,0.75,0.85,0.95, 0.21,0.34),**F**(0.12,0.97,0.85,0.81,0.86,0.79,0.75, 0.61,0.66,0.68)	**T**(0.31,0.27,0.47,0.59 ,0.92,0.50,0.47,0.38, 0.14,0.27),**I**(0.17,0.28 ,0.78,0.71,0.94,0.95, 0.68,0.74,0.71,0.92), **F**(0.21,0.94,0.92,0.97 ,0.93,0.82,0.81,0.87, 0.24,0.93)	**40**
C	T(0.45,0.87,0.36,0.45,0.36,0.54,0.63,0.28,0.13,0.11), I (0.51,0.29,0.27,0.19,0.23, 0.47,0.18,0.72,0.23,0.22), F (0.90,0.96,0.11,0.24,0.34, 0.87,0.21,0.36,0.78,0.11)	**T**(0.27,0.58,0.34,0.13,0.23,0.25,0.34,0.22,0.71, 0.62),**I**(0.67,0.24,0.31,0.45,0.65,0.74,0.39,0.52, 0.41,0.31), **F**(0.57,0.67,0.37,0.47,0.57,0.67,0.77,0.97,0.27, 0.68)	**T**(0.14,0.13,0.17,0.27 ,0.34,0.57,0.19,0.58, 0.19,0.74), **I**(0.37,0.47,0.97,0.24, 0.87,0.82,0.92,0.67,0.58,0.71),**F**(0.81,0.91, 0.96,0.92,0.97,0.82,0.81,0.79,0.88,0.67)	**20**
Requirement	**60**	**10**	**20**	

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Solution:

Step:1Using Ranking technique based on Centroid of Centroid Method for converting defuzzication

	KL	**KA**	**MP**	**Capacity**
A	(0.48,0.52,0.55)	(0.54,0.70,0.95)	(0.52,0.55,0.84)	**30**
B	(0.37,0.52,0.65)	(0.36,0.61,0.80)	(0.48,0.75,0.84)	**40**
C	(0.46,0.34,0.51)	(0.37,0.50,0.63)	(0.33,0.72,0.92)	**20**
Requirement	**60**	**10**	**20**	

Step:2Using Score Value for finding single value from each cell.

	KL	**KA**	**MP**	**Capacity**
A	0.47	0.29	0.37	**30**
B	0.40	0.32	0.29	**40**
C	0.54	0.41	0.23	**20**
Requirement	**60**	**10**	**20**	

Step:3Find IBFS using proposed method

	KL	**KA**	**MP**	**Capacity (a_i)**

A	0.47	0.29	0.37	**30**
B	0.40	0.32	0.29	**40**
C	0.54	0.41	0.23	**20**
Requirement(b_j)	**60**	**10**	**20**	

Step:4If $b_j > a_i$ then the cells values will be divided by 2. i.e It can be reduced half of the value.

	KL	**KA**	**MP**	**Capacity (a_i)**
A	0.23	0.29	0.37	**30**
B	0.20	0.32	0.29	**40**
C	0.27	0.41	0.23	**20**
Requirement(b_j)	**60**	**10**	**20**	

Apply VAM method then

Cost Z = (20×0.23) + (10×0.29) + (0×0.37) + (40×0.20) + (20×0.23)

= 4.6+2.9+0+8+4.6

= **20.1**

Comparison Table:

Example	**NWCM**	**LCM**	**VAM**	**PROPOSED**
1	**33.9**	**32.9**	**32.9**	**20.1**

Conclusion: In this paper, we have worked on Decagonal Neutrosophic transportation problem with proposed method to find minimum value for the above problem. In future we can apply this technique in various optimization techniques like assignment problem, sequencing problem,etc.

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