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SolvingMaximum Flow Network and Transportation Problems with Fuzzy Set Type-2Indices

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Abstract:

In this study, we have aim to showsomeconnotation of fuzzy set type-2, and apply it in the numerical examples, by two sidesmaximum flow networkand transportation problems, when the path of networkarc between two nodes is fuzzy type-2 where the intersection point of twosets is fuzzy, As well as mentioned, A linear programming model wasbuilt for a numerical examples in the maximum flow and transportation problemswhere the indices of the optimal path from node start todestination is fuzzy.

Keywords: Fuzzy set type-2, model building, linear and mathematical programming, maximum flowand transportation problems.

1-Introduction

The great interest of the fuzzy sets has been in finding many applications in four decades. In 1975 when Zadeh[9] introduced the second type of fuzzy sets he realized the existence of a problem in fuzzy sets type-1but it is extension of type-1,the membership functions oftype-2 includes fuzzy values,E. Hisdal[10] offered the fuzzy type-2as "increase ofthe ambiguity in the description,it means increased capability to deal with accurate information correctly and logically "The reason of this type does not appear is for a reasona little of it was published until the mid of 1990s, and then someresearchers were studied this type of uncertain like John [14],Dinagar andPrade [13]. Trigonometric matrices of fuzzy type-2 have been studied by both Dinagar and Latha[1],Nileshand Mendel[2] were also studied Mathematicaloperations on the second type of fuzzy.

2- Determinationof Membership Function of Fuzzy Set Type-2

We will review a simple set of mathematical formulas that help us to identify the fuzzy set type-2 (FST2), it can be refer to the set of (FST2) by$\tilde{Z}$, and membership function , $\mu_{\tilde{Z}}(x,\upsilon)$, where $x \in X$, $\upsilon \in H_x \subseteq [0,1]$ and . $0 \le \mu_{\tilde{Z}}(x,\upsilon) \le 1$, It is expressed by equation number (1) , below[3] :

$$\tilde{Z} = \left\{((x,\upsilon),\ \mu_{\tilde{Z}}(x,\upsilon)) \,\middle|\, \forall x \in X ,\forall \upsilon \in H_x \subseteq [0,1]\right\} \tag{1}$$

when $\tilde{Z}$, continuous themathematical expression become:

$$\tilde{Z} = \left\{ \int_{x \in X} \int_{\upsilon \in H_x} (\mu_{\tilde{Z}}(x,\upsilon)/(x,\upsilon)),\ H_x \subseteq [0,1] \right\} \tag{2}$$

Where H_x represented the elementarymembership function of$x$in$\tilde{Z}$.

The uncertainty of elementary membership function of (FST2)$\tilde{Z}$is forming a restricted area which we call it*the fingerprint of uncertainty*(FOU),it is a union of all elementarymembership that is[3]:

$$FOU(\tilde{Z}) = \bigcup_{x\in X} H_x^{\upsilon} \tag{3}$$

*The fingerprint of uncertainty*is also as the maximum and minimum boundsof membership function where,

$$\left\{FOU(\tilde{Z}) = \int_{x\in X} \left[\mu_{\tilde{z}}(x)^{\max}, \mu_{\tilde{z}}(x)^{\min}\right]\right\} \tag{4}$$

3.The concept of indices of networks in environment of(FST2)

Let's on some set A which is defined as a crisp set $\Upsilon_i, i\in\Psi$, where $\Psi=\{1,\dots,\psi\}$-set of indexes, on the other hand, suppose on the set Ψ determined a fuzzy set $\tilde{\Psi}$ with a *membership function* $\mu(i), i\in\Psi$,let specifythe notation $\tilde{\Upsilon} = \bigcap_{i\in\tilde{\Psi}} \Upsilon_i$ be the intersection of fuzzy sets $\tilde{\Psi}$ withcrisp set $\Upsilon_i, i\in\Psi$,To do this, on the set A for $i\in\Psi$,we define the membership function (characteristic function) of a crisp set Υ_i as[4]:

$$\Omega_i(x) = \begin{cases} 1, & x\in\Upsilon_i, \\ 0, & x\notin\Upsilon_i. \end{cases} \tag{5}$$

That is to say $x\in A$ such that the dominant relevant on Ψ. Let's say that the set with the index $i\in\Psi$ dominant on the index $j\in\Psi$ of $x\in A$,expressed it $i \overset{x}{\succ} j$, in the case of the inequalities are achieved $\Omega_i(x)\le\Omega_j(x), \mu(i)\ge\mu(j)$

, when there is at least one of it is arigorous,express as [4]:

$$\tilde{\mu}(x,i) = \begin{cases} \mu(i), & i\in \mathrm{B}\Delta(x), \\ 0, & i\notin \mathrm{B}\Delta(x), \end{cases} \quad where \quad \mathrm{B}\Delta(x) = \{i\in\Psi \mid j \overset{x}{\nsucc} i \quad \forall j\in\Psi\} \tag{6}$$

The intersection sets $\tilde{\Upsilon} = \bigcap_{i\in\tilde{\Psi}} \Upsilon_i$,a fuzzy sets $\tilde{\Psi}$ andnon-fuzzy sets Υ_i , $i\in\Psi$,a (FST2) will be known, and determined by $(x,\zeta(x,y))$ where $\zeta : X\times Y \to \{0,1\}$ - the exhibition fuzzy, performed as a*fuzzy membershipfunction*and express as :

$$\zeta(x,y) = \max_{i\in\psi}\{\tilde{\mu}(x,i) \mid \Omega_i(x) = y\} \tag{7}$$

$\zeta(x,y) = 0$ when $\exists i\in\Psi$ $\Omega_i(x) = y$;

If $\forall i\in\Psi$ $\Omega_i(x) \ne y$

where: x – Represented the elements of set X,

y – Represented the elements of universal set,

4.Solving method of mathematical models with fuzzy indicestype- 2

To solve the mathematical models with fuzzy set in indices let usillustrate in the following [5]:

Choose $\alpha \in (0,1)$,that have distinguished bysmallestvalue of reliability of membership function of the arc (index)to decision maker in the network problems.

Put a set of indices paths of network $T^{\alpha} = \{(i,j) \in T | \alpha \le T(i,j)\}$ that is has the reliability of membership function of index in network, at least within $\alpha \in (0,1)$ neverthelessis not equalto one; Forall routwith an index $(h,g) \in T^{\alpha}$ reduce the cost of transshipment like inmaximum flow $z(x)$ on the set of admissible indices of network N by added the constraints $x_{ij} > 0,\ (i,j) \in T^*$,It is important to involvementall routsin the network and adding the constraint $x_{hg} \le 0$, which prohibits the shipping on the selected pathwith the index $x_{hg} \le 0$, that is to solve the problem:

$$\min_{x \in X} g(x),\ x_{hg} \le 0,\ x_{ij} > 0,\ (i,j) \in T^* \qquad (8)$$

5.The maximumflow problem

In the capacitive network, sending the maximum flow from the source node (transmitter) to the destination node (receiver) is often valid. In many situations, the links in the network can be considered as a capacity limiting the quantity of the product that can be connected through the arc, this can be achieved by finding the maximum current that can be charged on the network,The goal of the maximum flow problem is to determine a conceivable flow modelnetwork overflow that increases the total flow from the supply node (origin) to the destination node (sink)[7].

Let π show that amount of flow in the network from node start to the node of destination through arcs(i,j),the maximum flow problem can be formulated as a linear programming model as following:

$$\left.\begin{aligned}&\max \pi\\&s.to\\&\sum_{j=1}^{m} f_{ij}-\sum_{k=1}^{m} f_{ki}=\begin{cases}\pi & if\ i=node\,1,\\ 0 & if\ i\neq node\,1\ or\ last\ node(m)\\ -\pi & if\ i=last\ node(m)\end{cases}\\&0\leq f_{ij}\leq \omega_{ij} \quad ,i,j=\overline{1,m}.\end{aligned}\right\} \quad (9)$$

6.Transportation problems

Transportationproblems is the most important linear programmingmodels based on the economic transfer of units produced from sources to destination locations at the lowest transport cost[11]. The transportationmodel is complementary to the production process according to the need for production. The transport problem is one of the importantmathematical methods that helped in the process of making the economic decision makers and the importance of the problemtransport when the productive facilities faced economic problems when distributing goods from factories to the consumer, it is formulated as a linear programmingwithminimize transportation costs [11]:

$$\min Z=\sum_{i=1}^{m}\sum_{j=1}^{n}\lambda_{ij}q_{ij}$$

Capacity of supply:

$$\sum_{j=1}^{n} q_{ij}\leq M_i, \quad i=\overline{1,m},$$

Constraints of demands

$$\sum_{i=1}^{m} q_{ij}\geq N_j, \quad j=\overline{1,n}$$

$$q_{ij}\geq 0, i=\overline{1,m},\ j=\overline{1,n}$$

$$Q=\left\|q_{ij}\right\|_{\substack{i=\overline{1,m},\\ j=\overline{1,n}}}=\begin{pmatrix} q_{11} & \cdots & q_{1n}\\ \cdots & q_{ij} & \cdots\\ q_{m1} & \cdots & q_{mn}\end{pmatrix}$$

Condition balance between demand and supply:

$$\sum_{i=1}^{m} M_i=\sum_{j=1}^{n} N_j,$$

Where the matrixsatisfies the equations above and represented transportation project, where:

q_{ij}: Quantity transferred from source i to destination j.

λ_{ij} :The cost of transporting one unitfrom source i to destination j.

6. numerical examples

6.1. Application area in Maximum flow and analytic tools (Linearprogramming, fuzzy set type-2)

Company owns four oil fields, four refineries and four distribution outlets.A main transportrelated stoppage has now reduced the ability of company to shipping the oil from fields to refineries and send oil products from refineries to distribution outlets. By using thousands of barrels of crude oil (and their remuneration in processed products), the following tables show the maximum number of units that can be shipped per day from each oilfield to each refinery and from each refinery to each distribution outlets, this data adopted from[6] .

Table (1)show the maximum quantitythat can be shipped per day from each oil field to each refinery

	Refinery			
Oil Field	New Orleans	Charleston	Seattle	St. Louis
Texas	11	7	2	8
California	5	4	8	7
Alaska	7	3	12	6
Middle East	8	9	4	15

Table (2)show the maximum quantity that can be shipped per dayfrom each refinery to each distribution center

	Distribution outlets			
Refinery	Pittsburgh	Atlanta	Kansas	San Francisco
New Orleans	5	9	6	4
Charleston	8	7	9	5
Seattle	4	6	7	8
St. Louis	12	11	9	7

The company administration now wants to put a plan for the number of units that will be shipped from each oilfield to each refinery and from each refinery to each distribution center, increasing the total number of units to reach distribution outlets.In addition, assume that the decision maker will not be able to specify which routs areactive, probably can assume a set of fuzzy indexes $\vec{\delta}$ *with membership function* $\vec{\delta}(i,j)=1$, for all vales of index (i,j) exemption:

$$\begin{Bmatrix} \vec{\delta}(tx,nc)=0.45,\ \vec{\delta}(nc,at)=0.75,\ \vec{\delta}(sl,kc)=0.8,\ \vec{\delta}(me,se)=0.15, \\ \vec{\delta}(ak,ch)=0.93, \vec{\delta}(kc,en)=0.4 \end{Bmatrix}$$

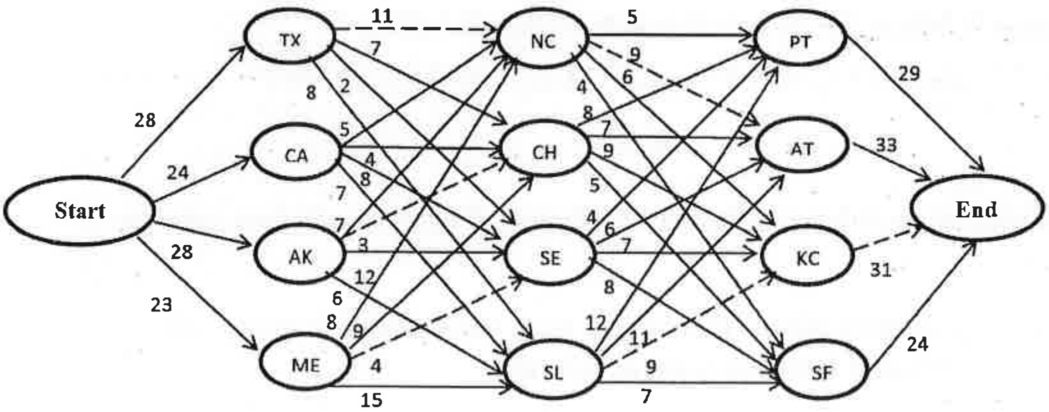

Figure (1) Represented network flow of oil from source to destination

To find the maximum flow of oil, let us formulate a mathematical model of network depending on linear programming as follows, where the definition of decision variables are:

$f_{i,j}$: Amounts flow through arci,j.

$$\max z = f_{st,tx} + f_{st,ca} + f_{st,ak} + f_{st,me}$$

Subject to

$$f_{st,nc} + f_{st,ca} + f_{st,ak} + f_{st,me} = 116,\ f_{tx,nc} + f_{tx,ch} + f_{tx,se} + f_{tx,sl} - f_{so,tx} = 0$$

$$f_{ca,nc} + f_{ca,ch} + f_{ca,se} + f_{ca,sl} - f_{so,ca} = 0,\ f_{ak,nc} + f_{ak,ch} + f_{ak,se} + f_{ak,sl} - f_{so,ak} = 0$$

$$f_{me,nc} + f_{me,ch} + f_{me,se} + f_{me,sl} - f_{so,me} = 0,\ f_{nc,pt} + f_{nc,at} + f_{nc,kc} + f_{nc,sf} - f_{tx,nc} - f_{ca,nc} - f_{ak,nc} - f_{me,nc} = 0$$

$$f_{ch,pt} + f_{ch,at} + f_{ch,kc} + f_{ch,sf} - f_{tx,ch} - f_{ca,ch} - f_{ak,ch} - f_{me,ch} = 0$$

$$f_{se,pt} + f_{se,at} + f_{se,kc} + f_{se,sf} - f_{tx,se} - f_{ca,se} - f_{ak,se} - f_{me,se} = 0$$

$$f_{sl,pt} + f_{sl,at} + f_{sl,kc} + f_{sl,sf} - f_{tx,sl} - f_{ca,sl} - f_{ak,sl} - f_{me,sl} = 0$$

$$f_{pt,sn} - f_{nc,pt} - f_{ch,pt} - f_{se,pt} - f_{sl,pt} = 0, f_{at,sn} - f_{ncat} - f_{ch,at} - f_{se,at} - f_{sl,at} = 0$$

$$f_{kc,sn} - f_{nc,kc} - f_{ch,kc} - f_{se,kc} - f_{sl,kc} = 0, f_{sf,so} - f_{nc,sf} - f_{ch,sf} - f_{se,sf} - f_{sl,sf} = 0$$

$$f_{pt,sn} + f_{at,sn} + f_{kc,sn} + f_{se,pt} + f_{sf,sn} = 117, f_{tx,nc} \le 11, f_{tx,ch} \le 7,\ f_{tx,se} \le 2,$$

$$f_{tx,sl} \le 8, f_{ca,nc} \le 5, f_{ca,ch} \le 4, f_{ca,se} \le 8, f_{ca,sl} \le 7, f_{ak,nc} \le 7, f_{ak,ch} \le 3,$$

$f_{ak,se} \leq 12, f_{ak,sl} \leq 6, f_{me,nc} \leq 8, f_{me,ch} \leq 9, f_{me,se} \leq 4, f_{me,sl} \leq 15, f_{nc,pt} \leq 5,$

$f_{nc,at} \leq 9, f_{nc,kc} \leq 6, f_{nc,sf} \leq 4, f_{ch,pt} \leq 8, f_{ch,at} \leq 7, f_{ch,kc} \leq 9, f_{ch,sf} \leq 5$

$f_{se,pt} \leq 4, f_{se,at} \leq 6, f_{se,kc} \leq 7, f_{se,sf} \leq 8, f_{sl,pt} \leq 12, f_{sl,at} \leq 11, f_{sl,kc} \leq 9$

$, f_{sl,sf} \leq 7, f_{pt,en} \leq 27, f_{at,en} \leq 33, f_{kc,en} \leq 31, f_{sf,en} \leq 24$

$$f_{i,j} \geq 0$$

Select the biggest confidence ofthe reject solution of networkwhich is equal to $(\chi = 0.93)$.

Define the set of indices ofrouts that have a *fuzzy membership* degree $\vec{\delta}$ always less than $(\chi = 0.93)$,and it is expressed as follows:

$\vec{\delta}^{\chi} = \{(i,j) \in \vec{\delta} \,|\, \vec{\delta}(i,j) \leq \chi\} = \{(tx,nc),(ak,ch),(me,se),(nc,at),(sl,kc),(kc,en)\}$.

When $\{(i,\, j) = (tx,nc)\}$,by solve the following linear programming model

$$\left.\begin{array}{l} Maximize\ z(f) = f_{st,tx} + f_{st,ca} + f_{st,ak} + f_{st,me} \\ subject.\ to: \\ f \in F, the\ same\ system\ of\ equations\ in\ (9), and\ add \\ f_{tx,nc} \leq 0,\ f_{ij} > 0,\ (i,\, j) \in \left\{\vec{\delta} \setminus \vec{\delta}^{\chi}\right\}. \end{array}\right\} \quad (10)$$

Then we obtained to the solution of maximum flow as: $\max z(f^{(tx,nc)}) = 104$

When $\{(i,\, j) = (ak,ch)\}$,by solve the following linear programming model

$$\left.\begin{array}{l} Maximize\ z(f) = f_{st,tx} + f_{st,ca} + f_{st,ak} + f_{st,me} \\ subject.\ to: \\ f \in F, the\ same\ system\ of\ equations\ in\ (9), and\ add \\ \\ f_{ak,ch} \leq 0,\ f_{ij} > 0,\ (i,\, j) \in \left\{\vec{\delta} \setminus \vec{\delta}^{\chi}\right\}. \end{array}\right\} \quad (11)$$

Then we obtained to the solution of maximum flow as: $\max z(f^{(ak,ch)}) = 105$

When $\{(i,\, j) = (me,se)\}$,by solve the following linear programming model

$$\left.\begin{array}{l} Maximize\ z(f)=f_{st,tx}+f_{st,ca}+f_{st,ak}+f_{st,me} \\ subject.\ to: \\ f\in F, the\ same\ system\ of\ equations\ in\ (9), and\ add \\ \quad f_{me,se}\le 0,\ f_{ij}>0,\ (i,j)\in\left\{\vec{\delta}\setminus\vec{\delta}^{\chi}\right\}. \end{array}\right\} \quad (12)$$

Then we obtained to the solution of maximum flow as: $\max z(f^{(me,se)})=106$

When $\{(i,j)=(nc,at)\}$, by solve the following linear programming model

$$\left.\begin{array}{l} Maximize\ z(f)=f_{st,tx}+f_{st,ca}+f_{st,ak}+f_{st,me} \\ subject.\ to: \\ f\in F, the\ same\ system\ of\ equations\ in\ (9), and\ add \\ \quad f_{nc,at}\le 0,\ f_{ij}>0,\ (i,j)\in\left\{\vec{\delta}\setminus\vec{\delta}^{\chi}\right\}. \end{array}\right\} \quad (13)$$

Then we obtained to the solution of maximum flow as: $\max z(f^{(nc,at)})=99$

When $\{(i,j)=(sl,kc)\}$, by solve the following linear programming model

$$\left.\begin{array}{l} Maximize\ z(f)=f_{st,tx}+f_{st,ca}+f_{st,ak}+f_{st,me} \\ subject.\ to: \\ f\in F, the\ same\ system\ of\ equations\ in\ (9), and\ add \\ \quad f_{sl,kc}\le 0,\ f_{ij}>0,\ (i,j)\in\left\{\vec{\delta}\setminus\vec{\delta}^{\chi}\right\}. \end{array}\right\} \quad (14)$$

Then we obtained to the solution of maximum flow as: $\max z(f^{(sl,kc)})=102$

When $\{(i,j)=(kc,en)\}$, by solve the following linear programming model

$$\left.\begin{array}{l} Maximize\ z(f)=f_{st,tx}+f_{st,ca}+f_{st,ak}+f_{st,me} \\ subject.\ to: \\ f\in F, the\ same\ system\ of\ equations\ in\ (9), and\ add \\ \quad f_{kc,en}\le 0,\ f_{ij}>0,\ (i,j)\in\left\{\vec{\delta}\setminus\vec{\delta}^{\chi}\right\}. \end{array}\right\} \quad (15)$$

Then we obtained to the solution of maximum flow as: $\max z(f^{(kc,en)})=86$

The data was entered into the WINQSB program [8] to obtain the above results.

Obviously when comparing results, that the maximum flow in networkis $\max z(f^{(me,se)}) = 106$,byconfidence of the admission solution equal to one and the confidenceof reject solution is less than (0.93).

6.2. Application area in transportation problems and analytic tools (Linearprogramming, fuzzy set type 2,)

Company has (3)factories producing chairs that are to be shipped to (4)allocation centers. Factories 1, 2, and 3 create 12, 17, and 11 freightage per month, respectively.Each allocationcenter requiresreceiving 10 freightagepermonth. Distance from each factory to allocationcenters shownflows[12]:

		Distance (miles)			
		AllocationCenters			
		1	2	3	4
Factory	1	820	1320	600	700
	2	1150	1410	600	1050
	3	630	1300	90	900

The shipping cost for each freightage is \$90 plus 50 cents per mile.in addition, assume that the decision maker will not be able to specify which arc are active, probably can assume a set of fuzzy indices $\vec{\delta}$ *with membership function* $\vec{\delta}(i,j) = 1$, for all vales of index (i,j) exemption:

$$\left\{ \vec{\delta}(1,1) = 0.50,\ \vec{\delta}(2,3) = 0.65,\ \vec{\delta}(2,4) = 0.8,\ \vec{\delta}(1,4) = 0.9 \right\}$$

Let us formulate a mathematical model of transportation depending on linear programming as follows, where the definition of decision variables is:
q_{ij} = Quantity transferred from source i to destination j.

Objective function

$$\begin{aligned} \min z = {} & 490q_{11} + 740q_{12} + 290q_{13} + 440q_{14} \\ & 640q_{21} + 790q_{22} + 390q_{23} + 590q_{24} \\ & 390q_{31} + 690q_{32} + 490q_{33} + 540q_{34} \end{aligned}$$

Subject to

$$q_{11}+q_{12}+q_{13}+q_{14}\le 12,\quad q_{11}+q_{21}+q_{31}\ge 10$$
$$q_{21}+q_{22}+q_{23}+q_{24}\le 17,\quad q_{12}+q_{22}+q_{32}\ge 10$$
$$q_{31}+q_{32}+q_{33}+q_{34}\le 11,\quad q_{13}+q_{23}+q_{33}\ge 10 \qquad (16)$$
$$q_{ij}\ge 0,\ i=\overline{1,m},\ j=\overline{1,n}$$

Select the biggest confidence ofthe reject solution of network which is equal to $(\chi=0.90)$.

Define the set of indices ofrouts that have a *fuzzy membership* degree $\vec{\delta}$ always less than $(\chi=0.90)$,and it is expressed as follows:

$$\vec{\delta}^{\chi}=\{(i,j)\in\vec{\delta}\,|\,\vec{\delta}(i,j)\le\chi\}=\{(1,1),(2,3),(2,4),(1,4)\}.$$

When $\{(i,\ j)=(1,1)\}$,by solving the following linear programming model

$$\min z=490q_{11}+740q_{12}+290q_{13}+440q_{14}$$
$$640q_{21}+790q_{22}+390q_{23}+590q_{24}$$
$$390q_{31}+690q_{32}+490q_{33}+540q_{34}$$

Subject to

$q\in Q,$ *the same system of equations in* (16), *and add*

$$q_{11}\le 0,\ q_{ij}>0,\ (i,j)\in\left\{\vec{\delta}\setminus\vec{\delta}^{\chi}\right\}.$$

Then we obtained to the solution of minimum cost of transportation as:
$\min z(q^{(1,1)})=19800$

When $\{(i,\ j)=(2,3)\}$,by solving the following linear programming model

$$\min z=490q_{11}+740q_{12}+290q_{13}+440q_{14}$$
$$640q_{21}+790q_{22}+390q_{23}+590q_{24}$$
$$390q_{31}+690q_{32}+490q_{33}+540q_{34}$$

Subject to

$q\in Q,$ *the same system of equations in* (16), *and add*

$$q_{23}\le 0,\ q_{ij}>0,\ (i,j)\in\left\{\vec{\delta}\setminus\vec{\delta}^{\chi}\right\}.$$

Then we obtained to the solution of minimum cost of transportation as:
$\min z(q^{(2,3)})=20200$

When $\{(i,\ j)=(2,4)\}$,by solving the following linear programming model

$$\min z = 490q_{11} + 740q_{12} + 290q_{13} + 440q_{14}$$
$$640q_{21} + 790q_{22} + 390q_{23} + 590q_{24}$$
$$390q_{31} + 690q_{32} + 490q_{33} + 540q_{34}$$

Subject to

$q \in Q$, *the same system of equations in* (16), *and add*

$$q_{24} \leq 0,\ q_{ij} > 0,\ (i, j) \in \left\{\vec{\delta} \setminus \vec{\delta}^{x}\right\}.$$

Then we obtained to the solution of minimum cost of transportation as:
$\min z(q^{(2,4)}) = 19850$

When $\{(i, j) = (1,4)\}$, by solving the following linear programming model

$$\min z = 490q_{11} + 740q_{12} + 290q_{13} + 440q_{14}$$
$$640q_{21} + 790q_{22} + 390q_{23} + 590q_{24}$$
$$390q_{31} + 690q_{32} + 490q_{33} + 540q_{34}$$

Subject to

$q \in Q$, *the same system of equations in* (16), *and add*

$$q_{14} \leq 0,\ q_{ij} > 0,\ (i, j) \in \left\{\vec{\delta} \setminus \vec{\delta}^{x}\right\}.$$

Then we obtained to the solution of minimum cost of transportation as:
$\min z(q^{(1,4)}) = 20400$

Obviously when comparing results, that the minimum total cost of transportation is $\min z(q^{(1,1)}) = 19800$, byconfidence of the admission solution equal to one and the confidence of reject solution is less than (0.90).

7. Conclusions

In this study, we have aim to show some connotation of fuzzy set type-2,a linear programming model was built for a problem with numerical examples, when the indicators of network are fuzzy type-2.Finally, it can bereferringthat the method which presented in this study does not include the application of network models only, but it can be applied in the field of transportation when the arc between the provider and the client is fuzzy.

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