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New Similarity Performance Measures of Fuzzy Transportation and its Application

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ABSTRACT: In this paper, we proposed the concept of reduced fuzzy soft Transportation table new performance measure of fuzzy table and also defined different types of minimization along with it. Then based on these minimization, three types of performance measures are done with example .Also we developed an algorithm which is a new approach in the industrial field by employing fuzzy minimized transportation table of performance measure fuzzy.

KEYWORDS: Transportation table, Fuzzy , New measure of fuzzy,Minimized fuzzy.

I. INTRODUCTION

Performance of two measure have been studied by Majumder and Samantha in[8]. D.K.Sut et al [8] and Rajarajeswari et al [20,21] used the notion of performance measure in [11] to make decision.performance measure of intuitionistic fuzzy transportation. Transportation measures of fuzzy performance and their applications are dicussed in [1]. In this paper, we have introduced the concept of reduced fuzzy transportation of performance measure of fuzzy table and defined different types of table reduction along with it. Then based on these table minimization, three types of peformance measures are done with example. Also we are developing an algorithm which is a new approach in the logistics industrial systems field by employing reduced fuzzy transportation table of performance measure of fuzzy .A performance measure using fuzzy introduced on shape of fuzzy numbers. Using this measure the fuzzy transportation problem is converted to a crisp valued problem, which can be solved using VAM for initial solution and MODI for optimal solution. The optimal solution can be got either as a fuzzy number or as a crisp number.

II. PRELIMINARIES

In this section, we re call some basic notion of fuzzy set theory.

2.1. FUZZY PERFORMANCE MEASURE SET [15]

Let U be an initial Universe set and A be the set of parameters. Let U contained A. A pair (F,A) is called fuzzy performance measure set over U, F mapping given by F: $A\rightarrow I^U$, where I^U denotes the collection of all fuzzy subsets of U.

2.2. INTUITIONISTIC FUZZY PERFORMANCE MEASURE SET (IFPMS)[16]

Let U be an initial Universe set and A be the set of parameters. A pair (F,A) is called intuitionistic fuzzy performance measure set over U where F is a mapping given by F: $A\rightarrow I^U$, where I^U denotes the collection of all intuitionistic fuzzy subsets of U.

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2.3. AXIOMATIC DEFINITION OF FUZZY

In order todevelop a transportation problem by axiom transportation models, the transportation problem (TP) must be able to specify the following elements:

A posteriori probability distribution:

$$p(s_j|x_k) = \frac{p(x_k|s_j)\cdot p(s_j)}{\sum_{j=1}^{n} P(x_k | s_j)\cdot p(s_j)}$$

(Bayes's formula) With the additional information that x_k is observed the optimal action $a^*(x_k)$ satisfies the term. The expected value of additional information is

$$E(a^*(x_k)) = \max_{a_i \in A} \sum_{j=1}^{n} u(g(a_i, s_j))\cdot p(s_j|x_k) \quad ; \quad E(X) = K\sum E(a^*(x_k))\cdot p(x_k) - E(A^*).k=1$$

Membership function is defined as

$\mu_{A^*} : X \to [0, 1].A^* = \{(x, \mu_A(x))\ x \in X\}$,

Similar to the definition of Cantor, the functional value 0 is given to objects which definitely do not show the requested attributesf the value set [0,1] implies that objects with the membership value 1 definitely belong to the required set, Zadeh's concept of a fuzzy set is directly an extension of the set definition by Cantor, where the value set is limited on the set {0, 1}. Sets in the sense of Cantor are called crisp sets.

2.4. MINIMIZED FUZZY PERFORMANCE MEASURE SET (MFPMS) OF PARAMETRIC MEASURE FUZZY SET(PMFS)

DEFINITION

Let $U=\{c_1,c_2,c_3\ldots c_m\}$ be an Universal set and X be the set of parameters given by $X=\{x_1,x_2,x_3\ldots x_n\}$.Let $A\subseteq X$ and (F,A) be Parametric measure of fuzzy set over U, where F is a mapping given by F: $A\to I^U$, Particularly, Let $p_1=1$, $p_2= 0$,or $p_1=0$, $p_2= 1$, or $p_1= p_2= 0.5$ three cases of minimized fuzzy transportation value respectively , high minimized fuzzy transportation value set, low minimized fuzzy transportation value set, medium minimized fuzzy transportation value set. They are defined as

$F_L(x_{ij}) =(c_i,\mu_{jL}\ c_i), \forall\ c_i \in U, \forall\ x_j \in A$,

$F_M(x_{ij})= [F_L(x_{ij})+ F_H(x_{ij})]/2$

$F_H(x_{ij})= (c_i,\mu_{ju}\ c_i), \forall\ c_i \in U, \forall\ x_j \in A$,

$G_L(x_{ij}) =(c_i,\mu_{jL}\ c_i), \forall\ c_i \in U, \forall\ x_j \in A$,

$G_M(x_{ij})= [G_L(x_{ij})+ G_H(x_{ij})]/2$

$G_H(x_{ij})= (c_i,\mu_{ju}\ c_i), \forall\ c_i \in U, \forall\ x_j \in A$.

III. SIMILARITY PERFORMANCE MEASURES OF FUZZY SETS

In this section we introduce similarity Performance measure transportation based on comparing travelling distance by transportation problem of theoretic approach.

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SIMILARITY MEASURES OF MINIMIZED FUZZY TRANSPORTATION PROBLEM BASED ON COMPARING FUNCTION

DEFINITION 3.1. Let (F,A) & (G,D) be two PMFTP over U, where F and G is a mapping given by F: $A\to I^U$,
G: $D\to I^U$ and I^U denotes the collection of all performance measure fuzzy subsets of U.
Then define similarity performance measure fuzzy subsets between (F,A) & (G,D) as j=1,2,3,…….m

$$SIM_H(F,G) = \frac{\sum pF_H(x_k | s_j)\cdot pG_H(s_j)}{\max \sum_{j=1}^{n} PF_H(x_k | s_j)\cdot pG_H(s_j)}$$

$$SIM_L(F,G) = \frac{\sum pF_L(x_k | s_j)\cdot Pg_L(s_j)}{\max \sum_{J=1}^{N} PF_L(x_k | s_j)\cdot Pg_L(s_j)}$$

$$SIM_M(F,G) = \frac{\sum pF_m(x_k | s_j)\cdot pG_m(s_j)}{\max \sum_{J=1}^{N} PF_m(x_k | s_j)\cdot pG_m(s_j)}$$

Similarity measure of Reduced Fuzzy Transportation problem based on distance performance measure.

Definition 3.1. Let U={$c_1,c_2,c_3\ldots c_m$} be the Universal set and A be the set of parameters given by (A,D) ={$(a,b)_1$, $(a,b)_2$, $(a,b)_3\ldots(a,b)_n$}. A pair (F,G) is called PMFTP set over U where F and G are mapping given by F: $A\to I^U$, G:$D\to I^U$ where I^U denotes the collection of all performance measure of fuzzy sets of U.

a)North west corner distance performance measure $d_{NWCRTP}(F,G)= \min \sum_{l=1}^{n}\sum_{l=1}^{m} pF(x_k | s_j) ,pG_H(s_j))/mn$

b)LCM distance performance measure

$d_{lcmTP}(F,G)= \min \sum_{l=1}^{n}\sum_{l=1}^{m} pF(x_k | s_j) .pG_H(s_j)) /m+n-1$

c) VAM distance performance measure $d_{VAMTP}(F,G)=\min \sum_{l=1}^{n}\sum_{l=1}^{m} pF(x_k | s_j) .pG_H(s_j))/(mn-(m+n-1))$

d) Optimal distance performance measure

case (1) $d_{ij}(F,G)\geq 0$, case (2) $d_{ij}(F,G)\geq 0$ and atleast one $d_{ij}(F,G)=0$, then the current transportation solution is Optimal distance performance measure.

e)Degenerated optimal distance performance measure $d_{VAMTP}(F,G)=\min\{ \sum_{l=1}^{n}\sum_{l=1}^{m} pF(x_k | s_j) .pG_H(s_j))+\epsilon\}/(mn-(m+n-1))$

NOTE:

If P=1then (e) minimize to Optimal distance of performance measure and if p=2 then (e) reduces to Optimal VAM distance of performance measure. Then the similarity measure between (F,G) denoted by $P(F,G)$ is defined as $P(F,G)=1-P_{TP}(F,G)$

Example 3.3.

Consider the example (**3.1**), VAM distance performance measure distance between (F,G), $P_{TP}(F,G)= \min \sum_{l=1}^{n}\sum_{l=1}^{m} pF(x_k | s_j) .pG_H(s_j))/(mn-(m+n-1))$= (minimized PMTPF cost)$=\min\sum_{l=1}^{5}\sum_{l=1}^{5} pF(x_k | s_j) pG_H(s_j))/(mn-(m+n-1))$

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Then the similarity measure between (F,G) as $P(F,G)$=1- P_{TP}(F,G)

Example 3.1.
Let U={c1,c2,c3} be the Universal set and supply and demand be the set of parameters and we consider two PMFTPS
sets (F,G) such that their corresponding Transportation table form are

	d_1	d_2	d_3	supply
C_1	[0.7,0.9]	[0.6,0.7]	[0.5,0.8]	0.3
C_2[	[0.6,0.8]	[0.2,0.5]	[0.6,0.9]	0.4
C_3	[0.5,0.6]	[0.1,0.7]	[0.2,1.0]	0.3
Demand	0.2	0.5	0.3	

Then similarity measure between (F,G) is given by the steps
CASE_1:
Step 1: $F_L(x_{ij})$ =(c_i,μ_{jL} c_i),∀ c_i ∈ U,∀ x_j∈ A ,

	d_1	d_2	d_3	supply
C_1	[0.7]	[0.6]	[0.5]	0.3
C_2[	[0.6]	[0.2]	[0.6]	0.4
C_3	[0.5]	[0.1]	[0.2]	0.3
Demand	0.2	0.5	0.3	

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Step 2: Using VAM procedure we obtain the initial solution as

	d_1	d_2	d_3
C_1	[0.7][0.2]	[0.6]	[0.5][0.1]
C_2[	[0.6]	[0.2]0.4]	[0.6]
C_3	[0.5]	[0.1][0.1]	[0.2][0.2]

Step 3: Therefore the fuzzy optimal solution for the given transportation problem is
x_{11} =0.2, x_{13}= 0.1 x_{22} = 0.4
x_{32} = 0.1 x_{33} = 0.2
and the fuzzy optimal value of z =0.2*0.7+0.1*0.5+0.7*0.4+0.1*0.1+0.2*0.2=0.14+0.05+0.28+0.01+0.04=0.52
$d_{VAMTP}(F,G)=\min \sum_{l=1}^{n} \sum_{l=1}^{m} pF(x_k \mid s_j).pG_H(s_j))/(mn-(m+n-1))$

Step 4: $G_L(x_{ij}) =(c_i,\mu_{jL}\, c_i), \forall c_i \in U, \forall x_j \in A$,

	d_1	d_2	d_3	supply
C_1	[0.2]	[0.4]	[0.3]	0.1
C_2[	[0.4]	[0.4]	[0.8]	0.8
C_3	[0.1]	[0.2]	[0.8]	0.1
Demand	*0.6*	0.2	0.2	

Step 5: Using VAM procedure we obtain the initial solution as

	d_1	d_2	d_3
C_1	[0.2]	[0.4]	[0.3] [0.1]
C_2[	[0.4] [0.5]	[0.4] [0.2]	[0.8] [0.1]
C_3	[0.1] [0.1]	[0.2]	[0.8]

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Step 6: Therefore the fuzzy optimal solution for the given transportation problem is

x_{13} =0.1, x_{21}= 0.5 x_{22} = 0.2 x_{23} = 0.1 x_{31} = 0.1

and the fuzzy optimal value of $G_L(x_{ij})$ z =0.1*0.3+0.1*0.1+0.5*0.4+0.2*0.4+0.1*0.8=0.03+0.01+0.2+0.08+0.08=0.4

$d_{VAMTP}(F,G)_L$=min $\sum_{i=1}^{n}\sum_{i=1}^{m}$ pF $(x_k \mid s_j)$ .p$G_H(s_j)$) /(mn-(m+n-1))=0.92/9-5=0.23

CASE 2:

Step 1:F {middle}= [L+U]/2;$F_M(x_{ij})$= [$F_L(x_{ij})$+ $F_H(x_{ij})$]/2

Step 2: Using VAM procedure we obtain the initial solution

Step 3: Therefore the fuzzy optimal solution for the given transportation problem is

x_{13} =0.3, x_{22}= 0.4 x_{31} = 0.2 x_{32} = 0.1 x_{33} = [∈]

and the fuzzy optimal value of z =0.3*0.65+0.4*0.35+0.2*0.55+0.1*0.4+0.6*0. ∈=0.195+0.14+0.11+0.04+0.6 ∈=0.485

Step 4:G {middle}= [L+U]/2

$G_M(x_{ij})$= [$G_L(x_{ij})$+ $G_H(x_{ij})$]/2

Step 5: Using VAM procedure we obtain the initial solution as

	d_1	d_2	d_3
C_1	[0.5]	[0.65]	[0.45] [0.1]
C_2[	[0.55] [0.6]	[0.45] [0.1]	[0.85] [0.1]
C_3	[0.55]	[0.35] [0.1]	[0.9]

Step 6: Therefore the fuzzy optimal solution for the given transportation problem is

x_{13} =0.1, x_{21}= 0.6 x_{22} = 0.1

3 = 0.1 x_{32} = 0.1

and the fuzzy optimal value of z =0.1*0.45+0.6*0.55+0.1*0.45+0.1*0.85+0.35*0.1=0.045+0.33+0.045+0.085+0.035=0.54

$d_{VAMTP}(F,G)_M$=min $\sum_{i=1}^{n}\sum_{i=1}^{m}$ pF $(x_k \mid s_j)$ .p$G_H(s_j)$) /(mn-(m+n-1))=0.25

CASE_3:

Step 1:F{Higher case}= $F_H(x_{ij})$= (c_i,μ_{iu} c_i),∀ c_i ∈ U,∀ x_j∈ A ,

	d_1	d_2	d_3	supply
C_1	[0.9]	[0.7]	[0.8]	0.3
C_2[	[0.8]	[0.5]	[0.9]	0.4
C_3	[0.6]	[0.7]	[1]	0.3
Demand	0.2	0.5	0.3	

Step 2: Using VAM procedure we obtain the initial solution

Step 3: Therefore the fuzzy optimal solution for the given transportation problem is

x_{13} = 0.3 x_{22} = 0.4 x_{31} = 0.2
$_{32}$ = 0.1 $_{13}$ = ∈
and the fuzzy optimal value of z =0.3*0.8+0.4*0.5+0.2*0.6+0.1*0.7+0.7*0. ∈=0.24+0.14+0.11+0.04+0.6 ∈=0.63

Step 4:

$G_H(x_{ij})$= (c_i, $_{ju}$ c_i),∀ c_i ∈ U,∀ x_j∈ A

Step 5: Using VAM procedure we obtain the initial solution as

	d_1	d_2	d_3
C_1	[0.8]	[0.9]	[0.6] [0.1]
C_2[	[0.7] [0.6]	[0.5] [0.1]	[0.9] [0.1]
C_3	[1.0]	[0.5] [0.1]	[1.0]

Step 6: Therefore the fuzzy optimal solution for the given transportation problem is
$_{13}$ = 0.1 $_{21}$ = 0.6 $_{22}$ = 0.1 $_{23}$ = 0.1 $_{32}$ = 0.1
and the fuzzy optimal value of z =0.1*0.6+0.6*0.7+0.1*0.5+0.1*0.9+0.5*0.1=0.06+0.42+0.05+0.09+0.05 =0.67
$d_{VAMTP}(F,G)_H$=min $\sum_{=1}\sum_{=1}$ pF $(x_k \mid s_j)$ .p$G_H(s_j)$) /(mn-(m+n-1))=0.325

$F_L(x_{ij})$	$G_M(x_{ij})$	$F_H(x_{ij})$	**Estimated Interval** + +	**Specified Probability**
0.14 0.05 0.28 0.01 0.04	0.045 0.33 0.045 0.085 0.035	0.06 0.42 0.05 0.09 0.05	0.063 0.29 0.085 0.073 0.038	0.01 0.02 0.03 0.04 0.05
Objective values (0.52, 0.4)	Objective values (0.485, 0.54)	Objective values (0.63, 0.67)	Critical value 0.549	

Similarity between F &G denoted by $SIM(F,G)$, then the following holds.
$SIM_H(F,G)$ = 1.3/0.66=1.9696
$SIM_L(F,G)$ =0.52x0.4/0.28+0.2=0.92/0.48=1.91666667,
$SIM_M(F,G)$ =[0.485+0.54]/[0.195+0.33]=1.025/0.525=1.9523

3.4. Similarity Performance measure of minimized Fuzzy transportation problem based on game theoretic approach .

Definition 3.2. Let U={$c_1, c_2, c_3 \ldots c_m$} be the Universal set and (A,D) be the set of parameters given by(A,D) ={$(a,b)_1$, $(a,b)_2$, $(a,b)_3 \ldots (a,b)_n$}. A pair F and G is called PMFTP set over U where F and G are mapping given by F: (A,D)→I^U, G: (A,D)→I^U where I^U denotes the collection of all performance measure fuzzy transportation problem of U. Let $STP(F,G)$ denote the similarity between the two approximations F and G. Define

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$$STP_H(F,G) = \frac{\text{minimax}(pF_H(x_k|s_j), pG_H(s_j))}{\text{maximin}(PF_H(x_k|s_j), pG_H(s_j))} = 0.4x0.6/0.5x0.5=0.96$$

$$STP_L(F,G) = \frac{\text{minimax}(pF\,L(x_k|s_j), pG_L(s_j))}{\text{maximin}(PFL(x_k|s_j), pG_L(s_j))} = 0.35x0.55/0.4x0.35.6=1.375$$

$$STP_M(F,G) = \frac{\text{minimax}(pF_M(x_k|s_j), pG_M(s_j))}{\text{maximin}(PF_m(x_k|s_j), pG_M(s_j))} = 0.4x0.4/0.1x0.1=1$$

Consider the example If STP (F,G) indicates the similarity transportation table between (F,G) then STP (F,G)= STP_H (F ,G). STP_M (F ,G)= STP_L (F ,G) STP_H (F ,G)= STP_H (F ,G)

IV. CONCLUSION

In this paper ,we have defined the concept of minimized fuzzy and defined different types of reduction along with it. Then based on these minization , three types of similarity measures are discussed. Moreover, an example is given to illustrate the application of similarity measure of transportation problem .Thus the method can be used to solve the problem which contains uncertainties. The important features of this work in this paper is that it reflects decision maker's highest or lowest or middle bias in achieving the non-inferior solution. The decision maker's preference may be changed from highest to lowest by considering the difference values of , where [0,1]. Also an another important feature of this paper is the flexibility, where the similarity maker to have his desired satisfactory solution by suitable arrangement of objective values of our specified problem. The last important aspect in this paper is that only a few steps are required to obtained the non-inferior solution of our mentioned problem.

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