Application of Intuitionistic Fuzzy Sets In Decision Making Problem Using Revised Max-Min Composition Technique

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Abstract— In this paper, we proposed an application of intuitionistic fuzzy sets in career determination using max-min average composition for intuitionistic fuzzy sets.

Index Terms— Fuzzy Set, Intuitionistic Fuzzy set, Max-Min Average Compostion, Career Determination.

1. INTRODUCTION

The notion of fuzzy set was proposed by Zadeh in 1965 as a frame work to encounter uncertainly, vagueness and partial truth, represents a degree of membership for each member of the universe of discourse to a subset of it. Intuitionistic fuzzy set was proposed by Atanassov [1, 2] in 1986, it consist of membership function as well as non membership function of a certain set of data, which looks more accurate to uncertainty quantification and provided the opportunity to precisely model the problem based on the existing knowledge and observations. The intuitionistic fuzzy set theory has been studied and applied in different areas. The intuitionistic fuzzy sets can be more relevant for application for solutions of decision making problems particularly in medical diagnosis, marketing and financial services. In 2012, Ejegwa et al [9]. proposed an application of intuitionistic fuzzy sets in career determination using normalized hamming distance. Thiruveni et al. introduced medical diagnostic reasoning using extended hausdroff distance for intuitionistic fuzzy sets. In this paper, the concept of max-min average composition is used. Discuss an application of intuitionistic fuzzy sets using the same technique.

2. PRELIMINARIES

In this section contains some basic definitions, which are used, in our next section.

DEFINITION 2.1

Intuitionistic fuzzy set was introduced first time by Atanassov [1] which is a generalization of an ordinary Zadeh fuzzy set. Let X be a fixed set. An intuitionistic fuzzy set A in X is an object having the form

$$A = \{< x, \mu_A(x), \nu_A(x) > / x \in X\} \qquad (1)$$

where the functions $\mu_A(x), \nu_A(x) : X \to [0,1]$ are the degree of membership and the degree of non-membership of the element $x \in X$ to A, respectively; moreover, $0 \le \mu_A(x) + \nu_A(x) \le 1$ must hold.

bviously, each fuzzy set may be represented by the following intuitionistic fuzzy set

$$A = \{< x, \mu_A(x), 1 - \mu_A(x) >\} \qquad (2)$$

In addition to that, we also include the hesitation margin, $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$

$$A = \{< x, \mu_A(x), \nu_A(x), \pi_A(x) > / x \in X\} \quad (3)$$

DEFINITION 2.2

If A and B are two IFS of the set X, the $A \subseteq B$ if and only if $\forall\, x \in X$, $\mu_A(x) \le \mu_B(x)$ and $\nu_A(x) \ge \nu_B(x)$.

$\bar{A} = \{< x, v_A(x), \mu_A(x) > / x \in X\}$

$A \cap B = \{< x, \min(\mu_A(x), \mu_B(x)), \max(v_A(x), v_B(x)) > / x \in X\}$

$A \cup B = \{< x, \max(\mu_A(x), \mu_B(x)), \min(v_A(x), v_B(x)) > / x \in X\}$

3. INTUITIONISTIC FUZZY MAX-MIN AVERAGE COMPOSITION

DEFINITION 3.1

Let $P(X \to Y)$ and $Q(Y \to Z)$ be two IFR. The max-min composition $P \circ Q$ is the intuitionistic fuzzy relation from $P \circ Q(X \to Z)$ defined by the membership function

$\mu_{PoQ}(x,z) = \text{Sup}\ (\min(\mu_R(x,y), \mu_Q(y,z))$

$\gamma_{RoQ}(x,z) = \text{Inf}\ (\max(\gamma_R(x,y), \gamma_Q(y,z))$

for all (x,y) in XxZ and for all y in Y.

DEFINITION 3.2

Let $P(X \to Y)$ and $Q(Y \to Z)$ be two IFR. The max-min average composition $P \circ Q$ is the intuitionistic fuzzy relation from $P \circ Q(X \to Z)$ defined by the membership function

$\mu_{PoQ}(x,z) = \text{Sup}\ (\mu_R(x,y) + \mu_Q(y,z))/2$

$\gamma_{RoQ}(x,z) = \text{Inf}\ (\gamma_R(x,y) + \gamma_Q(y,z))/2$

for all (x,y) in XxZ and for all y in Y.

4. CARREER DETERMINATION VAI MAX-MIN AVERAGE COMPOSITION FOR INTUITIONISTIC FUZZY SETS

The methodology involves mainly the following jobs:

i. Determination of Career.

ii. Formulation of subject knowledge based on intuitionistic fuzzy relations.

iii. Determination of career on the basis of AM-max-min composition of intuitionistic fuzzy relations.

An intuitionistic fuzzy relations P is given from the set of students X to the set of subjects Y and another intuitionistic fuzzy relation Q is given from a set of subjects Y to the set of career Z. The max-min composition R is an intuitionistic fuzzy relation of P and Q.

4.1 ALGORITHEM

i. Compute $R = P \circ Q$

ii. Compute R', where R' is equal to R, but including the hesitation margin π_R.

iii. Compute T, where
$T = \{\mu_T = \mu_R + \mu_R \pi_R, \nu_T = \nu_R + \nu_R \pi_R\}$.

iv. Compute U, where $U = \{\mu_T, 1 - \nu_T\}$.

v. Compute V, where $V = U/2$.

vi. Choose the minimum value of V in each row, that we conclude the students better to join the careers.

4.2 CASE STUDY

Let there be four students i.e., X = {A_1, A_2, A_3, A_4} and the set of subjects Y = {English Language, Mathematics, Biology, Physics, Chemistry}. Let the set of Careers be Z = {Medicine, Pharmacy, Surgery, Anatomy}.

TABLE 1: STUDENTS VS SUBJECTS

P	English	Maths	Biology	Physics	Chemistry
A1	(0.7,0.2)	(0.4, 0.5)	(0.5, 0.3)	(0.6, 0.2)	(0.5, 0.3)
A2	(0.5, 0.5)	(0.5, 0.3)	(0.6, 0.2)	(0.5, 0.4)	(0.6, 0.3)
A3	(0.5,0.3)	(0.6, 0.3)	(0.6, 0.0)	(0.8, 0.1)	(0.6, 0.4)
A4	(0.4,0.5)	(0.5,0.4)	(0.7,0.1)	(0.6,0.3)	(0.7,0.1)

TABLE 2: SUBJECTS VS CAREER

Q	Medicine	Pharmacy	Surgery	Anatomy
English	(0.8,0.1)	(0.9,0.1)	(0.5,0.3)	(0.7,0.2)
Maths	(0.7,0.2)	(0.8,0.1)	(0.5,0.2)	(0.5,0.4)
Biology	(0.9,0.0)	(0.8,0.1)	(0.9,0.0)	(0.9,0.1)
Physics	(0.6,0.3)	(0.5,0.3)	(0.5,0.4)	(0.7,0.1)
Chemistry	(0.8,0.1)	(0.7,0.2)	(0.7,0.1)	(0.8,0.0)

TABLE 3: MAX-MIN-AVERAGE COMPOSITION FOR IFS

R	Medicine	Pharmacy	Surgery	Anatomy
A1	(0.7,0.20)	(0.75,0.15)	(0.65,0.2)	(0.65,0.15)
A2	(0.75,0.10)	(0.7,0.15)	(0.75,0.1)	(0.75,0.15)
A3	(0.75,0.0)	(0.7,0.05)	(0.75,0.0)	(0.75,0.05)
A4	(0.8,0.05)	(0.75,0.1)	(0.8,0.05)	(0.8,0.05)

TABLE 4

R’	Medicine	Pharmacy	Surgery	Anatomy
A1	(0.7,0.20, 0.3)	(0.75,0.15, 0.1)	(0.65,0.2, 0.15)	(0.65,0.15, 0.2)
A2	(0.75,0.10,0.15)	(0.7,0.15, 0.15)	(0.75,0.1, 0.15)	(0.75,0.15, 0.1)
A3	(0.75,0.0, 0.25)	(0.7,0.05, 0.25)	(0.75,0.0, 0.25)	(0.75,0.05, 0.2)
A4	(0.8,0.05, 0.15)	(0.75,0.1, 0.15)	(0.8,0.05, 0.15)	(0.8,0.05, 0.15)

TABLE 6

U	Medicine	Pharmacy	Surgery	Anatomy
A1	(0.91, 0.74)	(0.825, 0.835)	(0.7475, 0.77)	(0.78, 0.82)
A2	(0.8625, 0.885)	(0.805, 0.8275)	(0.8625, 0.885)	(0.825, 0.835)
A3	(0.9375, 1)	(0.875, 0.9375)	(0.9375, 1)	(0.9, 0.94)
A4	(0.92, 0.9425)	(0.8625, 0.885)	(0.92, 0.9425)	(0.92, 0.9425)

TABLE 7

V	Medicine	Pharmacy	Surgery	Anatomy
A1	0.825	0.83	0.78875	0.8
A2	0.87375	0.81625	0.839375	0.83
A3	0.96875	0.90625	0.921875	0.92
A4	0.93125	0.87375	0.896875	0.93125

CONCLUSION

From Table 7, A_1 reads to Surgery, A_2, A_3 and A_4 are reads to Pharmacy (Pharmacist).

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