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## APPLICATION OF FUZZY MATRIX IN YOGA ON DEPRESSION

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### ABSTRACT:

A fuzzy matrix is a matrix with component having values in the closed interval  $(0,1)$ . Application of fuzzy set theory in medicine are by no means constricted to medical diagnosis, other applications involve for example, fuzzy controller for various medical devices and fuzzy decision making for determining appropriate therapies. In this paper some sufficient conditions for convergence under “max average” composition of the fuzzy matrix and of a fuzzy state process are established. An occurrence relation  $R$  and conformability relation  $S$  are determined from expert medical evidence and examination of the related patient with depression. Now yoga is being applied as a remedy around the world. It has observed that yoga is very beneficial for depression people to remain healthy and also to reduce the depression. As we find yoga brings as very positive change in attitude and behavior and increases mental capacities.

**KEYWORDS:** Fuzzy matrix, Fuzzy logic, Yoga , Depression, Pentagonal Fuzzy matrix.

### INTRODUCTION:

Decision making problems are very frequently happens in fuzzy in almost all possibilities. Fuzzy is used in various fields, such as fuzzy operation modeling, control theory, decision making, reasoning and so on. Some previous authors highlighted fuzzy numbers in their study as triangular fuzzy and trapezoidal fuzzy numbers. Fuzzy set can be hypothetically used in various fields at the same time matrix formulations can also be done in fuzzy by using mathematical modeling. Though the presence of uncertainty in many mathematical expressions in different branches of science and technology. Here a new concept is introduced termed has Pentagonal Fuzzy Number (PFN) and corresponding Pentagonal Fuzzy Matrices (PFM). Several authors have proposed result of the properties of a determinant, adjoint of fuzzy matrices, and convergence of the power sequences of fuzzy

matrices. The theoretical development of the fuzzy matrix was influenced through article on some fuzzy matrix proposed by Ragob et al., (Ragob and Eman,1994). Moreover, some important results of the determinant of a fuzzy matrix were proposed by Kim (Kim et al., 1989).

The concept of fuzzy matrices was introduced for the first time by Thomason (1977), in the article entitled convergence of power of fuzzy matrix. Then Hashimoto (1983) studied the fuzzy transitive matrix. Formation of an arithmetic operations in crucial in the study of it fuzzy numbers, establish some basic arithmetic operations of pentagonal fuzzy numbers. We newly introduced fuzzy comparable pentagonal fuzzy numbers to resolve. The fuzzy order performance problem between any two matrices, there is an any ordering relations either they are equal or different. Here we introduced some fundamental properties of pentagonal fuzzy matrices. Then we furnish the commutative and associative laws, which are well defined, for pentagonal fuzzy matrices under the arithmetic operations addition and multiplications. The notion of PFN is introduced in a generalized way. We proposed the logical definition in developing a pentagonal fuzzy numbers is studied, together with their basic properties. A pentagonal fuzzy number is a fiver table subset of a real number  $R$  having five parameter. A pentagonal fuzzy number  $P$  is denoted a  $P=(P_1,P_2,P_3,P_4,P_5)$  where  $P_3$  is the middle point and  $(P_1,P_2)$  and  $(P_4,P_5)$  are the left and right side points of  $P_3$ , respectively.

Now we construct the mathematical definition of a pentagonal fuzzy number. Depression is a mental health disorder charcterized by persistently depressed mood or loss of interest in activities causing significant impairment in daily life. A group of conditions associated with the elevation or lowering of a person's mental health is termed a depression or bipolar disorder.

Depression produces numerous physical and mental symptoms which vary according to each individual and his situational factors. They can leave many impact on physical and mental health. It is important for every individual to relieve himself from depression to lead a peaceful and healthy life. Though we have so many difficulties and obstacles in life we need to tackle them and we should learn the techniques to handle depression

## MATHEMATICAL MODELS

A fuzzy number 'X' is fuzzy set on the real line  $R$  must satisfy the following conditions.

- i.  $\mu_x(a_0)$  piecewise continous.
- ii.  $f$  at least on  $a_0 \in R$  with  $\mu_x(a_0)=1$ .
- iii.  $\mu_x$  must be normal and convex.

A Pentagonal fuzzy number of a fuzzy set  $P$  is defined as  $P = (P_1, P_2, P_3, P_4, P_5)$  and its membership is given by

$$\mu_{\tilde{x}}(a) = \begin{cases} 0 & \text{for } a \leq p_1 \\ \left(\frac{a - p_1}{p_2 - p_1}\right) & \text{for } p_1 \leq a \leq p_2 \\ \left(\frac{a - p_2}{p_3 - p_2}\right) & \text{for } p_2 \leq a \leq p_3 \\ 1 & \text{for } a = p_3 \\ \left(\frac{p_4 - a}{p_4 - p_3}\right) & \text{for } p_3 \leq a \leq p_4 \\ \left(\frac{p_5 - a}{p_5 - p_4}\right) & \text{for } a \leq p_5 \end{cases}$$

The elements of pentagonal fuzzy number matrix is  $P=(P_{ij})_{n \times n}$ ,  $P_{ij}=(P_{ijL}, P_{ijM}, P_{ijN}, P_{ijR}, P_{ijS})$  be the  $ij^{\text{th}}$  element of 'P'.

The membership function of  $(P_{ij})=(P_{ijL}, P_{ijM}, P_{ijN}, P_{ijR}, P_{ijS})$  is defined as  $\left(\frac{P_{ijL}}{10}, \frac{P_{ijM}}{10}, \frac{P_{ijN}}{10}, \frac{P_{ijR}}{10}, \frac{P_{ijS}}{10}\right)$ .

If  $0 \leq P_{ijO} \leq P_{ijM} \leq P_{ijN} \leq P_{ijR} \leq P_{ijS} \leq 1$ ,

Where  $0 \leq \frac{P_{ijL}}{10} \leq \frac{P_{ijM}}{10} \leq \frac{P_{ijN}}{10} \leq \frac{P_{ijR}}{10} \leq \frac{P_{ijS}}{10} \leq 1$ ,

Take two Pentagonal fuzzy number matrices  $P=(p_{ij})_{m \times n}$  and  $Q=(q_{ij})_{m \times n}$  are same order  $m \times n$ .

Addition for two Pentagonal fuzzy matrices are

$$(P+Q)=(p_{ij} + q_{ij})_{m \times n}$$

where  $(p_{ij}+q_{ij}) = (p_{ijL}+q_{ijL}, p_{ijM}+q_{ijM}, p_{ijN}+q_{ijN}, p_{ijR}+q_{ijR}, p_{ijS}+q_{ijS})$  is the  $ij^{\text{th}}$  element of  $(p+q)$ .

Subtraction for two Pentagonal fuzzy matrices are

$$(P-Q)=(p_{ij} - q_{ij})_{m \times n}$$

Where

$(p_{ij}-q_{ij}) = (p_{ijL}-q_{ijL}, p_{ijM}-q_{ijM}, p_{ijN}-q_{ijN}, p_{ijR}-q_{ijR}, p_{ijS}-q_{ijS})$  is the  $ij^{\text{th}}$  element of  $(p-q)$ .

The Maximum operation on pentagonal fuzzy numbers  $\max(p,q)=(\sup(p_{ij},q_{ij}))$

Where

$$\sup(p_{ij},q_{ij})=\{ \sup(p_{ijL},q_{ijL}), \sup(p_{ijM},q_{ijM}), \sup(p_{ijN},q_{ijN}), \sup(p_{ijR},q_{ijR}), \sup(p_{ijS},q_{ijS}) \}$$

is the  $ij^{\text{th}}$  element of  $\text{Max } \max(p,q)$ .

Let  $P=(P_1, P_2, P_3, P_4, P_5)$  be pentagonal fuzzy number  $AM(P)=\left(\frac{P_1, P_2, P_3, P_4, P_5}{5}\right)$  is called Arithmetic Mean (AM) for pentagonal fuzzy Number.

Let A and B be a variables defined on a universal set 'A'. The relativity function is denoted as

$$f\left(\frac{a}{b}\right) = \left\{ \frac{\mu_b(a) - \mu_a(b)}{\max\{\mu_b(a), \mu_a(b)\}} \right\}$$

Where  $\mu_b(a)$  is the membership function of 'a' with respect to 'b' for Pentagonal fuzzy Number and  $\mu_a(b)$  is the membership function of 'b' with respect to 'a' got calculated using subtraction operation and  $\max\{\mu_b(a), \mu_a(b)\}$ .

Let a  $p=\{p_1, p_2, p_3, p_4, \dots, p_{i-1}, p_i, p_{i+1}, \dots, p_n\}$  be a set of variables defined on p form a matrix of relatively values.

$R=(r_{ij})$  is a square matrix of order n is called comparison matrix or

$$-AM\left[\left(\frac{a_i}{b_j}\right)\right] = \frac{AM(\mu_{aj}(a_i) - 1)\mu_{ai}(a_i)}{AM(\max\mu_{aj}(a_i), \mu_{ai}(a_j))}$$

Where AM represents arithmetic mean.

## ALGORITHM

### Step 1

Take for the pentagonal fuzzy number matrix from the inexact value needed for the problem.

### Step 2

Convert the used matrix into membership function.

### Step 3

Workout the relativity values  $n\left(\frac{a_i}{a_j}\right)$

### Step 4

Workout the comparison matrix from the values of  $n\left(\frac{a_i}{a_j}\right)$ .

### Step 5

Determine the maximum value from each  $R_i$ .

### Step 6

The maximum value of the column  $R_i$  is the required solution.

## CASE STUDY

Depression is a group of conditions associated with the elevation or lowering of a person's mood, such as depression or bipolar disorder. Depression is medical term for a person with prolonged stress and it can be happened by a physical or psychological conditions. Stress is the body's reaction to any change that requires and adjustment or response, the body reacts to these changes with physical, mental and emotional responses. Depression is a normal part of life. You can experience depression from your environment, your body and your thoughts. Even positive life changes such promotions, a mortgage, or the birth of child will also cause stress which results in depression.

## YOGA FOR DEPRESSION

Yoga poses to tense muscles is your body. The areas of the body that tend to carry the most stress are the neck, shoulders, and back. But other part of the body (like the face, jaw, fingers and wrists) also can benefit for simple yoga stretches. Yoga is the best way of relieving stress and anxiety and feature among tips for fighting depression, our list of effective yoga pose not only calm and rejuvenate the mind, but also help in refreshing the body. It is indeed the ultimate meditation for all diseases, practical and propagated by great yogis.

Five yoga poses which to help reduce depression,

- ❖ Balasana
- ❖ Sethu Bandhasana
- ❖ Halasana
- ❖ Uttasana
- ❖ Savasana

### Balasana

Balasana helps calm your brain and relieves stress and anxiety. It gently stretches your lower back and hips, enabling your body to relax. Peace and calm prevail over your entire being, helping you deal with your depression better. Balasana is considered as one of the most comfortable yoga poses. All you have to do is kneel and sit on your heels. Make sure your big toes touch each other. Keep your hands on your knees and spread your knees hip-width apart. Then bend your torso forward, in between your divided thighs, with your face touching the ground. Bring your arms forward and place them on either side of your head, with the palms facing down. Be in this position for a few minutes.

### Sethu bandhasana

Sethu Bandhasana strengthens the back muscles, buttocks, and hamstrings and relieves a tired back. It helps you relax and works wonders for people suffering from stress, anxiety, and depression. Sethu Bandhasana opens up your heart, making you feel light and at ease. To do the pose, lie down on the floor on your back. Keep your arms on the floor on either side with palms facing down. Lift your legs by folding them at the knees. Make sure the ankles and knees are in a straight line, and they are a few inches apart. Then, gently lift your entire back off the floor and stay there for a few seconds. While doing this your thighs should be parallel to each other, and your chest should touch your chin. Make sure you do not bend your chin.

### Halasana

Halasana reduces the strain on your back and enhances your postures. It calms your brain, gives is a good stretch, and reduces stress. It keeps headaches and insomnia at bay. To do the pose, lie flat on your back, with your arms kept alongside your body. Lift your legs off the ground at an angle of 90 degrees to the ground. Then, vplace your hands on your hips and using them as support, lift your hips towards your chest. Slowly bring them down your legs and take them over your head, touching the ground beyond your head and placing your toes firmly on the ground.

### Uttasana

Uttasana relieves tension in your back, shoulders, and neck and improves the functioning of your nervous system. It calms you and reduces anxiety. Uttasana also improves blood circulation. To do the asana, stand straight with your arms alongside your body and your feet at arms length. Now, place your arms on your hips and bend forward at the hips. Make your head and chest touch your thighs. Bring your hands down and put them beside your feet or hold your ankles from behind. Keep your thighs straight.

### Savasana

Savasana rejuvenates you and helps your body relax. It reduces blood pressure and lets the effects of the previous poses to sink in better. Finally, after all the mind and body invigorating poses, Savasana will give you all the rest and scope to heal. To do the savasana, lie on the floor on your back . Keep your feet a few inches apart and let them fall side ways. Let your arms lie alongside your body with your palms facing upwards. Now, gently close your eyes and let your whole body relax, slowly and gently. Take a deep breaths and stay in the moment.

Among the three patient affected by five types of depression related symptoms. Medico's analyst analyse their depression level by five different types of questions. From their stress ratio, applied over the pentagonal matrix, let us consider the set  $\{v_1, v_2, v_3, v_4, v_5\}$  as an universal set, where  $v_1, v_2, v_3, v_4, v_5$  denotes the symptoms of depression.

### Step 1

$$P = \begin{matrix} & a & b & c \\ \begin{matrix} a \\ b \\ c \end{matrix} & \begin{bmatrix} (22,32,10,05,10) \\ (24,27,18,04,18) \\ (20,23,12,06,12) \end{bmatrix} & \begin{bmatrix} (05,18,02,02,02) \\ (06,20,11,01,01) \\ (04,16,05,01,03) \end{bmatrix} & \begin{bmatrix} (06,15,02,03,04) \\ (10,17,13,03,05) \\ (07,11,06,03,05) \end{bmatrix} \end{matrix}$$

### Step 2

$$P_{Mem} = \begin{matrix} & a & b & c \\ \begin{matrix} a \\ b \\ c \end{matrix} & \begin{bmatrix} (0.22,0.32,0.10,0.05,0.10) \\ (0.24,0.27,0.18,0.04,0.18) \\ (0.20,0.23,0.12,0.06,0.12) \end{bmatrix} & \begin{bmatrix} (0.05,0.18,0.02,0.02,0.02) \\ (0.06,0.20,0.11,0.01,0.01) \\ (0.04,0.16,0.05,0.01,0.03) \end{bmatrix} & \begin{bmatrix} (0.06,0.15,0.02,0.03,0.04) \\ (0.10,0.17,0.13,0.03,0.05) \\ (0.07,0.11,0.06,0.03,0.05) \end{bmatrix} \end{matrix}$$

$$\mu_a(a) = (0.22, 0.32, 0.10, 0.05, 0.10)$$

$$\mu_a(b) = (0.05, 0.18, 0.02, 0.02, 0.02)$$

$$\mu_a(c) = (0.06, 0.15, 0.02, 0.03, 0.04)$$

$$\mu_b(a) = (0.24, 0.27, 0.18, 0.04, 0.18)$$

$$\mu_b(b) = (0.06, 0.20, 0.11, 0.01, 0.01)$$

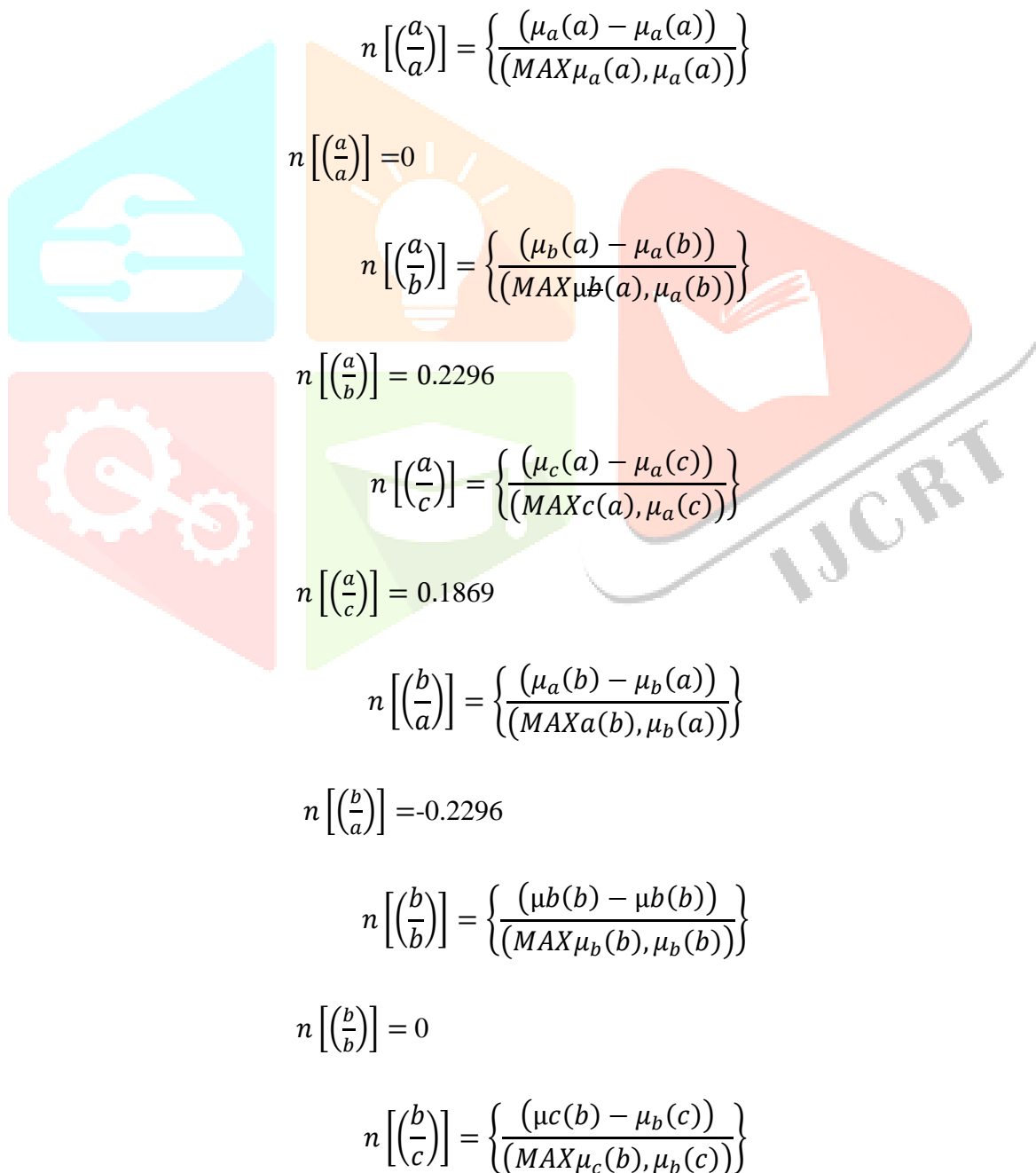
$$\mu_b(c) = (0.10, 0.17, 0.13, 0.03, 0.05)$$

$$\mu_c(a) = (0.20, 0.23, 0.12, 0.06, 0.12)$$

$$\mu_c(b) = (0.04, 0.16, 0.05, 0.01, 0.03)$$

$$\mu_c(c) = (0.07, 0.11, 0.06, 0.03, 0.05)$$

### Step 3



$$n \left[ \left( \frac{a}{a} \right) \right] = \left\{ \frac{(\mu_a(a) - \mu_a(a))}{(\text{MAX} \mu_a(a), \mu_a(a))} \right\}$$

$$n \left[ \left( \frac{a}{a} \right) \right] = 0$$

$$n \left[ \left( \frac{a}{b} \right) \right] = \left\{ \frac{(\mu_b(a) - \mu_a(b))}{(\text{MAX} \mu_b(a), \mu_a(b))} \right\}$$

$$n \left[ \left( \frac{a}{b} \right) \right] = 0.2296$$

$$n \left[ \left( \frac{a}{c} \right) \right] = \left\{ \frac{(\mu_c(a) - \mu_a(c))}{(\text{MAX} \mu_c(a), \mu_a(c))} \right\}$$

$$n \left[ \left( \frac{a}{c} \right) \right] = 0.1869$$

$$n \left[ \left( \frac{b}{a} \right) \right] = \left\{ \frac{(\mu_a(b) - \mu_b(a))}{(\text{MAX} \mu_a(b), \mu_b(a))} \right\}$$

$$n \left[ \left( \frac{b}{a} \right) \right] = -0.2296$$

$$n \left[ \left( \frac{b}{b} \right) \right] = \left\{ \frac{(\mu_b(b) - \mu_b(b))}{(\text{MAX} \mu_b(b), \mu_b(b))} \right\}$$

$$n \left[ \left( \frac{b}{b} \right) \right] = 0$$

$$n \left[ \left( \frac{b}{c} \right) \right] = \left\{ \frac{(\mu_c(b) - \mu_b(c))}{(\text{MAX} \mu_c(b), \mu_b(c))} \right\}$$

$$n \left[ \left( \frac{b}{c} \right) \right] = -0.111$$

$$n \left[ \left( \frac{c}{a} \right) \right] = \frac{(\mu_a(c) - \mu_c(a))}{(MAX \mu_a(c), \mu_c(a))}$$

$$n \left[ \left( \frac{c}{a} \right) \right] = -0.1869$$

$$n \left[ \left( \frac{c}{b} \right) \right] = \frac{(\mu_b(c) - \mu_c(b))}{(MAX \mu_b(c), \mu_c(b))}$$

$$n \left[ \left( \frac{c}{b} \right) \right] = 0.1117$$

$$= 0.111$$

$$n \left[ \left( \frac{c}{c} \right) \right] = \frac{(\mu_c(c) - \mu_c(c))}{(MAX \mu_c(c), \mu_c(c))}$$

$$n \left[ \left( \frac{c}{c} \right) \right] = 0$$

**Step 4**

	<i>a</i>	<i>b</i>	<i>c</i>
<i>a</i>	0	0.23	0.19
<i>b</i>	-0.23	0	-0.11
<i>c</i>	-0.19	0.11	0

**Step 5**

$R_i = \text{minimum of } i^{\text{th}} \text{ row}$

$$\begin{matrix} a \\ b \\ c \end{matrix} \begin{pmatrix} 0 \\ -0.23 \\ -0.19 \end{pmatrix}$$

**Comparison**

Pentagonal fuzzy number matrix in decision making	Normal Method
<i>a</i>	<i>a</i>



**Step 6**

'a' is the most depressed person.

**CONCLUSION**

Here we used pentagonal fuzzy matrix in the decision making process. It makes easy to solve everyday problems very easily in real life situation. Yoga poses and proper medication makes it easy to solve our day to day problems. Hence Sanchez's approach for medical diagnosis has been made with a generalized notions. And then we apply score and accuracy function to order fuzzy numbers and its applications has been used in many different approaches to model of medical diagnosis process.

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