Disease Diagnosing Using Bipolar Pythagorean Fuzzy Matrix

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Abstract:

In this paper, we use composition operator to diagnose disease which results appropriate examination for bipolar Pythagorean fuzzy matrix. It consists of both negative, positive membership and non-membership.

Keywords: Bipolar Pythagorean Fuzzy Set, Bipolar Pythagorean Fuzzy Matrix, Composition Operator.

1.INTRODUCTION

Zadeh [11] introduced the concepts of fuzzy set and allocated membership functions to element of a set in the interval [0, 1] by offering the idea of fuzzy sets. Atanassov [1] defined intuitionistic fuzzy set($\mathcal{IFS}$) which consists of membership degree and non-membership degree. The extension of $\mathcal{IFS}$ is pythagorean fuzzy set ($\mathcal{PFS}$) was developed by Yager [9, 10]. $\mathcal{PFS}$and their basic operations were studied by Silambarasan and Sriram [6]. Negative and positive membership are applied in fuzzy set and turned to bipolar fuzzy set which was constructed by Zhang [12]. Bipolar fuzzy matrix initiated by Pal and Mondal [5]. They studied some basic properties using few operators. Basic properties of bipolar $\mathcal{IF}$ matrix was developed by Lalitha ad Dhivya [3]. Wasim Akram Mondal [8] demonstrated bipolar Pythagorean fuzzy set($\mathcal{BiPytFS}$). Few properties of $\mathcal{BiPytF}$ matrices were discussed by Sriram and Sivaranjani [7]. Noval operations of $\mathcal{BiPyF}$ matrix was examined by Chinnadurai et al [2]. Multi-criteria decision-making problem in bipolar Pythagorean fuzzy sets were investigated by Mohana and Jansi [4]. In this paper, we discuss operators of $\mathcal{BiPytFM}$ and its properties. Also, we apply composition operator in $\mathcal{BiPytF}$ matrix to diagnose disease. Which provides more proximate result.

2.PRELIMINARIES

In this section, let us recall some basic definitions of Pythagorean fuzzy set and Bipolar Pythagorean Fuzzy Set.

Definition 2.1: [7]

A Pythagorean Fuzzy Set($\mathcal{PytFS}$) over the universal set $\mathfrak{U}$ is defined as $Q = \{\langle \mathcal{k}_f, q'(\mathcal{k}_f), q''(\mathcal{k}_f) \rangle / \mathcal{k}_f \in \mathcal{K}\}$ where, $q'(\mathcal{k}_f), q''(\mathcal{k}_f): \mathcal{K} \longrightarrow [0,1]$. Also, $0 \leq \left(q'(\mathcal{k}_f)\right)^2 + \left(q''(\mathcal{k}_f)\right)^2 \leq 1$.

Definition 2.2: [7]

A Pythagorean Fuzzy Matrix($\mathcal{PytFM}$) is denoted as $\mathcal{Q} = \langle q'_{sv}, q''_{sv} \rangle$. Where, $q'_{sv}, q''_{sv} \in [0,1]$ and $0 \leq (q'_{sv})^2 + (q''_{sv})^2 \leq 1$ for all s, p.

Definition 2.3: [7]

A bipolar valued fuzzy set($\mathcal{BiFS}$) of $\mathcal{K}$ is an object of the for $\mathcal{Q} = \{\langle k_f, q'^{n}(k_f), q'^{p}(k_f) \rangle / k_f \in \mathcal{K}\}$. Also, $q'^{n}(k_f): \mathcal{K} \longrightarrow [-1, 0]$ and $q'^{p}(k_f): \mathcal{K} \longrightarrow [0,1]$.

Definition 2.4: [7]

A Bipolar Pythagorean Fuzzy Set ($\mathcal{BiPytFS}$) is defined as $\mathcal{Q} = \{\langle k_f, q'^{n}(k_f), q'^{p}(k_f), q''^{n}(k_f), q''^{p}(k_f) \rangle / k_f \in \mathcal{K}\}$. Where, $q'^{n}(k_f), q''^{n}(k_f) \in [-1,0]$ and $q'^{p}(k_f), q''^{p}(k_f) \in [0,1]$. Also, $-1 \leq \left(q'^{n}(k_f)\right)^2 + \left(q''^{n}(k_f)\right)^2 \leq 0$, $0 \leq \left(q'^{p}(k_f)\right)^2 + \left(q''^{p}(k_f)\right)^2 \leq 1$

Definition 2.4: [7]

A Bipolar Pythagorean Fuzzy Matrix ($\mathcal{BiPytFM}$) is defined as $\mathcal{Q} = \langle q'^{n}_{sv}, q'^{p}_{sv}, q''^{n}_{sv}, q''^{p}_{sv} \rangle$. Where, q'^{n}_{sv}, q'^{p}_{sv} are degree of negative and positive membership. Also, q''^{n}_{sv}, q''^{p}_{sv} are degree of negative and positive non membership respectively.

Definition 2.5: [7]

Let $\mathcal{Q} = \langle q'^{n}_{sv}, q'^{p}_{sv}, -q''^{n}_{sv}, q''^{p}_{sv} \rangle$, $\mathcal{R} = \langle r'^{n}_{sv}, r'^{p}_{sv}, -r''^{n}_{sv}, r''^{p}_{sv} \rangle$ be two $\mathcal{BiPytFMs}$ of order $u \times v$. Then,

(a) If $\mathcal{Q} \geq \mathcal{R}$ then $q'^{n}_{sv} \geq r'^{n}_{sv}, q'^{p}_{sv} \geq r'^{p}_{sv}$, $q''^{n}_{sv} \leq r''^{n}_{sv}$, $q''^{p}_{sv} \leq r''^{p}_{sv}$

(b) $\mathcal{Q} \vee \mathcal{R} = \langle -max(q'^{n}_{sv}, r'^{n}_{sv}), max(q'^{p}_{sv}, r'^{p}_{sv}), -min(q''^{n}_{sv}, r''^{n}_{sv}), min(q''^{p}_{sv}, r''^{p}_{sv}) \rangle$

(c) $\mathcal{Q} \wedge \mathcal{R} = \langle -min(q'^{n}_{sv}, r'^{n}_{sv}), min(q'^{p}_{sv}, r'^{p}_{sv}), -max(q''^{n}_{sv}, r''^{n}_{sv}), max(q''^{p}_{sv}, r''^{p}_{sv}) \rangle$

(d) $\mathcal{Q}^c = \langle q''^{n}_{sv}, q''^{p}_{sv}, q'^{n}_{sv}, q'^{p}_{sv} \rangle$

(e) $\mathcal{Q} \circledcirc \mathcal{R} = \begin{pmatrix} -\sum_{g=1}^{s} min(q'^{n}_{sg}, r'^{n}_{gp}), \sum_{g=1}^{s} min(q'^{p}_{sg}, r'^{p}_{gp}), -\prod_{g=1}^{s} max(q''^{n}_{sg}, r''^{n}_{gp}), \\ \prod_{g=1}^{s} max(q''^{p}_{sg}, r''^{p}_{gp}) \end{pmatrix}$

3. Liver Disease Diagnose using Bipolar Pythagorean Fuzzy Matrix

Diagnosing liver disease involves several steps, typically starting with a medical history and physical examination followed by tests to determine liver function and detect specific liver conditions. Liver disease enquired by symptoms, risk factors, family history such as underling any conditions then laboratory tests can be liver function test, complete blood count, Hepatitis panel, auto immune markers, coagulation panel then imaging test etc., Also symptoms of liver disease vary from different types and stages of the disease.

These are the common symptoms such as fatigue, nausea, weight loss, abdominal pain then some of the specific disease which causes liver disease are Jaundice, itchy skin, swelling in the abdomen, memory issue etc., Here, we use bipolar Pythagorean fuzzy matrix for diagnosing liver disease using composition operator.

$\mathcal{BiPytFM}$ for diagnosing those people who are suffering from liver disease and the consequences. Assume $\mathfrak{S}$ be a set of symptoms and $\mathfrak{D}$ denotes the disease associated to these signs. Let $\mathcal{P}$ be a set of patients characterized the set of signs presenting in the $\mathfrak{S}$.

The relation of two matrices $\mathcal{Q}'_1 = \mathcal{R} \circledcirc \mathcal{Q}$ and $\mathcal{Q}'_2 = \mathcal{R} \circledcirc \mathcal{Q}^c$ known as symptoms patient disease and patient symptoms non-disease matrix appropriately. In the same way, the relation $\mathcal{Q}'_3 = \mathcal{R}^c \circledcirc \mathcal{Q}$ and $\mathcal{Q}'_4 = \mathcal{R}^c \circledcirc \mathcal{Q}^c$ known as the patient non-symptoms disease matrix and patient non-symptoms non-disease matrix. Compute the diagnose score value for $\mathbb{S}(\mathcal{Q}'_1)$ and $\mathbb{S}(\mathcal{Q}'_2)$

3.1 Algorithm

Step 1: Compute $\mathcal{BiPytFM}$ and its complement

Step 2: Let $\mathcal{R}$ and $\mathcal{R}^c$ represents the symptoms and patient matrix.

Step 3: Evaluate the symptoms and non-symptoms patient matrix

Step 4: Evaluate the positive, negative membership and non-membership

Step 5: Calculate the score value

Step 6: Ranking the values

3.2 Case Study:

Consider $\mathcal{P} = \{\wp^I, \wp^{II}, \wp^{III}, \wp^{IV}, \wp^V\}$ be a patient suffering from a disease whose symptoms are jaundice, diarrhoea, fatigue, weakness, nausea and represented as $\mathfrak{S} = \{\mathcal{S}^I, \mathcal{S}^{II}, \mathcal{S}^{III}, \mathcal{S}^{IV}, \mathcal{S}^V\}$. The possible related to the above symptoms may be caused by liver disease by $\mathfrak{D} = \{d^I, d^{II}, d^{III}, d^{IV}, d^V\}$

$$\mathcal{Q} = \begin{bmatrix} \langle -0.1,0.7,-0.8,0.2\rangle & \langle -0.2,0.8,-0.2,0.1\rangle & \langle -0.6,0.9,-0.3,0.7\rangle & \langle -0.2,0.4,-0.3,0.5\rangle & \langle -0.3,0.4,-0.6,0.8\rangle \\ \langle -0.8,0.3,-0.4,0.6\rangle & \langle -0.7,0.3,-0.5,0.8\rangle & \langle -0.2,0.4,-0.8,0.1\rangle & \langle -0.6,0.7,-0.5,0.6\rangle & \langle -0.2,0.1,-0.4,0.2\rangle \\ \langle -0.4,0.5,-0.2,0.8\rangle & \langle -0.5,0.4,-0.6,0.7\rangle & \langle -0.3,0.7,-0.8,0.8\rangle & \langle -0.1,0.8,-0.2,0.7\rangle & \langle -0.5,0.3,-0.1,0.5\rangle \\ \langle -0.1,0.2,-0.3,0.2\rangle & \langle -0.6,0.3-0.7,0.5\rangle & \langle -0.2,0.6,-0.8,0.6\rangle & \langle -0.4,0.3,-0.2,0.6\rangle & \langle -0.1,0.2,-0.7,0.5\rangle \\ \langle -0.4,0.6,-0.1,0.5\rangle & \langle -0.2,0.4,-0.5,0.4\rangle & \langle -0.3,0.9,-0.8,0.3\rangle & \langle -0.1,0.3,-0.4,0.7\rangle & \langle -0.3,0.4,-0.5,0.3\rangle \end{bmatrix}$$

$$\mathcal{R} = \begin{bmatrix} \langle -0.6,0.3,-0.6,0.2\rangle & \langle -0.6,0.3,-0.2,0.5\rangle & \langle -0.2,0.9,-0.6,0.5\rangle & \langle -0.1,0.4,-0.6,0.3\rangle & \langle -0.3,0.2,-0.4,0.6\rangle \\ \langle -0.8,0.2,-0.7,0.1\rangle & \langle -0.7,0.2,-0.1,0.6\rangle & \langle -0.6,0.1,-0.8,0.2\rangle & \langle -0.5,0.2,-0.4,0.4\rangle & \langle -0.2,0.6,-0.3,0.5\rangle \\ \langle -0.3,0.8,-0.3,0.3\rangle & \langle -0.3,0.5,-0.4,0.5\rangle & \langle -0.5,0.7,-0.3,0.8\rangle & \langle -0.3,0.7,-0.2,0.7\rangle & \langle -0.4,0.3,-0.2,0.1\rangle \\ \langle -0.4,0.1,-0.2,0.4\rangle & \langle -0.2,0.5,-0.1,0.6\rangle & \langle -0.3,0.1,-0.2,0.4\rangle & \langle -0.5,0.1,-0.3,0.5\rangle & \langle -0.6,0.5,-0.5,0.2\rangle \\ \langle -0.3,0.7,-0.1,0.5\rangle & \langle -0.1,0.4,-0.4,0.3\rangle & \langle -0.2,0.5,-0.3,0.7\rangle & \langle -0.2,0.3,-0.1,0.4\rangle & \langle -0.1,0.6,-0.7,0.3\rangle \end{bmatrix}$$

$$\mathcal{Q}^c = \begin{bmatrix} \langle -0.8,0.2,-0.1,0.7\rangle & \langle -0.2,0.1,-0.2,0.8\rangle & \langle -0.3,0.7,-0.6,0.9\rangle & \langle -0.3,0.5,-0.2,0.4\rangle & \langle -0.6,0.8,-0.3,0.4\rangle \\ \langle -0.4,0.6,-0.8,0.3\rangle & \langle -0.5,0.8,-0.7,0.3\rangle & \langle -0.8,0.1,-0.2,0.4\rangle & \langle -0.5,0.6,-0.6,0.7\rangle & \langle -0.4,0.2,-0.2,0.1\rangle \\ \langle -0.2,0.8,-0.4,0.5\rangle & \langle -0.6,0.7,-0.5,0.4\rangle & \langle -0.8,0.8,-0.3,0.7\rangle & \langle -0.2,0.7,-0.1,0.8,\rangle & \langle -0.5,0.3,-0.1,0.5\rangle \\ \langle -0.1,0.2,-0.3,0.2\rangle & \langle -0.6,0.3-0.7,0.5\rangle & \langle -0.2,0.6,-0.8,0.6\rangle & \langle -0.4,0.3,-0.2,0.6\rangle & \langle -0.7,0.5,-0.1,0.2\rangle \\ \langle -0.1,0.5,-0.4,0.6\rangle & \langle -0.5,0.4,-0.2,0.4\rangle & \langle -0.8,0.3,-0.3,0.9\rangle & \langle -0.4,0.7,-0.1,0.3\rangle & \langle -0.5,0.3,-0.3,0.4\rangle \end{bmatrix}$$

$$\mathcal{R}^c = \begin{bmatrix} \langle -0.2,0.9,-0.6,0.3\rangle & \langle -0.2,0.5,-0.6,0.3\rangle & \langle -0.6,0.5,-0.2,0.9\rangle & \langle -0.6,0.3,-0.1,0.4\rangle & \langle -0.4,0.6,-0.3,0.2\rangle \\ \langle -0.6,0.1,-0.8,0.2\rangle & \langle -0.1,0.6,-0.7,0.2\rangle & \langle -0.8,0.2,-0.6,0.1\rangle & \langle -0.4,0.4,-0.5,0.2\rangle & \langle -0.3,0.5,-0.2,0.6\rangle \\ \langle -0.5,0.3,-0.3,0.8\rangle & \langle -0.4,0.5,-0.3,0.5\rangle & \langle -0.3,0.8,-0.5,0.7\rangle & \langle -0.2,0.7,-0.3,0.7\rangle & \langle -0.2,0.1,-0.4,0.3\rangle \\ \langle -0.6,0.4,-0.2,0.1\rangle & \langle -0.1,0.6,-0.2,0.5\rangle & \langle -0.2,0.4,-0.3,0.1\rangle & \langle -0.3,0.5,-0.5,0.1\rangle & \langle -0.5,0.2,-0.6,0.5\rangle \\ \langle -0.1,0.3,-0.3,0.7\rangle & \langle -0.4,0.3,-0.1,0.4,\rangle & \langle -0.3,0.7,-0.2,0.5,\rangle & \langle -0.1,0.4,-0.2,0.3\rangle & \langle -0.7,0.3,-0.1,0.6\rangle \end{bmatrix}$$

$$\mathcal{Q}_1' = \begin{bmatrix} \langle -0.6,0.8,-0.2,0.3\rangle & \langle -0.5,0.7,-0.4,0.4\rangle & \langle -0.6,0.8,-0.2,0.5\rangle & \langle -0.5,0.7,-0.2,0.6\rangle & \langle -0.6,0.5,-0.2,0.3\rangle \\ \langle -0.8,0.2,-0.4,0.4\rangle & \langle -0.2,0.,-0.3,0.4\rangle & \langle -0.7,0.3,-0.2,0.7\rangle & \langle -0.5,0.6,-0.3,0.4\rangle & \langle -0.6,0.3,-0.2,0.3\rangle \\ \langle -0.3,0.7,-0.2,0.5\rangle & \langle -0.5,0.7,-0.2,0.4\rangle & \langle -0.3,0.7,-0.2,0.5\rangle & \langle -0.4,0.7,-0.2,0.3\rangle & \langle -0.4,0.8,-0.2,0.4\rangle \\ \langle -0.3,0.5,-0.3,0.5\rangle & \langle -0.5,0.4-0.5,0.2\rangle & \langle -0.5,0.3,-0.2,0.6\rangle & \langle -0.4,0.5,-0.6,0.3\rangle & \langle -0.5,0.3,-0.2,0.4\rangle \\ \langle -0.3,0.5,-0.1,0.3\rangle & \langle -0.2,0.5,-0.5,0.3\rangle & \langle -0.3,0.7,-0.2,0.3\rangle & \langle -0.1,0.6,-0.2,0.3\rangle & \langle -0.1,0.7,-0.1,0.3\rangle \end{bmatrix}$$

$$\mathcal{Q}_2' = \begin{bmatrix} \langle -0.3,0.5,-0.1,0.3\rangle & \langle -0.3,0.5,-0.3,0.9\rangle & \langle -0.6,0.7,-0.2,0.4\rangle & \langle -0.4,0.6,-0.2,0.3\rangle & \langle -0.6,0.8,-0.1,0.3\rangle \\ \langle -0.6,0.6,-0.4,0.2\rangle & \langle -0.6,0.6,-0.2,0.3\rangle & \langle -0.4,0.3,-0.6,0.4\rangle & \langle -0.3,0.6,-0.2,0.3\rangle & \langle -0.6,0.4,-0.8,0.2\rangle \\ \langle -0.5,0.8,-0.3,0.5\rangle & \langle -0.2,0.1,-0.4,0.4\rangle & \langle -0.4,0.8,-0.3,0.5\rangle & \langle -0.4,0.7,-0.3,0.3\rangle & \langle -0.5,0.5,-0.3,0.4\rangle \\ \langle -0.6,0.6,-0.8,0.7\rangle & \langle -0.5,0.6,-0.5,0.3\rangle & \langle -0.4,0.7,-0.3,0.9\rangle & \langle -0.4,0.6,-0.2,0.3\rangle & \langle -0.6,0.5,-0.2,0.2\rangle \\ \langle -0.4,0.7,-0.1,0.3\rangle & \langle -0.5,0.7,-0.2,0.3\rangle & \langle -0.4,0.7,-0.2,0.4\rangle & \langle -0.4,0.7,-0.1,0.8\rangle & \langle -0.5,0.5,-0.2,0.3\rangle \end{bmatrix}$$

$$\mathcal{Q}_3' = \begin{bmatrix} \langle -0.4,0.7,-0.2,0.3\rangle & \langle -0.6,0.8,-0.5,0.3\rangle & \langle -0.3,0.9,-0.2,0.3\rangle & \langle -0.4,0.9,-0.2,0.3\rangle & \langle -0.4,0.2,-0.2,0.3\rangle \\ \langle -0.4,0.6,-0.2,0.2\rangle & \langle -0.6,0.4,-0.5,0.2\rangle & \langle -0.6,0.6,-0.8,0.2\rangle & \langle -0.4,0.6,-0.2,0.5\rangle & \langle -0.5,0.4,-0.2,0.2\rangle \\ \langle -0.4,0.5,-0.3,0.5\rangle & \langle -0.5,0.4,-0.3,0.4\rangle & \langle -0.5,0.7,-0.3,0.3\rangle & \langle -0.4,0.8,-0.3,0.6\rangle & \langle -0.3,0.3,-0.4,0.3\rangle \\ \langle -0.4,0.4,-0.3,0.2\rangle & \langle -0.6,0.4,-0.2,0.1\rangle & \langle -0.6,0.5,-0.3,0.1\rangle & \langle -0.3,0.6,-0.3,0.5\rangle & \langle -0.3,0.4,-0.3,0.5\rangle \\ \langle -0.4,0.5,-0.1,0.6\rangle & \langle -0.4,0.4,-0.3,0.5\rangle & \langle -0.3,0.7,-0.2,0.3\rangle & \langle -0.4,0.7,-0.2,0.6\rangle & \langle -0.3,0.3,-0.2,0.3\rangle \end{bmatrix}$$

$$\mathcal{Q}_4' = \begin{bmatrix} \langle -0.6,0.4,-0.3,0.6\rangle & \langle -0.6,0.4,-0.2,0.6\rangle & \langle -0.6,0.7,-0.3,0.1\rangle & \langle -0.6,0.8,-0.3,0.6\rangle & \langle -0.3,0.3,-0.4,0.5\rangle \\ \langle -0.7,0.6,-0.3,0.2\rangle & \langle -0.6,0.4,-0.5,0.1\rangle & \langle -0.6,0.6,-0.3,0.4\rangle & \langle -0.6,0.3,-0.4,0.5\rangle & \langle -0.5,0.4,-0.4,0.5\rangle \\ \langle -0.3,0.7,-0.2,0.3\rangle & \langle -0.5,0.8,-0.5,0.3\rangle & \langle -0.3,0.8,-0.2,0.3\rangle & \langle -0.3,0.7,-0.2,0.5\rangle & \langle -0.5,0.4,-0.3,0.3\rangle \\ \langle -0.4,0.5,-0.2,0.4\rangle & \langle -0.5,0.4-0.5,0.4\rangle & \langle -0.3,0.5,-0.2,0.3\rangle & \langle -0.4,0.5,-0.2,0.5\rangle & \langle -0.3,0.4,-0.3,0.3\rangle \\ \langle -0.3,0.4,-0.3,0.3\rangle & \langle -0.3,0.3,-0.2,0.3\rangle & \langle -0.3,0.7,-0.3,0.3\rangle & \langle -0.2,0.5,-0.2,0.5\rangle & \langle -0.3,0.4,-0.3,0.3\rangle \end{bmatrix}$$

Value matrix is given below,

$$\mathcal{V}_1' = \begin{bmatrix} 0.83 & 0.78 & 0.49 & 0.59 & 1.15 \\ 0.44 & 0.82 & 0.63 & 0.88 & 0.96 \\ 0.75 & 0.73 & 0.68 & 0.83 & 0.81 \\ 0.84 & 1.00 & 0.87 & 0.88 & 0.92 \\ 0.97 & 0.95 & 0.80 & 1.00 & 0.97 \end{bmatrix}$$

$$\mathcal{V}_2' = \begin{bmatrix} 0.41 & 0.75 & 0.49 & 0.73 & 0.60 \\ 0.58 & 1.05 & 0.75 & 0.74 & 0.68 \\ 0.83 & 0.63 & 0.83 & 0.68 & 0.64 \\ 1.00 & 0.94 & 0.93 & 1.12 & 0.83 \\ 0.84 & 1.13 & 0.75 & 0.90 & 0.80 \end{bmatrix}$$

$$\mathcal{V}_3' = \begin{bmatrix} 0.68 & 0.62 & 0.59 & 0.52 & 0.91 \\ 0.72 & 0.83 & 1.12 & 0.83 & 0.73 \\ 0.93 & 0.84 & 0.64 & 0.79 & 1.07 \\ 0.87 & 0.61 & 0.61 & 0.95 & 1.05 \\ 0.91 & 0.98 & 0.75 & 0.82 & 0.95 \end{bmatrix}$$

$$\mathcal{V}_4' = \begin{bmatrix} 0.84 & 1.28 & 0.52 & 0.75 & 0.38 \\ 0.64 & 0.55 & 1.24 & 0.82 & 1.22 \\ 0.65 & 1.20 & 0.74 & 0.73 & 0.80 \\ 1.35 & 0.87 & 1.09 & 0.75 & 0.58 \\ 0.65 & 0.59 & 0.72 & 0.93 & 0.71 \end{bmatrix}$$

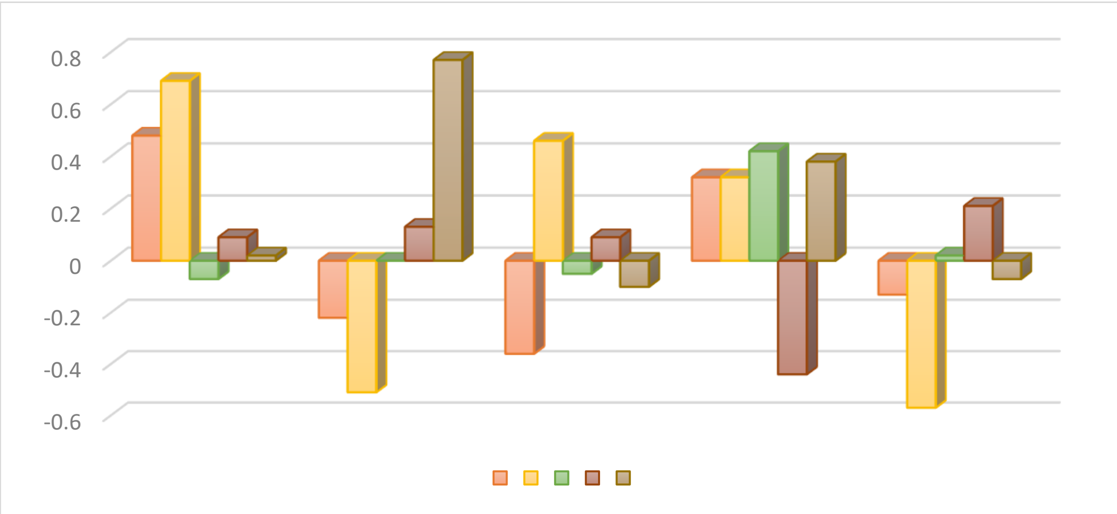
$$\mathcal{M}_{\mathcal{V}_1'} = \mathcal{V}_1' - \mathcal{V}_3' = \begin{bmatrix} 0.05 & 0.16 & -0.1 & 0.07 & 0.24 \\ 0.28 & -0.01 & 0.49 & 0.05 & 0.23 \\ 0.18 & -0.11 & 0.04 & 0.04 & -0.26 \\ -0.03 & 0.39 & 0.26 & -0.07 & -0.13 \\ 0.06 & -0.03 & 0.05 & 0.18 & 0.02 \end{bmatrix}$$

$$\mathcal{M}_{\mathcal{V}_2'} = \mathcal{V}_2' - \mathcal{V}_4' = \begin{bmatrix} -0.43 & -0.53 & -0.03 & -0.02 & 0.22 \\ -0.06 & 0.50 & -0.49 & -0.08 & -0.54 \\ 0.18 & -0.57 & 0.09 & -0.05 & -0.16 \\ -0.35 & 0.07 & -0.16 & 0.37 & 0.25 \\ 0.19 & 0.54 & 0.03 & -0.03 & 0.09 \end{bmatrix}$$

$$\mathcal{M}_{\mathcal{V}_1'} - \mathcal{M}_{\mathcal{V}_2'} = \begin{bmatrix} 0.48 & 0.69 & -0.07 & \mathbf{0.09} & 0.02 \\ -0.22 & -0.51 & 0 & 0.13 & \mathbf{0.77} \\ -0.36 & \mathbf{0.46} & -0.05 & 0.09 & -0.1 \\ 0.32 & 0.32 & \mathbf{0.42} & -0.44 & 0.38 \\ -0.13 & -0.57 & 0.02 & \mathbf{0.21} & -0.07 \end{bmatrix}$$

5. Conclusion

The $\mathcal{BiPytFM}$ for disease diagnosis in patients who suffering from different liver disease such as using the symptoms fatigue, nausea, weight loss, jaundice, itchy skin etc. Using the composition operator in bipolar pythagorean fuzzy matrix we conclude that $\wp^{I}$ suffering from jaundice, $\wp^{II}$ suffering from itchy skin, $\wp^{III}$ suffering from nausea, $\wp^{IV}$ suffering from weight loss, $\wp^{V}$ suffering jaundice.



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