ISSN: 0974-2115
www.jchps.com Journal of Chemical and Pharmaceutical Sciences

# Application of Fuzzy Parameterized Generalized Fuzzy Soft Expert Set In Healthcare Decision Making

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**ABSTRACT**

Healthcare sector quality demands are exponentially rising to design expert system for medical diagnosis. Fuzzy Parameterized Generalized Fuzzy soft expert set (FPGFSES) can be used to handle decision-making problems. In this paper we give an application of this FPGFSES in a decision-making problem is designed and practically tested. A group of some patients is use to develop this model and another group of same count patients was used to test it. All results are compared using mathematical model.

**KEY WORDS:** Healthcare system, Fuzzy Parameterized Generalized Fuzzy soft expert set, Fuzzy soft expert set, Fuzzy soft set.

## 1. INTRODUCTION

Healthcare monitoring is a recent term coined for healthcare practice supported by electronic processes and communication. Most of the problems in medical science, engineering and economics etc, have various uncertainties. Geetharamani (2015) proposed the theory of fuzzy parameterized generalized soft expert set (FPGFSES) to solve a decision-making problem. Sharmiladevi (2015) has introduced the application of fuzzy parameterized generalized soft expert set in a decision-making problem. In this paper, design a fuzzy parameterized generalized soft expert set model for healthcare diagnosis. A model of fuzzy parameterized generalized soft expert set is based on different decease and knowledge of experts. We consider the following healthcare problem.

**Application of Fuzzy Parameterized Generalized Fuzzy Soft Expert Set In Healthcare Decision Making:** In this section, we illustrate an application of Fuzzy Parameterized Generalized Fuzzy soft expert set in a healthcare decision making problem. The architecture diagram of proposed model is shown below,


**Figure.1.Architecture of Proposed FPGFSES model**

We believe that one of the Healthcare system wishes to appraise some patents from a health checkups and decide the healthiest patent for it to samples and find the health level of all patents in samples.

Let $P = \{A, B, C, D\}$ be a set of patients.

let $E = \{T(\text{Temperature}), H(\text{Headahe}), C(\text{Cough})\}$ a set of symptoms.

Let $\Psi = \left\{\frac{T}{0.6}, \frac{H}{0.7}, \frac{C}{0.3}\right\}$ be a fuzzy subset of $I^E$.

$X = \{V\ (\text{Viral Fever}), M(\text{Malaria}), Ty(Typhoid)\}$be a set of diagnosis.

Let $Z = \Psi \times X \times O$ and $A \subseteq Z$, Where $\Psi \subset I^E$ $\mu: Z \to I = [0,1]$

Define a function, $F_\psi: A \to I^U \times I$ as follows

$$F_\psi\left(\frac{T}{0.6}, \text{V}, 1\right) = \left(\left\{\frac{u_1}{0.4}, \frac{u_2}{0.7}, \frac{u_3}{0.8}, \frac{u_4}{0.6}\right\}, 0.8\right), \quad F_\psi\left(\frac{T}{0.6}, \text{M}, 1\right) = \left(\left\{\frac{u_1}{0.3}, \frac{u_2}{0.6}, \frac{u_3}{0.9}, \frac{u_4}{0.7}\right\}, 0.9\right)$$

$$F_\psi\left(\frac{T}{0.6}, \text{Ty}, 1\right) = \left(\left\{\frac{u_1}{0.9}, \frac{u_2}{0.7}, \frac{u_3}{0.2}, \frac{u_4}{0.3}\right\}, 0.8\right), \quad F_\psi\left(\frac{H}{0.7}, \text{V}, 1\right) = \left(\left\{\frac{u_1}{0.5}, \frac{u_2}{0.7}, \frac{u_3}{0.8}, \frac{u_4}{0.3}\right\}, 0.6\right)$$

$$F_\psi\left(\frac{H}{0.7}, \text{M}, 1\right) = \left(\left\{\frac{u_1}{0.3}, \frac{u_2}{0.2}, \frac{u_3}{0.4}, \frac{u_4}{0.6}\right\}, 0.8\right), \quad F_\psi\left(\frac{H}{0.7}, \text{Ty}, 1\right) = \left(\left\{\frac{u_1}{0.3}, \frac{u_2}{0.5}, \frac{u_3}{0.4}, \frac{u_4}{0.3}\right\}, 0.7\right)$$

$$F_\psi\left(\frac{C}{0.3}, \text{V}, 1\right) = \left(\left\{\frac{u_1}{0.7}, \frac{u_2}{0.4}, \frac{u_3}{0.2}, \frac{u_4}{0.1}\right\}, 0.4\right), \quad F_\psi\left(\frac{C}{0.3}, \text{M}, 1\right) = \left(\left\{\frac{u_1}{0.8}, \frac{u_2}{0.7}, \frac{u_3}{0.3}, \frac{u_4}{0.4}\right\}, 0.5\right)$$

$$F_\psi\left(\frac{C}{0.3}, \text{Ty}, 1\right) = \left(\left\{\frac{u_1}{0.7}, \frac{u_2}{0.6}, \frac{u_3}{0.4}, \frac{u_4}{0.7}\right\}, 0.2\right), \quad F_\psi\left(\frac{T}{0.6}, \text{V}, 0\right) = \left(\left\{\frac{u_1}{0.7}, \frac{u_2}{0.4}, \frac{u_3}{0.3}, \frac{u_4}{0.4}\right\}, 0.3\right)$$

$$F_\psi\left(\frac{T}{0.6}, \text{M}, 0\right) = \left(\left\{\frac{u_1}{0.8}, \frac{u_2}{0.3}, \frac{u_3}{0.2}, \frac{u_4}{0.3}\right\}, 0.1\right), \quad F_\psi\left(\frac{T}{0.6}, \text{Ty}, 0\right) = \left(\left\{\frac{u_1}{0.4}, \frac{u_2}{0.2}, \frac{u_3}{0.6}, \frac{u_4}{0.5}\right\}, 0.4\right)$$

$$F_\psi\left(\frac{H}{0.7}, \text{V}, 0\right) = \left(\left\{\frac{u_1}{0.7}, \frac{u_2}{0.4}, \frac{u_3}{0.2}, \frac{u_4}{0.7}\right\}, 0.4\right), \quad F_\psi\left(\frac{H}{0.7}, \text{M}, 0\right) = \left(\left\{\frac{u_1}{0.8}, \frac{u_2}{0.6}, \frac{u_3}{0.5}, \frac{u_4}{0.3}\right\}, 0.3\right)$$

$$F_\psi\left(\frac{H}{0.7}, \text{Ty}, 0\right) = \left(\left\{\frac{u_1}{0.6}, \frac{u_2}{0.4}, \frac{u_3}{0.5}, \frac{u_4}{0.7}\right\}, 0.6\right), \quad F_\psi\left(\frac{C}{0.3}, \text{V}, 0\right) = \left(\left\{\frac{u_1}{0.2}, \frac{u_2}{0.6}, \frac{u_3}{0.7}, \frac{u_4}{0.9}\right\}, 0.7\right)$$

$$F_\psi\left(\frac{C}{0.3}, \text{M}, 0\right) = \left(\left\{\frac{u_1}{0.1}, \frac{u_2}{0.4}, \frac{u_3}{0.5}, \frac{u_4}{0.7}\right\}, 0.4\right), \quad F_\psi\left(\frac{C}{0.3}, \text{Ty}, 0\right) = \left(\left\{\frac{u_1}{0.2}, \frac{u_2}{0.5}, \frac{u_3}{0.6}, \frac{u_4}{0.4}\right\}, 0.5\right)$$

Then we can find the Fuzzy parameterized generalized fuzzy soft expert sets ($F_\psi$ , Z) as consisting of the following collections of approximations

$$(F_\psi,\mathrm{Z})=\left\{\begin{array}{l}\left(\left(\frac{T}{0.6},\mathrm{V},1\right),\left(\left\{\frac{u_1}{0.4},\frac{u_2}{0.7},\frac{u_3}{0.8},\frac{u_4}{0.6}\right\},0.8\right)\right),\left(\left(\frac{T}{0.6},\mathrm{M},1\right),\left(\left\{\frac{u_1}{0.3},\frac{u_2}{0.6},\frac{u_3}{0.9},\frac{u_4}{0.7}\right\},0.9\right)\right)\\ \left(\left(\frac{T}{0.6},\mathrm{Ty},1\right),\left(\left\{\frac{u_1}{0.9},\frac{u_2}{0.7},\frac{u_3}{0.2},\frac{u_4}{0.3}\right\},0.8\right)\right),\left(\left(\frac{H}{0.7},\mathrm{V},1\right),\left(\left\{\frac{u_1}{0.5},\frac{u_2}{0.7},\frac{u_3}{0.8},\frac{u_4}{0.3}\right\},0.6\right)\right)\\ \left(\left(\frac{H}{0.7},\mathrm{M},1\right),\left(\left\{\frac{u_1}{0.3},\frac{u_2}{0.2},\frac{u_3}{0.4},\frac{u_4}{0.6}\right\},0.8\right)\right),\left(\left(\frac{H}{0.7},\mathrm{Ty},1\right),\left(\left\{\frac{u_1}{0.3},\frac{u_2}{0.5},\frac{u_3}{0.4},\frac{u_4}{0.3}\right\},0.7\right)\right)\\ \left(\left(\frac{C}{0.3},\mathrm{V},1\right),\left(\left\{\frac{u_1}{0.7},\frac{u_2}{0.4},\frac{u_3}{0.2},\frac{u_4}{0.1}\right\},0.4\right)\right),\left(\left(\frac{C}{0.3},\mathrm{M},1\right),\left(\left\{\frac{u_1}{0.8},\frac{u_2}{0.7},\frac{u_3}{0.3},\frac{u_4}{0.4}\right\},0.5\right)\right)\\ \left(\left(\frac{C}{0.3},\mathrm{Ty},1\right),\left(\left\{\frac{u_1}{0.7},\frac{u_2}{0.6},\frac{u_3}{0.4},\frac{u_4}{0.7}\right\},0.2\right)\right),\left(\left(\frac{T}{0.6},\mathrm{V},0\right),\left(\left\{\frac{u_1}{0.7},\frac{u_2}{0.4},\frac{u_3}{0.3},\frac{u_4}{0.4}\right\},0.3\right)\right)\\ \left(\left(\frac{T}{0.6},\mathrm{M},0\right),\left(\left\{\frac{u_1}{0.8},\frac{u_2}{0.3},\frac{u_3}{0.2},\frac{u_4}{0.3}\right\},0.1\right)\right),\left(\left(\frac{T}{0.6},\mathrm{Ty},0\right),\left(\left\{\frac{u_1}{0.4},\frac{u_2}{0.2},\frac{u_3}{0.6},\frac{u_4}{0.5}\right\},0.4\right)\right)\\ \left(\left(\frac{H}{0.7},\mathrm{V},0\right),\left(\left\{\frac{u_1}{0.7},\frac{u_2}{0.4},\frac{u_3}{0.2},\frac{u_4}{0.7}\right\},0.4\right)\right),\left(\left(\frac{H}{0.7},\mathrm{M},0\right),\left(\left\{\frac{u_1}{0.8},\frac{u_2}{0.6},\frac{u_3}{0.5},\frac{u_4}{0.3}\right\},0.3\right)\right)\\ \left(\left(\frac{H}{0.7},\mathrm{Ty},0\right),\left(\left\{\frac{u_1}{0.6},\frac{u_2}{0.4},\frac{u_3}{0.5},\frac{u_4}{0.7}\right\},0.6\right)\right),\left(\left(\frac{C}{0.3},\mathrm{V},0\right),\left(\left\{\frac{u_1}{0.2},\frac{u_2}{0.6},\frac{u_3}{0.7},\frac{u_4}{0.9}\right\},0.7\right)\right)\\ \left(\left(\frac{C}{0.3},\mathrm{M},0\right),\left(\left\{\frac{u_1}{0.1},\frac{u_2}{0.4},\frac{u_3}{0.5},\frac{u_4}{0.7}\right\},0.4\right)\right),\left(\left(\frac{C}{0.3},\mathrm{Ty},0\right),\left(\left\{\frac{u_1}{0.2},\frac{u_2}{0.5},\frac{u_3}{0.6},\frac{u_4}{0.4}\right\},0.5\right)\right)\end{array}\right\}$$

In this problem, we give five steps to find the healthiest patent from sample healthcare system.

**Step 1: Calculate Agree FPGFSES and disagree FPGFSES of Healthcare system:** Table 1 and Table 2 we present the Agree FPGFSES and Disagree FPGFSES of Healthcare system.

**Table.1.Agree FPGFSES**

| P | *A* | *B* | *C* | *D* | *λ* |
|---|---|---|---|---|---|
| $\left(\frac{T}{0.6},\mathrm{V}\right)$ | 0.4 | 0.7 | 0.8 | 0.6 | 0.8 |
| $\left(\frac{T}{0.6},\mathrm{M}\right)$ | 0.3 | 0.6 | 0.9 | 0.7 | 0.9 |
| $\left(\frac{T}{0.6},\mathrm{Ty}\right)$ | 0.9 | 0.7 | 0.2 | 0.3 | 0.8 |
| $\left(\frac{H}{0.7},\mathrm{V}\right)$ | 0.5 | 0.7 | 0.8 | 0.3 | 0.6 |
| $\left(\frac{H}{0.7},\mathrm{M}\right)$ | 0.3 | 0.2 | 0.4 | 0.6 | 0.8 |
| $\left(\frac{H}{0.7},\mathrm{Ty}\right)$ | 0.3 | 0.5 | 0.4 | 0.3 | 0.7 |
| $\left(\frac{C}{0.3},\mathrm{V}\right)$ | 0.7 | 0.4 | 0.2 | 0.1 | 0.4 |
| $\left(\frac{C}{0.3},\mathrm{M}\right)$ | 0.8 | 0.7 | 0.3 | 0.4 | 0.5 |
| $\left(\frac{C}{0.3},\mathrm{Ty}\right)$ | 0.7 | 0.6 | 0.4 | 0.7 | 0.2 |

**Table.2.Disagree FPGFSES**

| P | *A* | *B* | *C* | *D* | *λ* |
|---|---|---|---|---|---|
| $\left(\frac{T}{0.6},\mathrm{V}\right)$ | 0.7 | 0.4 | 0.3 | 0.4 | 0.3 |
| $\left(\frac{T}{0.6},\mathrm{M}\right)$ | 0.8 | 0.3 | 0.2 | 03 | 0.1 |
| $\left(\frac{T}{0.6},\mathrm{Ty}\right)$ | 0.4 | 0.2 | 0.6 | 0.5 | 0.4 |
| $\left(\frac{H}{0.7},\mathrm{V}\right)$ | 0.7 | 0.4 | 0.2 | 0.7 | 0.4 |
| $\left(\frac{H}{0.7},\mathrm{M}\right)$ | 0.8 | 0.6 | 0.5 | 0.3 | 0.3 |
| $\left(\frac{H}{0.7},\mathrm{Ty}\right)$ | 0.6 | 0.4 | 0.5 | 0.7 | 0.6 |
| $\left(\frac{C}{0.3},\mathrm{V}\right)$ | 0.2 | 0.6 | 0.7 | 0.9 | 0.7 |
| $\left(\frac{C}{0.3},\mathrm{M}\right)$ | 0.1 | 0.4 | 0.5 | 0.7 | 0.4 |
| $\left(\frac{\mathrm{C}}{0.3},\mathrm{Ty}\right)$ | 0.2 | 0.5 | 0.6 | 0.4 | 0.5 |

**Step 2: Calculate Weighted Agree FPGFSES and Weighted Disagree FPGFSES of Healthcare system:** Multiply each parameter weight value with Value of Patents. Table 3 and Table 4 we present the Weighted Agree FPGFSES and Weighted Disagree FPGFSES of Healthcare system. And select the best Value of Patents from all universal possible values.

**Step 3: Find Generalized Value of Patents**

Multiply the generalized value with best Value of Patents and add each Value of Patents values in weighted agree FPGFSES and weighted disagree FPGFSES of Healthcare system.

For weighted Agree FPGFSES,

A = 0.678, B = 0.245, C =1.206, D =0.378

For weighted disagree FPGFSES,

A =0.538, B =0.000, C =0.234, D =0.763

**Step 4: Find Target Value of Patents:** Subtract disagree Generalized Value of Patents value from agree Generalized Value of Patents.

A = 0.678 – 0.538 = 0.14, B = 0.245 - 0.000 = 0.245, C =1.206 – 0.234 = 0.972, D =0.378 – 0.763 = -0.385.

**Step 5: Find best Value from Target Value of Patents:** $C = 0.972$

Here, $C$ is a healthiest patent in the sample healthcare system. Because $C$ get a highest agree value from other Value of Patents, so we select $u_3$ is the healthiest patent using FPGFSES decision making.

**Table.3.Weighted Agree FPGFSES**

| P | $A$ | $B$ | $C$ | $D$ | $\lambda$ |
|---|---|---|---|---|---|
| $\left(\frac{T}{0.6}, \mathrm{V}\right)$ | 0.24 | 0.42 | **0.48** | 0.36 | 0.8 |
| $\left(\frac{T}{0.6}, \mathrm{M}\right)$ | 0.18 | 0.36 | **0.54** | 0.42 | 0.9 |
| $\left(\frac{T}{0.6}, \mathrm{Ty}\right)$ | **0.54** | 0.42 | 0.12 | 0.18 | 0.8 |
| $\left(\frac{H}{0.7}, \mathrm{V}\right)$ | 0.35 | 0.49 | **0.56** | 0.21 | 0.6 |
| $\left(\frac{H}{0.7}, \mathrm{M}\right)$ | 0.21 | 0.14 | 0.28 | **0.42** | 0.8 |
| $\left(\frac{H}{0.7}, \mathrm{Ty}\right)$ | 0.21 | **0.35** | 0.28 | 0.21 | 0.7 |
| $\left(\frac{C}{0.3}, \mathrm{V}\right)$ | **0.21** | 0.12 | 0.06 | 0.01 | 0.4 |
| $\left(\frac{C}{0.3}, \mathrm{M}\right)$ | **0.24** | 0.21 | 0.09 | 0.12 | 0.5 |
| $\left(\frac{C}{0.3}, \mathrm{Ty}\right)$ | **0.21** | 0.18 | 0.12 | **0.21** | 0.2 |

**Table.4.Weighted Disagree FPGFSES**

| P | $A$ | $B$ | $C$ | $D$ | $\lambda$ |
|---|---|---|---|---|---|
| $\left(\frac{T}{0.6}, \mathrm{V}\right)$ | **0.42** | 0.24 | 0.18 | 0.24 | 0.3 |
| $\left(\frac{T}{0.6}, \mathrm{M}\right)$ | **0.48** | 0.18 | 0.12 | 0.18 | 0.1 |
| $\left(\frac{T}{0.6}, \mathrm{Ty}\right)$ | 0.24 | 0.12 | **0.36** | 0.30 | 0.4 |
| $\left(\frac{H}{0.7}, \mathrm{V}\right)$ | **0.49** | 0.28 | 0.14 | **0.49** | 0.4 |
| $\left(\frac{H}{0.7}, \mathrm{M}\right)$ | **0.56** | 0.42 | 0.35 | 0.21 | 0.3 |
| $\left(\frac{H}{0.7}, \mathrm{Ty}\right)$ | 0.42 | 0.28 | 0.35 | **0.49** | 0.6 |
| $\left(\frac{C}{0.3}, \mathrm{V}\right)$ | 0.06 | 0.18 | 0.21 | **0.27** | 0.7 |
| $\left(\frac{C}{0.3}, \mathrm{M}\right)$ | 0.03 | 0.12 | 0.15 | **0.21** | 0.4 |
| $\left(\frac{C}{0.3}, \mathrm{Ty}\right)$ | 0.06 | 0.15 | **0.18** | 0.12 | 0.5 |

## 2. CONCLUSION

In this work we have introduced the application of Fuzzy Parameterized Generalized Fuzzy soft expert set is given in solving a decision making problem. Using the Fuzzy Parameterized Generalized Fuzzy soft expert set model, the patent health level and status of patent are calculated. The model is found to be accurate for classification and, when compared; it proved to be a higher best as the solution value.

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