



APPLICATION OF VAGUE SET IN MEDICAL DIAGNOSIS

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ABSTRACT

In this paper, we study the application of a vague set in medical diagnosis using normalized Euclidean distance method to measure the distance between each worker and each health problem respectively. Solution is obtained by looking for the smallest distance between each worker and each health problem.

Key words: Fuzzy set, Vague set, Normalized euclidean distance.

INTRODUCTION

In real world, we frequently deal with imprecise information. Information available is sometimes imprecise, sometimes inexact or sometimes insufficient. Out of several higher order fuzzy sets, vague sets have been found to be highly useful to deal with vagueness. There are situations where due to insufficiency in the information available, the evaluation of membership values is not possible up to our satisfaction. Due to some reason, evaluation of non-membership values is not also always possible. Certainly fuzzy sets theory by Zadeh¹ is not appropriate to deal with such problem, rather vague set theory is more suitable. Out of several generalizations of fuzzy set theory for various objectives, the notion introduced by Gau and Buehrer² in defining vague sets is interesting and useful. According to Gau and Buehrer³, a vague set A of a set X is a pair of functions (t_A, f_A) , where t_A and f_A are fuzzy sets on X satisfying $t_A(x) + f_A(x) \leq 1$, for all x in X . A fuzzy set t_A of X can be identified with the pair $(t_A, 1 - t_A)$. Thus, the theory of vague sets is a generalization of fuzzy sets.

In this paper, we study a novel application of vague set in a medical diagnosis by applying the normalized Euclidean distance method to measure the distance between each IT

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worker and each health problem. In this connection, we have taken a survey from friends and relatives, which are working in software industries in India. The most common problems, which are identified in IT professionals are namely Musculoskeletal discomfort, Computer Vision Syndrome, some of them were staying away from their family and their regular source of meal was hotel, overweight, were not satisfied with the time they spent with their family etc. In the present study, particularly about the Stress, Ulcer, Vision Problem, Spinal Problem and Blood Pressure and finally, we obtain the solution, which determines the health problem of the IT worker.

Preliminaries

In this section, we recall some of the fundamental definitions, which are necessary for this paper.

Definition 2.1: Let X be any non-empty set. A mapping $\mu : X \rightarrow [0,1]$ is called a fuzzy subset of R .

Definition 2.2: A vague set A in the universe of discourse X is a pair (t_A, f_A) , where $t_A : X \rightarrow [0, 1]$, $f_A : X \rightarrow [0, 1]$ are mappings such that $t_A(x) + f_A(x) \leq 1, \forall x \in X$. The functions t_A and f_A are called true membership function and false membership function respectively.

Definition 2.3: The interval $[t_A(x), 1 - f_A(x)]$ is called the vague value of x in A and it is denoted by $V_A(x)$ i.e., $V_A(x) = [t_A(x), 1 - f_A(x)]$.

Definition 2.4: A vague set $A = (t_A, f_A)$ of a set X with $t_A(x) = 0$ and $f_A(x) = 1, \forall x \in X$ is called zero vague set of X .

Definition 2.5: A vague set $A = (t_A, f_A)$ of a set X with $t_A(x) = 1$ and $f_A(x) = 0, \forall x \in X$ is called unit vague set of X .

Definition 2.6: The normalized Euclidean distance for fuzzy sets A and B in $X = \{x_1, x_2, \dots, x_n\}$ is –

$$\sqrt{\frac{1}{n} \sum_{i=1}^n [(\mu_A(x_i) - \mu_B(x_i))^2]}$$

Definition 2.7³: The normalized Euclidean distance between two vague sets $A = (t_A, f_A)$ and $B = (t_B, f_B)$ in $X = \{x_1, x_2, \dots, x_n\}$ is –

$$\sqrt{\frac{1}{2n} \sum_{i=1}^n \left[(t_A(x_i) - t_B(x_i))^2 - (f_A(x_i) - f_B(x_i))^2 \right]}$$

Application of vague sets in medical diagnosis

We have taken survey from the IT professional in which they are facing many problems in which we have chosen the most common problems. Among the workers we have consider only four workers, let the workers be W_1, W_2, W_3, W_4 are denoted by the set $W = \{W_1, W_2, W_3, W_4\}$ and the set of symptoms $S = \{\text{Head ache, acidity, burning eyes, back pain and depression}\}$. Let the set of health problems be $H = \{\text{Stress, ulcer, vision problem, spinal problem and blood pressure}\}$.

Table 1: Represents the workers and their symptoms

	Head ache	Acidity	Burning eyes	Back pain	Depression
W_1	(0.9, 0.1)	(0.7, 0.2)	(0.1, 0.9)	(0.7, 0.2)	(0.2, 0.7)
W_2	(0, 0.7)	(0.4, 0.5)	(0.6, 0.2)	(0.2, 0.7)	(0.1, 0.2)
W_3	(0.7, 0.1)	(0.7, 0.1)	(0, 0.5)	(0.1, 0.7)	(0, 0.6)
W_4	(0.5, 0.1)	(0.4, 0.3)	(0.4, 0.5)	(0.8, 0.2)	(0.3, 0.4)

Table 2: Represents related health problems

	Stress	Ulcer	Vision problem	Spinal problem	Blood pressure
Head ache	(0.3, 0)	(0, 0.6)	(0.2, 0.2)	(0.2, 0.8)	(0.2, 0.9)
Acidity	(0.3, 0.5)	(0.2, 0.6)	(0.5, 0.2)	(0.1, 0.5)	(0, 0.7)
Burning eyes	(0.2, 0.8)	(0, 0.8)	(0.1, 0.7)	(0.7, 0)	(0.2, 0.8)
Back pain	(0.7, 0.3)	(0.5, 0)	(0.2, 0.6)	(0.1, 0.7)	(0.1, 0.8)
Depression	(0.2, 0.6)	(0.1, 0.8)	(0.1, 0.9)	(0.2, 0.7)	(0.8, 0.1)

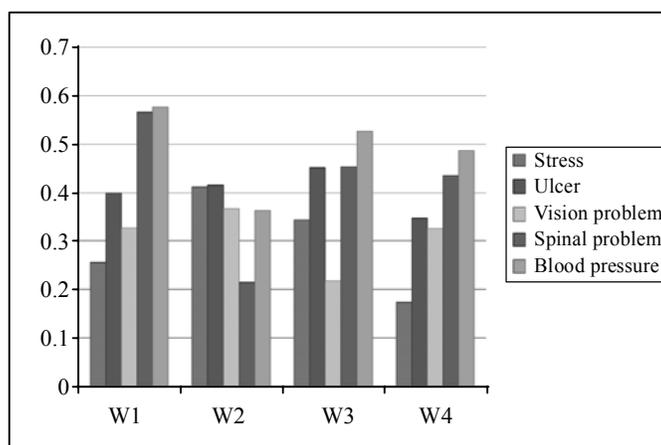
Using Definition 2.7 above to calculate the distance between each worker and each health problem with reference to the symptoms, we get the table below.

Table 3: Workers vs Health Problems

	Stress	Ulcer	Vision problem	Spinal problem	Blood pressure
W₁	0.2569	0.3987	0.3271	0.5666	0.5771
W₂	0.4111	0.4147	0.3674	0.2145	0.3633
W₃	0.3435	0.4505	0.2191	0.4528	0.5263
W₄	0.1732	0.3478	0.3256	0.4347	0.4868

From the above Table 3, the shortest distance gives the health problem of four IT workers.

This is represented by the Chart diagram given as below:

**Fig. 1: Graph of Workers vs Health Problems**

CONCLUSION

Overall the normalized Euclidean distance method gives the final result of four IT workers health problems that is from Table 3, we see that –

- (i) The shortest value of W_1 is 0.2569 and therefore W_1 faces stress.
- (ii) The shortest value of W_2 is 0.2145 and therefore W_2 faces spinal problem.
- (iii) The shortest value of W_3 is 0.2191 and therefore W_3 faces vision problem.
- (iv) The shortest value of W_4 is 0.2500 and therefore W_4 faces stress.

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