International Journal of Mathematical Archive-9(7), 2018, 19-22
Available online through www.ijma.info ISSN 2229 – 5046

# FUZZY MATRIX FOR DENGUE VIRUS DISEASE IN HUMAN BODY

Dr. T. GEETHA[1] AND A. USHA*[2]
[1]Assistant Professor, Department of Mathematics,
K. N. Govt. Arts College (Woman), Thanjavur-613007, Tamil Nadu, India.

[2]Assistant Professor, Department of Mathematics,
Prist University, Thanjavur-613403, Tamil Nadu, India.

*(Received On: 21-05-18; Revised & Accepted On: 28-06-18)*

***ABSTRACT***

*Dengue is a life threatening disease prevalent in several developed as well as developing countries like India. This is a virus born disease caused by breeding of Aedes mosquito. Datasets that are available for dengue describe information about the patients suffering with dengue disease and without dengue disease along with their symptoms like: Fever Temperature, WBC, Platelets, Severe Headache, Vomiting, Metallic Taste, Joint Pain, Appetite, Diarrhea, Hematocrit, Hemoglobin, and how many days suffer in different city. In this paper we discuss various algorithm approaches of Atanassov's intuitionistic fuzzy matrices that have been utilized for dengue disease prediction. The main objective of this paper is to classify data and assist the users in extracting useful information from data and easily identify a suitable algorithm for accurate predictive model from it. Further, we extended our approach in the sector of addition and multiplication factors of Atanassov's intuitionistic fuzzy matrices based on membership and non-membership function. Finally, we presented a decision making problem based on one of the operation of Atanassov's intuitionistic fuzzy matrices.*

***Keywords:*** *fuzzy matrix, Atanassov's intuitionistic fuzzy matrix (AIFM), Atanassov's intuitionistic fuzzy matrix intersection, medical knowledge.*

## INTRODUCTION

Initially, fuzzy set theory was proposed by Zadeh as a means of representing mathematically any imprecise or vague system of information in the real world. In fuzzy set theory, there were no scope to think about the hesitation in the membership degrees which is arise in various real life situations. This situation is overcome by invention of Atanassov's intuitionistic fuzzy sets (AIFSs) by Atanassov. Here it is possible to model hesitation and uncertainty by using an additional degree. The fuzzy matrix have been proposed to represent fuzzy relation in a system based on fuzzy sets theory. Several authors presented a number of results on fuzzy matrices. Pal and Shyama shown several properties on fuzzy matrices and interval-valued fuzzy matrices. In this paper, we studied AIFM and presented a simple algorithm to evaluate it and by using the notion of Atanassov's intuitionistic fuzzy matrices, we apply Atanassov's intuitionistic fuzzy set technology through for medical diagnosis and we exhibit the technique with Dengue fever disease case study. Dengue virus infection is one of the most important among human arbovirus infections. The global incidence of dengue fever (DF) and dengue hemorrhagic fever (DHF) has increased melodramatic in recent decades. Dengue is a mosquito-borne infection which in recent years has become a major international public health concern. Dengue is found in equatorial and sub-equatorial regions around the world, mainly in urban and semi-urban areas. DHF, a potentially lethal complication, was first recognized in the 1950s during the dengue epidemics in the Philippines and Thailand, but today DHF affects most Asian countries and has become a leading cause of hospitalization and death, majority of them were children. The global prevalence of dengue has grown dramatically in recent decades. The disease is now endemic in more than 100 countries in Africa, the Americas, the Eastern Mediterranean, South-east Asia and the Western Pacific. Southeast Asia and the Western Pacific are most seriously affected. Before 1970 only nine countries had experienced DHF epidemics, a number that had increased more than four-fold by 1995. Some 2500 million people, i.e. two fifths of the world's population are now at risk from dengue. WHO currently estimates there may be 50 million cases of dengue infection worldwide every year. This is greater than double the number of dengue cases which were recorded in the same region in 1995. Not only is the number of cases increasing as the disease is spreading to new areas, but explosive outbreaks are occurring (WHO).

*Corresponding Author: A. Usha*[2]*
*[2]Assistant Professor, Department of Mathematics,*
*Prist University, Thanjavur-613403, Tamil Nadu, India.*

## 2. PRELIMINARIES

**Definition 2.1. (Fuzzy matrix):** A fuzzy matrix (FM) of order $m \times n$ is defined as A = < $a_{ij}$ , $a_{ij_\gamma}$> where $a_{ij_\gamma}$ is the membership value of the $ij$ -th element in $A$ . Let $F_{m \times n}$ denotes the set of all fuzzy matrices of order $m \times n$. If $m = n$, in short, we write $F_n$ , the set of all square FMs of order $n$ .

Fuzzy set was not enough to study then hesitation about the membership degree of an element in a set. For dealing this situation Atanassov introduced intuitionistic fuzzy sets,which is defined below.

**Definition2.2. (Atanassov's intuitionistic fuzzy set):** An AIFS $A$ is defined as an object of the form A= {< x, $\mu_A(x)$ , $\nu_A(x)$>/ x$\epsilon$ X} where the function $\mu\, A$: $X \to [0,1]$ and $\nu A : X \to [0,1]$ define the degree of membership and degree of non-membership of an element $x \in X$ respectively and $0 \leq \mu_A(x) + \nu_A(x) \leq 1$ , for every $x \in X$. The value of $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$ is called the degree of non-determinacy (or hesitation) of the element $x \in X$ to the AIFS $A$. Let us define $<F> = \{< x, y> : x, y \in [0,1]$ and $0 \leq x + y \leq 1\}$ .

**Definition2.3. (Atanassov's intuitionistic fuzzy matrix intersection): Let** [$\mathbf{a}_{ij}$ ,$\lambda_j$] , [$\mathbf{b}_{ij}$ ,$\lambda_j'$] $\epsilon$ AIFM $_{m \times n}$ then AIFM[$c_{ij}$ , $d_j$]is called **intersection** of [$\mathbf{a}_{ij}$ ,$\lambda_j$] and [$\mathbf{b}_{ij}$ ,$\lambda_j'$] dented [$\mathbf{a}_{ij}$ ,$\lambda_j$]$\widetilde{\cap}$ [$\mathbf{b}_{ij}$ ,$\lambda_j'$] if $c_{ij}$ =min { $a_{ij}$ ,$b_{ij}$ } and $d_j$= max{ $\lambda_j$,$\lambda_j'$ } for all i, j .

**Definition2.4:** Let [$c_{ij}$, $d_j$] $\epsilon\ \tilde{A}\ \widetilde{\cap}\ \tilde{B}$ where $\tilde{A}$ and $\tilde{B}$ are two **Atanassov's intuitionistic** fuzzy matrices. Then the set $W\ (ui) = \{ui\ \epsilon\ U\ |\Sigma cij\}$ is called **weight** for each $ui\ \epsilon\ U$.

## 3. APPLICATION OF AIFM IN HUMAN DISEASE

In this section, we are put forwarding the problem which is based upon AIFM in Human disease.

### 3.1 Awareness in mosquito protection measures

Use of nets, screening of houses, creating smoke with Neem leaves, spraying of insecticides and closing of doors and windows were the common protective measures used against mosquitoes. These measures either reduce the number of mosquitoes or provide protection against bites and thus reduce the risk of dengue infection. The model showed that the variable mosquito protection measures had negative association with the dengue incidence, i.e. the more protection measures were used, the fewer incidences there was of dengue.

### 3.2 Procedure of solving problem:

A real life problem can be solved by using different Mathematical methods. The decision maker can choose the easiest method from the alternative. After taking decision by the decision makers that, they solve a particular problem by using the operation of **Atanassov's intuitionistic** fuzzy matrices , the decision makers go through the following algorithm.

**Algorithm:**

***Step*-1**: To construct the **Atanassov's intuitionistic** fuzzy matrices with respect to their own choice parameters of the decision makers.

***Step*-2:** To compute the union or intersection of **Atanassov's intuitionistic** fuzzy matrices.

***Step*-3**: To compute the weight of each object ($O_i$) by adding the membership values of the entries of its concerned row ( $i^{th}$-row) of the union or intersection of **Atanassov's intuitionistic** fuzzy matrices .

***Step*-4**: The object having the highest weight becomes the optimal choice object.

To illustrate the basic idea of the AIFM-algorithm, now we apply it to the following **Atanassov's intuitionistic** fuzzy matrices based decision making problems.

***Case Study*:**

Generally in medical science a patient suffering from a disease may have multiple symptoms. Again it is also observed that there are certain symptoms which may be common to more than one diseases leading to peculiar dilemma. Sometimes the doctor has to face many problems when an area is largely affected new disease. Then the doctor has detected the disease commencing the common symptoms of the patients.

Let M = {$P_1$, $P_2$, $P_3$, $P_4$, $P_5$, $P_6$, $P_7$, $P_8$} be the set of patients and
S = {$S_1$, $S_2$, $S_3$, $S_4$, $S_5$, $S_6$, $S_7$, $S_8$} be the set of parameters of symptoms of dengue
where
$S_1$ = high fever (104 F, 40°C),
$S_2$ = headache,
$S_3$= extreme fatigue

$S_4$ = red eyes and pain in the eyes,
$S_5$ = enlarged lymph nodes,
$S_6$ = deep muscle and joint pains
$S_7$ =nausea and vomiting,
$S_8$= low pressure and heart rate.

Suppose two Dr.X and Dr.Y examines the patients on based on the same set of parameters.

Let F : S → [0, 1] . They consider the function on the parameters as follows:

***Step*-1:** Based on these functions the two doctors construct **Atanassov's intuitionistic** fuzzy matrices given as follows:

$\tilde{A}$ =

| | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ |
|---|---|---|---|---|---|---|---|---|
| $P_1$ | (0.5,0.5) | (0.8,0.2) | (0.8,0.2) | (0.7,0.3) | (0.9,0.1) | (1,0) | (0.8,0.2) | (0.5,0.5) |
| $P_2$ | (0.6,0.4) | (0.5,0.5) | (0.8,0.2) | (0.5,0.5) | (0.8,0.2) | (1,0) | (0.4,0.6) | (0.5,0.5) |
| $P_3$ | (0.8,0.2) | (0.8,0.2) | (0.6,0.4) | (0.7,0.3) | (0.6,0.4) | (0.8,0.2) | (0.4,0.3) | (0.5,0.4) |
| $P_4$ | (0.9,0.1) | (0.9,0.1) | (0.6,0.4) | (0.5,0.5) | (0.3,0.7) | (0.6,0.4) | (1,0) | (0.6,0.4) |
| $P_5$ | (0.7,0.3) | (0.8,0.2) | (0.6,0.4) | (0.8,0.1) | (0.4,0.6) | (0.3,0.6) | (1,0) | (0.6,0.3) |
| $P_6$ | (0.5,0.6) | (0.8,0.2) | (0.6,0.4) | (0.5,0.5) | (0.7,0.1) | (0.4,0.5) | (1,0) | (0.1,0.9) |
| $P_7$ | (0.8,0.2) | (0.6,0.2) | (0.5,0.4) | (0.9,0.1) | (0.8,0.1) | (0.9,0.1) | (0.6,0.4) | (0.8,0.2) |
| $P_8$ | (0.6,0.4) | (0.9,0.1) | (0.6,0.4) | (0.9,0.1) | (0.9,0.1) | (0.8,0.2) | (0.7,0.2) | (0.3,0.7) |

$\tilde{B}$ =

| | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ |
|---|---|---|---|---|---|---|---|---|
| $P_1$ | (0.5,0.5) | (0.8,0.2) | (0.8,0.2) | (0.7,0.3) | (0.9,0.1) | (1,0) | (0.4,0.6) | (0.4,0.5) |
| $P_2$ | (0.4,0.4) | (0.5,0.5) | (0.8,0.2) | (0.7,0.3) | (0.8,0.2) | (1,0) | (0.4,0.6) | (0.5,0.5) |
| $P_3$ | (0.8,0.1) | (0.8,0.2) | (0.6,0.4) | (0.5,0.5) | (0.3,0.7) | (0.8,0.2) | (0.6,0.3) | (0.5,0.5) |
| $P_4$ | (0.6,0.3) | (0.6,0.2) | (0.4,0.6) | (0.5,0.3) | (0.6,0.4) | (0.8,0.1) | (1,0) | (0.6,0.4) |
| $P_5$ | (0.7,0.3) | (0.7,0.2) | (0.6,0.4) | (0.9,0.1) | (0.4,0.6) | (0.3,0.7) | (1,0) | (0.6,0.3) |
| $P_6$ | (0.5,0.5) | (0.8,0.2) | (0.6,0.4) | (0.5,0.4) | (0.4,0.6) | (0.4,0.6) | (0.9,0.1) | (0.1,0.9) |
| $P_7$ | (0.8,0.2) | (0.9,0.1) | (0.6,0.4) | (0.5,0.5) | (0.9,0.1) | (0.9,0.1) | (0.6,0.3) | (0.3,0.6) |
| $P_8$ | (0.6,0.4) | (0.9,0.1) | (0.6,0.4) | (0.9,0.1) | (0.9,0.1) | (0.8,0.2) | (0.7,0.3) | (0.8,0.2) |

***Step*-2:**

$\tilde{A} \cap \tilde{B}$ =

| | $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ | $S_6$ | $S_7$ | $S_8$ |
|---|---|---|---|---|---|---|---|---|
| $P_1$ | (0.5,0.5) | (0.8,0.2) | (0.8,0.2) | (0.7,0.3) | (0.9,0.1) | (1,0) | (0.4,0.6) | (0.4,0.5) |
| $P_2$ | (0.4,0.4) | (0.5,0.5) | (0.8,0.2) | (0.5,0.5) | (0.8,0.2) | (1,0) | (0.4,0.6) | (0.5,0.5) |
| $P_3$ | (0.8,0.2) | (0.8,0.2) | (0.6,0.4) | (0.5,0.5) | (0.3,0.7) | (0.8,0.2) | (0.4,0.3) | (0.5,0.5) |
| $P_4$ | (0.6,0.3) | (0.6,0.2) | (0.4,0.6) | (0.5,0.5) | (0.3,0.7) | (0.6,0.4) | (1,0) | (0.6,0.4) |
| $P_5$ | (0.7,0.3) | (0.8,0.2) | (0.6,0.4) | (0.8,0.1) | (0.4,0.6) | (0.3,0.7) | (1,0) | (0.6,0.3) |
| $P_6$ | (0.5,0.5) | (0.8,0.2) | (0.6,0.4) | (0.5,0.5) | (0.4,0.6) | (0.4,0.6) | (0.9,0.1) | (0.1,0.9) |
| $P_7$ | (0.8,0.2) | (0.6,0.2) | (0.5,0.4) | (0.5,0.5) | (0.8,0.1) | (0.9,0.1) | (0.6,0.4) | (0.3,0.6) |
| $P_8$ | (0.6,0.4) | (0.9,0.1) | (0.6,0.4) | (0.9,0.1) | (0.9,0.1) | (0.8,0.2) | (0.7,0.3) | (0.3,0.7) |

***Step*-3:**

$W(P_1)$ = 0.5+0.8+0.8+0.7+0.9+1+0.6+0.6 = 5.8
$W(P_2)$ = 0.8+0.8+0.6+0.5+0.7+0.8+0.4+0.5 = 5.1
$W(P_3)$ = 0.8+0.8+0.6+0.5+0.7+0.8+0.4+0.5 = 5.1
$W(P_4)$ = 0.6+0.6+0.6+0.5+0.7+0.6+1+0.6 = 5.2
$W(P_5)$ = 0.7+0.8+0.6+0.8+0.6+0.7+1+0.6 = 5.8
$W(P_6)$ = 0.5+0.8+0.6+0.5+0.6+0.6+0.9+0.9 = 5.4
$W(P_7)$ = 0.8+0.6+0.5+0.5+0.8+0.9+0.6+0.6 = 5.3
$W(P_8)$ = 0.6+0.9+0.6+0.9+0.9+08+0.7+0.7 = 6.1

Therefore the maximum weight (6.1) 0btain by the patient is $P_8$.

Hence the patient $P_8$ has heavy suffered in dengu.

## 4. CONCLUSION

In this paper, we clarify the theory of Atanassov's intuitionistic fuzzy matrices and some of their properties. We also defined Atanassov's intuitionistic fuzzy matrix intersection. Then we defined weighted Atanassov's intuitionistic fuzzy sets. Finally we presented an application of Atanassov's intuitionistic fuzzy matrices in Human disease.

## REFERENCES


1. K.T. Atanassov, Intuitionistic fuzzy sets, *Fuzzy Sets and Systems*, 20, 87-96 (1986).
2. A.R. Meenakhi and C. Inbam, The minus partial order in fuzzy matrices, *The Journal of Fuzzy Mathematics*, 12(3), 695-700 (2004).
3. L.J. Xin, Convergence of power of a controllble fuzzy matrices, *Fuzzy Sets and System*, 45, 313-319 (1992).
4. S.K. Shyamal and M. Pal, Interval-valued fuzzy matrices, *The Journal of Fuzzy Mathematics*, 14(3), 583-604 (2006).
5. A. K. Shyamal and M. Pal, Two new operators on fuzzy matrices, *J. Applied Mathematics and Computng*, 15, 91- 107 (2004).
6. M. Dehghan, M. Ghatee and B. Hashemi, The inverse of a fuzzzy matrix of fuzzy numbers, *International Journal of Computer Mathematics*, 86(8), 1433-1452 (2009).
7. Y.B.Im, E.P. Lee , S.W.Park, The Determinant of Square Intuitionistic Fuzzy Matrices, Far East Journal of Mathematical Sciences, 3(5)(2001), 789-796.
8. An, J., J. Kimura-Kuroda, Y. Hirabayashi, and K. Yasui. 1999. Development of a novel mouse model for dengue virus infection. Virology 263:70-77.
9. Atrasheuskaya, A., P. Petzelbauer, T. M. Fredeking, and G. Ignatyev. 2003. Anti-TNF Antibody treatment reduces mortality in experimental dengue virus infection. FEMS Immunol. Med. Microbiol. 35:33-42.
10. Bandyopadhyay, S., L. C. Lum, and A. Kroeger. 2006. Classifying dengue: a review of the difficulties in using the WHO case classification for dengue haemorrhagic fever. Trop.Med. Int. Health 11:1238-1255.


**Source of support: Nil, Conflict of interest: None Declared.**