

Application of Intuitionistic Fuzzy Set - Commodities Distribution In COVID-19 Affected Area

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Abstract - An application of Intuitionistic fuzzy set (IFS) in distribution of groceries identifying the most required COVID-19 affected area via Normalized Euclidean Distance Method is presented in this article. The expected path of distribution of groceries to different Houses in Containment zones during Covid-19 is identified by calculating the distance between each House and different commodities required

Key Words: Intuitionistic fuzzy set, containment zone, red zone, COVID-19 Patient, Normalized Euclidean Distance

1. INTRODUCTION

Corona virus disease (COVID -19) is an infectious disease caused by a newly discovered corona virus. The Coronavirus patients experience a mild to moderate symptoms of cough, fever and other variety of symptoms. The virus mainly transmits through droplets generated by the infected person coughs, sneezes or exhales. A human being can be infected by breathing in the virus if they are in the contaminated radius. Normally the infection spreads through eyes, nose and mouth. You can be infected by breathing in the virus if you are within close proximity of someone who has COVID-19, or by touching a contaminated surface and then your eyes, nose or mouth. Hence the Government has taken the decision of Lockdown. Moreover special rules of Lockdown is imposed in containment zones. The idea of containment zones was to contain the virus in that particular area and not allow it to spread to other areas. Those providing essential services would be allowed on production of their identity card. There are many challenges before the government during the Covid-19 pandemic, specially in containment zones, the municipal corporation has to clean the roads, clear the garbage, clean the public toilets, etc. Emergency numbers have been displayed prominently within the respective zones to enable residents to contact in case of medical emergencies other than COVID-19 and for essential commodities. People supplying essential commodities to those areas are issued passes.

Once an area is defined as a containment zone, private vehicle movement is banned and individuals who step outside their homes must wear masks. The containment, however, excludes vegetable vendors/agriculture-related transport, essentials including grocery and medical,

institutional and government vehicles for scheduled period.

In this article, the ideal process of distribution of variety of commodities to different houses using Intuitionistic Fuzzy sets in a containment zone is presented.

2. BASIC DEFINITIONS

Definition 1 (Zadeh, 1965): A fuzzy set A of a non empty set X is defined as $\{ \langle x, \mu_A(x) \rangle : x \in X \}$, $\mu_A(x)$ is the membership function of the fuzzy set A.

Definition 2 (Atanassov, 1999): An intuitionistic fuzzy set (IFS) A in X is a pair $A = (\mu_A, \nu_A)$, where μ_A, ν_A are functions from the set X to the closed interval [0, 1] of real numbers such that for each $x \in X$, $0 \leq \mu_A(x) + \nu_A(x) \leq 1$, where μ_A is called the membership function of A and ν_A is called the non-membership function of A.

Furthermore, we have $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$ called the intuitionistic Fuzzy set index or hesitation margin of x in A. Furthermore, we have $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$ called the intuitionistic Fuzzy set index or hesitation margin of x in A. $\pi_A(x)$ is the degree of indeterminacy of to the IFS A and $\pi_A(x) : X \rightarrow [0,1]$ and $0 \leq \pi_A(x) \leq 1$ for every $x \in X$. $\pi_A(x)$ expresses the lack of knowledge of whether x belongs to IFS A or not.

Definition 3 (Szmidt and Kacprzyk, 2014): The normalized Euclidean distance $d_{n-H}(A, B)$ between two IFS A and B is defined as

$$d_{n-H}(A, B) =$$

$$\left[\frac{1}{2n} \sum_{i=1}^n \left[(\mu_A(x_i) - \mu_B(x_i))^2 + (\nu_A(x_i) - \nu_B(x_i))^2 + (\pi_A(x_i) - \pi_B(x_i))^2 \right] \right]^{1/2}$$

where $X = \{x_1, x_2, \dots, x_n\}$ for $i = 1, 2, \dots, n$.

3. APPLICATION OF INTUITIONISTIC FUZZY SETS IN IDENTIFYING THE ORDER OF SUPPLY OF REQUIRED COMMODITIES VIA NORMALIZED EUCLIDEAN DISTANCE METHOD IN CONTAINMENT ZONES

There are numerous problems of regarding requirements of a containment zone. House members need different commodities and its distribution is big target for the administrative department. Therefore, it is expedient that the Administrative department be given sufficient information of the requirements of different containment zones to enhance adequate planning, preparation and proficiency for ideal dispersion of commodities. We use intuitionistic fuzzy sets as measure since it incorporate the membership degree (i.e. based on the no. of members of a containment zone opting for a particular commodity), the non-membership degree (i.e. based on the no. of members of a zone not opting for a particular commodity) and the hesitation degree (i.e. based on the no. of members opting for a commodity which is not available for supply). Let House = H = {H1, H2, H3,..., H10} be the set of Houses in a containment zone, Requirement = {R1, R2, R3, R4} be the requirements sent by the House owner by Phone call or Text message or whatsapp message and Commodities = {C1, C2, C3,C4}. We assume the above House owners send their requirements by Phone call or Text message or whatsapp message for the above commodities.

Table 1:

Commodities Vs Requirements				
	R1	R2	R3	R4
C1	(0.6,0.3,0.1)	(0.7,0.2,0.1)	(0.8,0.2,0.0)	(0.9,0.1,0.0)
C2	(0.6,0.2,0.2)	(0.7,0.2,0.1)	(0.8,0.1,0.1)	(0.8,0.1,0.1)
C3	(0.9,0.1,0.0)	(0.8,0.1,0.1)	(0.7,0.1,0.2)	(0.8,0.2,0.0)
C4	(0.7,0.3,0.0)	(0.7,0.2,0.1)	(0.8,0.1,0.1)	(0.8,0.1,0.1)

Table 2

House owners Vs Requirements				
	R1	R2	R3	R4
H1	(0.8,0.2,0)	(0.6,0.4,0)	(0.5,0.5,0)	(0.7,0.3,0)
H2	(0.6,0.4,0)	(0.7,0.3,0)	(0.6,0.4,0)	(0.9,0.1,0)
H3	(0.9,0.1,0)	(0.9,0.1,0)	(0.8,0.2,0)	(0.9,0.1,0)
H4	(0.7,0.3,0)	(0.9,0.1,0)	(0.5,0.4,0.1)	(0.9,0.1,0)
H5	(0.8,0.2,0)	(0.9,0.1,0)	(0.8,0.2,0)	(0.9,0.1,0)
H6	(0.8,0.2,0)	(0.8,0.2,0)	(0.8,0.2,0)	(0.9,0.1,0)
H7	(0.6,0.4,0)	(0.7,0.3,0)	(0.6,0.4,0)	(0.8,0.2,0)
H8	(0.6,0.4,0)	(0.6,0.4,0)	(0.6,0.4,0)	(0.9,0.1,0)
H9	(0.6,0.4,0)	(0.7,0.3,0)	(0.5,0.5,0)	(0.9,0.1,0)
H10	(0.5,0.5,0)	(0.7,0.3,0)	(0.6,0.4,0)	(0.9,0.1,0)

Using definition 3 above to calculate the distance between each patient and attributes with respect to the corresponding level of symptoms, we get the table below:

Table 3

House owners Vs Commodities				
	C1	C2	C3	C4
H1	0.2179	0.2398	0.2	0.2236
H2	0.1225	0.1803	0.2	0.1581
H3	0.1581	0.1732	0.0866	0.15
H4	0.1658	0.2	0.1581	0.1803
H5	0.1225	0.15	0.1	0.1225
H6	0.1	0.1323	0.1	0.1
H7	0.1323	0.1803	0.1936	0.1581
H8	0.1414	0.1936	0.2236	0.1732
H9	0.1658	0.2179	0.2236	0.2
H10	0.1414	0.2	0.2398	0.1803

From table 3, based on the distance between a particular House owner and different commodities the most required commodity is identified. And the House owner H1 may be provided with the commodities in order of C2,C4,C1 and C3.

4. CONCLUSION

This application of intuitionistic fuzzy sets in providing adequate information to the administration department of the most ideal order of distribution of commodities in a containment zone as per the requirement of the House owners. The different tables may be updated time to time as per the requirement of the commodities in different containment zones.

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