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Psychology of Women And Men in Quitting Tobacco Usage Using Madm as an Application of Intuitionistic Fuzzy Set

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Abstract:

MADM (Multi – Attribute Decision Making) is one of the most popular research topics in the subject of group decision making and Data Science. MADM problem of alternatives under different attributes is given in the form of intuitionistic number (IFN), intuitionistic fuzzy set (IFS), which plays a vital role in dealing with uncertain and incomplete information. The modified similarity measures of IFSs based on cosine similarity, develop a MADM method. Distance measure and similarity measure are the important content of IFS. Euclidean distance is applied by taking the hesitation degree into account. In addition to the distance measure the modified Euclidean similarity measure has received attention. Hung and Wang (2012) considered the membership degree, non-membership degree and hesitation degree and then defined a modified cosine similarity for IFS. In this paper membership degree, non-membership degree and hesitation degree of IFS based on the modified Euclidean similarity measure $E_M(A,B)$ for two IFSs, A = $(\mu_A(x_i), \gamma_A(x_i), \theta_A(x_i))$ and B =$(\mu_B(x_i), \gamma_B(x_i), \theta_B(x_i))$ is expressed as follows

$$E_M(A,B) = \sqrt[3]{\frac{1}{3}\sum_{i=1}^{n} |(\mu_A(x_i) - \mu_B(x_i))|^3 + |(\gamma_A(x_i) - \gamma_B(x_i))|^3 + |(\theta_A(x_i) - \theta_B(x_i))|^3}$$

and modified Canberra distance expressed as follows:

$$d(A,B) = \sum_{i=1}^{n} \frac{|(\mu_A(x_i) - \mu_B(x_i)|}{|(\mu_A(x_i) + \mu_B(x_i)|} + \frac{|(\gamma_A(x_i) - \gamma_B(x_i)|}{|(\gamma_A(x_i) + \gamma_B(x_i)|} + \frac{|(\theta_A(x_i) - \theta_B(x_i)|}{|(\theta_A(x_i) + \theta_B(x_i)|}$$

Decision making skill in quieting tobacco usage is found using MADM as an Application of Intuitionistic Fuzzy Set (IFS) with the attribute's women and men and arrived same conclusion using two different similarity measure.

Keywords: Fuzzy set (FS), Intuitionistic fuzzy set (IFS), Modified Euclidean similarity measure $E_{M.}$, Modified Canberra distanced.

1. Introduction

Some basic concepts and definitions related to fuzzy sets, a modified Euclidean distance similarity measure for fuzzy sets, which will be needed in the following analysis, is given.

Term fuzzy set was firstly defined by L.A. Zadeh in 1965[1]. He defined the fuzzy sets for the ambiguity in the real life. He overcomes the problem of confusion about inclusion and exclusion of any element to a set. He defined membership value for each element of a set in between zero and one and the non-membership value is one minus the membership value.

The term intuitionistic fuzzy set is the extension of fuzzy sets it is defined by K. Atanassov in 1986. He defines membership value, non-membership value as well as the hesitation index. He says that the sum of membership value and non-membership value is lies between zero and one and the hesitation index is one minus the sum of membership value and non-membership value of an element of asset. The hesitation index for a fuzzy set is zero. The fuzzy sets and intuitionistic fuzzy sets are very useful tools in real life application areas like decision making problems, medical problems, engineering problems, control systems and various fields [3]. In this work we use the concept of distance between two intuitionistic fuzzy sets [4-6] in decision making process. The decision has been taken by measuring the smallest Euclidean distance between a person and a society

2. Preliminaries

Definition 2.1.[1] Let X be a non-empty set. A fuzzy set A drawn from X is defined as $\{(x, \mu(x)): x \in X\}$, where $\mu(x): X \rightarrow [0,1]$ called the membership function of the fuzzy set A and (x) is called the membership value of the element x.

Definition 2.2.[2,3] Let X be a non-empty set. An intuitionistic fuzzy set (IFS) A drawn from X is defined as $A = \{(x, \mu(x), \gamma(x), \theta(x)): x \in X\}$, where $\mu(x): X \rightarrow [0,1]$ called the membership function of the intuitionistic fuzzy set A and $\mu_A(x)$ is called the membership value of the element x. $\gamma(x): X \rightarrow [0,1]$ called the non-membership function of the intuitionistic fuzzy set A and $\gamma_A(x)$ is called the non-membership value of the element x. $0 \leq \mu_A(x) + \gamma_A(x) \leq 1$ for all $x \in X$. Furthermore, we have $\theta_A(x) = 1 - \{\mu_A(x) + \gamma_A(x)\}$ called the hesitation index of x in X. $\theta(x)$ express the lack of knowledge about inclusion and exclusion of x in X.

MADM (Multi – Attribute Decision Making) is one of the most popular research topics in the subject of group decision making and Data Analysis. MADM problem of alternatives under different attributes is given in the form of intuitionistic number (IFN), intuitionistic fuzzy set (IFS) plays a vital role in dealing with uncertain and incomplete information. The modified similarity measures of IFSs based on cosine similarity develop a MADM method. Distance measure and similarity measure are the important content of IFS.

Euclidean distance is applied by considering the hesitation degree into account. In addition to the distance measure the modified cosine similarity measure has received attention. Hung and Wang (2012) considered the membership degree, non-membership degree and hesitation degree for IFS.

In this paper membership degree, non-membership degree and hesitation degree of IFS based on the modified Euclidean similarity measure E_M (A,B) for two IFSs, $A = (\mu_A(x_i), \gamma_A(x_i), \theta_A(x_i))$ and $B = (\mu_B(x_i), \gamma_B(x_i), \theta_B(x_i))$ is expressed as follows

$$E_M(A,B) = \sqrt[3]{\frac{1}{3}\sum_{i=1}^{n} |(\mu_A(x_i) - \mu_B(x_i))|^3 + |(\gamma_A(x_i) - \gamma_B(x_i))|^3 + |(\theta_A(x_i) - \theta_B(x_i))|^3}$$

In this paper membership degree, non-membership degree and hesitation degree of IFS based on the modified Canberra distance $Cd(A,B)$ for two IFSs, $A = (\mu_A(x_i), \gamma_A(x_i), \theta_A(x_i))$ and $B = (\mu_B(x_i), \gamma_B(x_i), \theta_B(x_i))$ is expressed as follows

$$Cd(A,B) = \sum_{i=1}^{n} \frac{|(\mu_A(x_i) - \mu_B(x_i)|}{|(\mu_A(x_i) + \mu_B(x_i)|} + \frac{|(\gamma_A(x_i) - \gamma_B(x_i)|}{|(\gamma_A(x_i) + \gamma_B(x_i)|} + \frac{|(\theta_A(x_i) - \theta_B(x_i)|}{|(\theta_A(x_i) + \theta_B(x_i)|}$$

In this paper decision making skill of North Indians Women / Men in quieting tobacco usage is found in MADM as an Application of Intuitionistic Fuzzy Set (IFS) by considering the attributes Women and Men using IFS with the above formulae.

3. Application

In this section IFS application is presented. The North Indian women and men in quitting the tobacco usage is to be found by considering two attributes as women and men. Let $\{A, B\}$ be the set of attributes and a set of north Indian states are {Delhi, Himachal Pradesh, Jammu & Kasmir, Ladah, Punjab, Rajasthan, Uttarakhand}. Let us consider Membership value, Non-Membership value and Hesitation Value and it is represented by μ, γ, θ respectively.

Table 1: Membership values

Range	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80
Value (μ)	0.5	0.10	0.15	0.20	0.25	0.30	0.35	0.40

Table 2: Non-Membership values

Range	0-15	15-30	30-45	45-60	60-75	75-90
Value (γ)	0.10	0.14	0.18	0.22	0.24	0.28

Table 3: Hesitation values

Range	0- 20	20-40	40-60	60-80	80-100
Value (θ)	0.1	0.11	0.12	0.13	0.14

In this paper the persons who smoke always is considered as membership value μ, the persons who were advised to quit the smoke is considered as non – membership γ and the persons who try to stop the tobacco usage and using tobacco in any other form is considered as hesitation value θ for the two attributes.

Table 4: Assignment of membership value to real Data for the first Attribute

Women	Smoking Always	Delhi	Himachal Pradesh	Jammu& Kashmir	Ladak	Punjab	Rajasthan	Uttarakhand
	Values	56.6	51.1	59.3	50.4	32.4	67.6	57.3
	Membership	0.30	0.30	0.30	0.30	0.20	0.35	0.30

Table 5: Assignment of non- membership value to real Data for the first Attribute

Women	Advise to quit smoking	Delhi	Himachal Pradesh	Jammu& Kashmir	Ladak	Punjab	Rajasthan	Uttarakhand
	Values	44.4	10.3	57.8	59.1	0	57.5	39.0
	Non membership	0.18	0.10	0.22	0.22	0.001	0.22	0.18

Table 6: Assignment of hesitation value to real Data for the first Attribute

Women	Try to stop smoking but using tobacco in any other form	Delhi	Himachal Pradesh	Jammu& Kashmir	Ladak	Punjab	Rajasthan	Uttarakhand
	Values	40.7	25.2	17.1	10.7	22.4	31.7	39.6
	Hesitation	0.12	0.11	0.1	0.1	0.11	0.11	0.11

Table 7: Assignment of membership value to real Data for the Second Attribute

Men	Smoking always	Delhi	Himachal Pradesh	Jammu& Kashmir	Ladak	Punjab	Rajasthan	Uttarakhand
	Values	81.4	75.3	66.3	59.6	53.8	80.1	85.8
	Membership	0.45	0.40	0.35	0.30	0.30	0.45	0.45

Table 8: Assignment of non- membership value to real Data for the second Attribute

Men	Advise to quit smoking	Delhi	Himachal Pradesh	Jammu& Kashmir	Ladak	Punjab	Rajasthan	Uttarakhand
	Values	65.8	66.6	38.5	15.1	82.3	41.6	30.0
	Non membership	0.24	0.24	0.18	0.14	0.28	0.18	0.14

Table 9: Assignment of hesitation value to real Data for the second Attribute

Men	Try to stop smoking but using tobacco in any other form	Delhi	Himachal Pradesh	Jammu& Kashmir	Ladak	Punjab	Rajasthan	Uttarakhand
	Values	36.2	31.1	11.9	3.5	33.9	23.6	44.5
	Hesitation value	0.11	0.11	0.1	0.1	0.11	0.11	0.12

For various North Indian State, by considering two attributes and using IFSs, after consolidation, values are shown in following Table.

Table 10: Decision values

States	Women			Men		
	μ_A	γ_A	θ_A	μ_B	γ_B	θ_B
Delhi	0.30	0.18	0.12	0.45	0.24	0.11
Haryana	0.30	0.24	0.12	0.40	0.22	0.11
Himachal Pradesh	0.30	0.10	0.11	0.40	0.24	0.11
Jammu& Kashmir	0.30	0.22	0.1	0.35	0.18	0.1
Ladak	0.30	0.22	0.1	0.30	0.14	0.1
Punjab	0.20	0.001	0.11	0.30	0.28	0.11
Rajasthan	0.35	0.22	0.11	0.45	0.18	0.11
Uttarakhand	0.30	0.18	0.11	0.45	0.14	0.12

From the estimated value the decision matrix is arrived and it's given below.

Table 11: Decision matrix

Cities/Attributes	Women (A)	Men (B)
Delhi	(0.30,0.18,0.12)	(0.45,0.24,0.11)
Himachal Pradesh	(0.30,0.10,0.11)	(0.40,0.24,0.11)
Jammu& Kashmir	(0.30,0.22,0.1)	(0.35,0.18,0.1)
Ladak	(0.30,0.22,0.1)	(0.30,0.14,0.1)
Punjab	(0.20,0.001,0.11)	(0.30,0.28,0.11)
Rajasthan	(0.35,0.22,0.11)	(0.45,0.18,0.11)
Uttarakhand	(0.30,0.18,0.11)	(0.45,0.24,0.11)

Algorithm for finding Decision using the Modified Euclidean similarity measure E_M and IFS.

Step1: Get the input data's.
Step2: Fix the Attributes.
Step3: Fix the Region for which the study is to be done
Step4: Fix the cities among the fixed region
Step5: Find the Decision Matrix
Step6: Apply the membership Values in E_M
Step7: Tabulate the E_M values.
Step8: Finalise the Recommendations.
Step9: Get the output.

Applying Modified Euclidean similarity measure, the following table is arrived.

Table12: Estimated E_M

States	Values (A)	Values (B)	E_M
Delhi	(0.30,0.18,0.12)	(0.45,0.24,0.11)	**0.106**
Himachal Pradesh	(0.30,0.10,0.11)	(0.40,0.24,0.11)	**0.108**
Jammu& Kashmir	(0.30,0.22,0.1)	(0.35,0.18,0.1)	**0.040**
Ladak	(0.30,0.22,0.1)	(0.30,0.14,0.1)	**0.055**
Punjab	(0.20,0.001,0.11)	(0.30,0.28,0.11)	**0.196**
Rajasthan	(0.35,0.22,0.11)	(0.45,0.18,0.11)	**0.071**
Uttarakhand	(0.30,0.18,0.11)	(0.45,0.24,0.11)	**0.105**

Table 13: Recommendations based on E_M

States	Recommendation
Delhi	3
Himachal Pradesh	2
Jammu& Kashmir	7
Ladak	6
Punjab	1
Rajasthan	5
Uttarakhand	4

Algorithm for finding Decision using the Canberra distance measure Cd and IFS.

Step1: Get the input data's.
Step2: Fix the Attributes.
Step3: Fix the Region for which the study is to be done
Step4: Fix the cities among the fixed region
Step5: Find the Decision Matrix
Step6: Apply the membership Values in Canberra distance measure Cd.
Step7: Tabulate the Canberra distance values.
Step8: Finalise the Recommendations.
Step9: Get the output.

Applying Canberra distance, the estimated values are tabulated in the following table.

Table 14: Estimated Cd

States	Values (A)	Values (B)	Cd
Delhi	(0.30,0.18,0.12)	(0.45,0.24,0.11)	**0.453**
Himachal Pradesh	(0.30,0.10,0.11)	(0.40,0.24,0.11)	**0.616**
Jammu& Kashmir	(0.30,0.22,0.1)	(0.35,0.18,0.1)	**0.218**
Ladak	(0.30,0.22,0.1)	(0.30,0.14,0.1)	**0.222**
Punjab	(0.20,0.001,0.11)	(0.30,0.28,0.11)	**1.400**
Rajasthan	(0.35,0.22,0.11)	(0.45,0.18,0.11)	**0.256**
Uttarakhand	(0.30,0.18,0.11)	(0.45,0.24,0.11)	**0.435**

Table 15: Recommendations based on Cd

States	Recommendation
Delhi	3
Himachal Pradesh	2
Jammu& Kashmir	7
Ladak	6
Punjab	1
Rajasthan	5
Uttarakhand	4

4. Conclusion

In this paper IFS is used for making a decision with two attributes Men, Women among seven North Indian states and arrived to the conclusion that usage of tobacco by the Men's is much higher than Women is ranked, from the top to bottom is Punjab, Himachal Pradesh, Delhi, Uttarakhand, Rajasthan, Ladak and Jammu & Kashmir. Above conclusion is ascertained using two MADM (Multi – Attribute Decision Making) measures namely Modified Euclidean similarity measure and Canberra distance measure. So, the authorities can concentrate and focus according to the ranking found.

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