Impact of Fuzzy Techniques in Psychology

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Abstract- **The fuzzy set theory has been proposed in 1965 by Lofti A. Zadeh from the University of Berkeley. This theory depends on the intuitive reasoning by taking into account the human subjectivity and imprecision. It is not an imprecise theory yet a thorough scientific theory which deals with subjectivity and uncertainty which are common in the natural phenomena In the year 1998 Fuzzy matrix theory was developed by W.B.Vasantha Kandsamy. A fuzzy matrix is a matrix with elements having values in the fuzzy interval. This paper devoted to the application of fuzzy matrix in the field of psychology. In psychology, the Thurstone interest schedule was the first formal technique to express preferences for different occupations of a person. It was developed by Louis Leon Thurstone in 1947.In this paper we utilized Fuzzy matrix theory to find the best personality among the personalities by their scores in Thurstone interest schedule.**

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INTRODUCTION

Fuzzy set theory, which was first proposed by the researcher Zadeh (1965)[8], has become a very important tool to solve problems and it provides an appropriate framework for representing vague concepts by allowing partial membership. The different properties of the notions of union, intersection and its complement in the given context of fuzzy sets were established. This notion appears to be particularly useful in applications involving pattern classification and other related problems. Many complicated problems in Economics, Science, Engineering, technology, medical sciences, social sciences and many other fields involve uncertain data. All the problems cannot be solved using classical mathematical methods. In classical mathematics, a mathematical tool of an object is formulated and the notion of the accurate solution of this model is determined. Because of that, the mathematical model is very difficult and the exact solution cannot be found. To overcome these difficulties fuzzification is required.

A fuzzy matrix is a matrix with elements having values in the fuzzy interval. Fuzzy Matrix theory also plays a vital role in the field of Decision Making. Decision Making is a most important scientific, social and economic endeavor. In classical crisp decision making theories, decisions are made under conditions of certainty but in real life situations this is not possible which gives rise to fuzzy decision making theories. Applications of the theory of fuzzy matrices are of fundamental importance in the formulation and analysis of many classes of discrete structural models which arise in physical, biological, medical, social and engineering sciences. In the year 1998 Fuzzy matrix theory was developed by W.B.Vasantha[7] and V.Indira to study the passenger transportation problem. To study this problem they divided and defined four types of new matrices called Initial Raw Matrix, Average Time Dependent Data matrix (ATD), Refined Time Dependent Data matrix (RTD matrix) and Combined Effect Time Dependent Data matrix (CETD matrix). The same technique was used by the first author to study the migrant laborers who were affected by HIV/AIDS in the year 2003. In 2004, W.B.Vasantha and A. Victor Devadoss used to study the agriculture laborers. In 2017, Dr.D.Radhika et.al[4,5] used fuzzy matrix in the field of aqua culture by choosing the appropriate feed, in which the uncertain information gathered by experimentally using Azolla microphyla as a feed to the fishes Cyprinus Carpio. The application of Fuzzy matrix to the prediction of biological values has been attempted previously in many cases of health care issues like cancer and also nutrition is investigated by R.Umarani and H.Lokman Sithic[3].

1.2.Basic concept of Fuzzy Matrix Theory:

We say [0, 1] denotes the unit interval. We say $x\epsilon$ [0, 1] if $0\leq x\leq 1$. We also call the nit interval as a Fuzzy interval. We say [a, b] is a Fuzzy sub interval of Fuzzy interval [0, 1] if $0\leq a < b \leq 1$: we denote this by [a, b] sub-section of [0, 1]. We also use the convention of calling [-1, 1] to be also a Fuzzy interval, $x\epsilon$ [-1, 1] if $-1\leq x \leq 1$. Thus we have { x / $x\epsilon$[0, 1] i.e. $0\leq x\leq 1$ } is uncountable: hence [0, 1] is a infinite set as [0, 1] is an uncountable set. Let X be any universal set. The characteristic function maps elements of X to elements of the set to {0, 1}, which is formally expressed by X_A : X [0, 1]. Set A is defined by its characteristics function X_A. To be more non-technical a Fuzzy set can be defined mathematically by assigning to each possible individual in the universe of discourse a value representing its grade of membership in the Fuzzy set with boundaries that are not precise. The

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membership in a Fuzzy set in not a matter of affixation or denial but rather a matter of a degree. The significance of Zadeh's contribution was that it challenged not only probability theory as a sole agent for uncertainty: but the very foundations upon which the probability theory is based Aristotelian two-valued logic.

For when A is a Fuzzy set and x is a relevant object the proposition x is a member of A is not necessarily either true or false as required by two-valued logic, but it may be true only to some degree the degree to which x is actually a member of A. it is most common, but not required to express degrees of membership in the fuzzy sets as well as degrees of truth of the associated propositions by numbers in the closed unit intervals [0, 1]. The extreme values in this interval 0 and 1, then represent respectively, the total denial and affirmation of the membership in a given fuzzy set as well as the falsity or truth of the associated proposition.

The capability of Fuzzy sets to express gradual transitions to membership to non-membership and vice versa has a broad utility. This not only helps in the representation of measurement of uncertainties but also gives a meaningful representation of vague concepts in a simple natural language.

1.3. Methodology:

1. The raw data of the problem at hand is converted or transformed into a Average Quantity Dependent Matrix (AQD Matrix)
2. The average and standard deviation of each column of AQD Matrix is determined.
3. The refined quantity dependent matrix (RQDM) is formed by choosing α from the interval [0, 1] and using the formula,

$$e_{ij} = -1, \quad if \quad a_{ij} \leq (\mu_j - \alpha.\sigma_j)$$

$$\text{Else } e_{ij} = 0, \quad if \quad a_{ij} \in (\mu_j - \alpha.\sigma_j, \mu_j + \alpha.\sigma_j)$$

$$\text{Else } e_{ij} = 1, \quad if \quad a_{ij} \geq (\mu_j + \alpha.\sigma_j)$$

4. The combination of these matrices obtained by varying $\alpha \in [0, 1]$ results in Combined Effect Quantity Dependent Data (CEQD)
5. The independent of the results and the representation of the same in graphs assist in drawing conclusions.

1.4. Result and Discussion

Using the linguistic questionnaire the following 10 attributes are taken for this study

PS – Physical Science
BS – Biological Science
C - Computational
B – Business
E – Executive
P – Persuasive
L – Linguistic
H – Humanitarian
A – Artistic
M – Musical

The above attributes are taken as the columns of the initial raw data matrix

TABLE 1: Initial Raw Matrix

S.No	Subject Name	Gender	Edu. Qual	PS	BS	C	B	E	P	L	H	A	M
1.	A.M.G	M	M.Sc	13	8	5	11	12	10	9	6	15	10
2.	Y.J.S	M	M.Sc	6	1	2	2	5	1	7	9	1	5
3.	M.J	M	M.A	0	4	5	2	9	7	7	7	2	9
4.	P.S.U	M	M.Sc	0	1	0	0	2	8	1	10	0	0
5.	R.T.S.N	M	M.A	7	5	1	3	4	11	16	12	11	14
6.	R.L	F	Ph.D	4	20	4	3	11	6	10	13	14	11
7.	J.S	F	BHMS	9	18	5	5	6	3	7	13	13	15
8.	A.F	F	BHMS	7	19	5	5	12	1	10	11	5	12
9.	G.S	F	M.Sc	0	3	0	0	2	1	2	9	1	16
10	S.K.M	F	BHMS	1	3	0	0	6	0	2	11	11	14

STEP 1

In order to obtain an unbiased uniform effects on each and every data so collected transform this initial matrix into an Average Quantity Dependent Data Matrix (AQD Matrix). To convert AQD Matrix, every row of the row data matrix is divided by 100.

S.No	subject name	Gender	Edu Qual	PS	BC	C	B	E	P	L	H	A	M
1	A.M.G	M	M.Sc	0.13	0.08	0.05	0.11	0.12	0.1	0.09	0.06	0.15	0.1
2	Y.J.S	M	M.Sc	0.06	0.01	0.02	0.02	0.05	0.01	0.07	0.09	0.01	0.05
3	M.J	M	M.A	0	0.04	0.05	0.02	0.09	0.07	0.07	0.07	0.02	0.09
4	P.S.U	M	M.Sc	0	0.01	0	0	0.02	0.08	0.01	0.1	0	0
5	R.T.S.N	M	M.A	0.07	0.05	0.01	0.03	0.04	0.11	0.16	0.12	0.11	0.14
6	R.L	F	Ph.D	0.04	0.2	0.04	0.03	0.11	0.06	0.1	0.13	0.14	0.11
7	J.S	F	BHMS	0.09	0.18	0.05	0.05	0.06	0.03	0.07	0.13	0.13	0.15
8	A.F	F	BHMS	0.07	0.19	0.05	0.05	0.12	0.01	0.1	0.11	0.05	0.12
9	G.S	F	M.Sc	0	0.03	0	0	0.02	0.01	0.02	0.09	0.01	0.16
10	S.K.M	F	BHMS	0.01	0.03	0	0	0.06	0	0.02	0.11	0.11	0.14

STEP 2:

Using the formula $\frac{\sum x}{n} = \mu$ & $\sqrt{\frac{\sum x^2}{n} - \left(\frac{\sum x}{n}\right)^2} = \sigma$,Find μ, σ the mean and standard deviation of the given parameters.The Average (μ_j) and Standard Deviation (σ_j) of the AQD matrix as follows:

Mean	0.047	0.082	0.027	0.031	0.069	0.048	0.071	0.101	0.073	0.106
SD	0.045	0.077	0.023	0.033	0.039	0.041	0.046	0.024	0.061	0.049

STEP 3

At the third stage, the Average or Mean and the Standard Deviation (SD) of every column in the AQD Matrix are determined using the average of μ_j of each jth column and σ_j, the SD of each jth column, a parameter α from the interval [0,1] is chosen and the Refined Dependent Data Matrix (RQD Matrix) or Fuzzy Matrix (eij) is formed using the formula

Using the conditions, $a_{ij} \leq (\mu_j - \alpha * \sigma_j)$ then $e_{ij} = -1$.

$a_{ij} \in (\mu_j - \alpha * \sigma j, \mu j + \alpha * \sigma_j)$ then $e_{ij} = 0$.

$a_{ij} \geq (\mu_j + \alpha * \sigma_j)$ then $e_{ij} = 1$.

STEP 4

Calculate RQD Matrix for different α – values that is randomly chosen between [0,1] based on the values Average and Standard deviation tables and also Row Sum Matrix .i.e. sum the row values of the founded Fuzzy Matrices.

RQD1 or Fuzzy 1 i.e. α = 0.2 (randomly chosen based on the average and SD values)

The RQD 1 Matrix for α= 0.2 The row sum matrix

1	0	1	1	1	1	1	-1	1	0	6
1	-1	-1	-1	-1	-1	0	-1	-1	-1	-7
-1	-1	1	-1	1	1	0	-1	-1	-1	-3
-1	-1	-1	-1	-1	1	-1	0	-1	-1	-7
1	-1	-1	0	-1	1	1	1	1	1	3
0	-1	1	0	1	1	1	1	1	0	5
1	1	1	1	-1	-1	0	1	1	1	5
1	1	1	1	1	-1	1	1	-1	1	6
-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-8
-1	-1	-1	-1	-1	-1	-1	1	1	1	-4

The RQD 2 Matrix for α=0.4 The row sum matrix

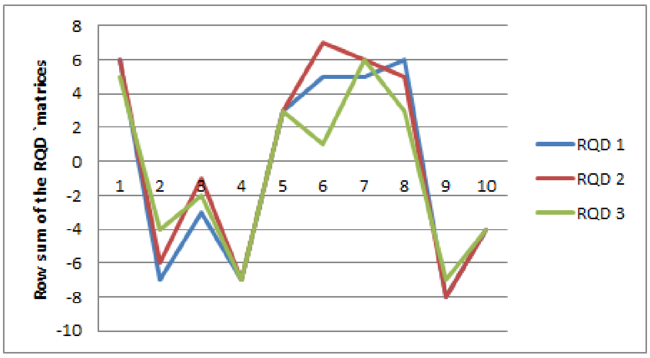
1	0	1	1	1	1	1	-1	1	0	6
0	-1	0	0	-1	-1	0	-1	-1	-1	-6
-1	-1	1	0	1	1	0	-1	-1	0	-1
-1	-1	-1	-1	-1	1	-1	0	-1	-1	-7
1	-1	-1	0	-1	1	1	1	1	1	3
0	1	1	0	1	0	1	1	1	1	7
1	1	1	1	0	-1	0	1	1	1	6
1	1	1	1	1	-1	1	0	0	0	5
-1	-1	-1	-1	-1	-1	-1	-1	-1	0	-8
-1	-1	-1	-1	0	-1	-1	0	1	1	-4

The RQD 3 Matrix forα=0.6 The row sum matrix

1	0	1	1	1	1	0	-1	1	0	5
0	-1	0	0	0	-1	0	0	-1	-1	-4
-1	0	1	0	0	0	0	-1	-1	0	-2
-1	-1	-1	-1	-1	1	-1	0	-1	-1	-7
0	0	-1	0	-1	1	1	1	1	1	3
0	-1	0	0	1	0	-1	1	1	0	1
1	1	1	0	0	0	0	1	1	1	6
0	1	1	0	1	-1	1	0	0	0	3
-1	-1	-1	-1	-1	-1	-1	0	-1	1	-7
-1	-1	-1	-1	0	-1	-1	0	1	1	-4

Graph 1:

The comparison graph between the three RQD Matrices



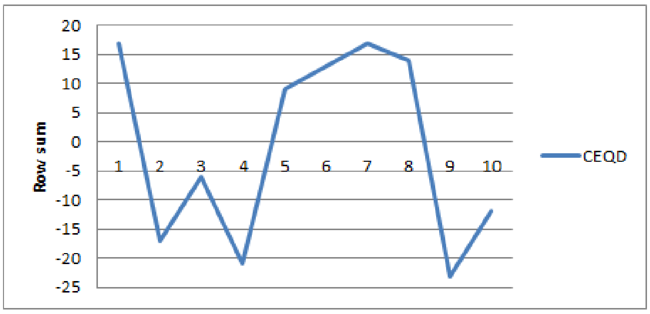
By combining all these three matrices, the Combined Effect Quantity Dependent Data Matrix (CEQD Matrix), which gives the cumulative effect of all these entries was obtained as follows:

STEP 5

At the final stage using Fuzzies obtained Combined Effect Quantity Dependent Data Matrix (CEQD Matrix) which gives the Cumulative effect of all these entries, i.e. we have to add the above different α – value fuzzies together. This gives the following CEQD Matrix and also CEQD Row Matrix.

CEQD MATRIX ROW SUM

3	0	3	3	3	3	2	-3	3	0	17
1	-3	-1	-1	-2	-3	0	-2	-3	-3	-17
-3	-2	3	-1	2	2	0	-3	-3	-1	-6
-3	-3	-3	-3	-3	3	-3	0	-3	-3	-21
2	-2	-3	0	-3	3	3	3	3	3	9
0	-1	2	0	3	1	1	3	3	1	13
3	3	3	2	-1	-2	0	3	3	3	17
2	3	3	2	3	-3	3	1	-1	1	14
-3	-3	-3	-3	-3	-3	-3	-2	-3	3	-23
-3	-3	-3	-3	-1	-3	-3	1	3	3	-12



Graph 5: The graphical representation of CEQD Matrix

1.5 CONCLUSION:

From the CEQD Matrix and its graphical representation we conclude that the subject R.L has the finest interest among the fields and it is Biological Science. She chose this interest with the most confidence level.

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