Fuzzy Analysis of Decision Making on Students' Choice of Programme in College of Education

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Abstract:**Fuzzy reasoning is based on fuzzy sets theory, where membership of a set by an entity is incremental instead of either a member or not a member. Fuzzy logic provides the control interval of real numbers between zero (False) and one (True) to establish logic as the base for inference rules. The fuzzed variant of the design philosophy case of this research rule of inference helps computers to make decisions using fuzzy reasoning instead of precision. This study adopts the use of Fuzzy Max – Min method, Minimization of regret method (FMMR) and ordered weighted averaging (OWA) in decision making problem under uncertainty.**

Keywords: **Fuzzy theory, decision – making, programmes, Max – Min**

I. INTRODUCTION

Clutter, (2010)discussed the crucial role of the parents, teachers and other relatives in the career choices and ambitions of their children. The study had a brief history of past career counseling methods, subsumed in it, which starts in the formative years by analyzing the student's personality in order to assess proper occupational fit. It also examined the parental impact on career choices for teenagers, as well as bordering studies on the effects of socioeconomic status, gender and race. Alika, (2010)researched parents and peer group impact among secondary school students as correlates of career choice in the humanities(Kumar, 2016). According to Akyina, Oduro-Okyireh and Osei-Owusu, (2014) school counselors can strengthen the ethical conduct of students in selecting programs by stepping up therapy in schools so that students continue to make reasonable decisions about school programmes. Furthermore, Ogunlade and Akeredolu, (2012) suggested that professional career counselors be consulted to assist students in planning and selecting their careers, and professional career counselors should involve students in the selection process, taking into account the students' interest, ability, skills and personality.

Igbinedion, (2011)recommended that there were variations in perceived factors influencing the vocational choice of students between male and female students; and there were also substantial gaps between university and college students with respect to some of the factors influencing their choice. Based on this, it was proposed, among others, that candidates be encouraged to seek good counseling, regardless of gender, before enrolling in the programs of choice. However, (Eremie, 2014), revealed major disparities in career choices among male and female high school students in terms of: program reputation, gender differences and parental control. Brownsom, (2014) reported that parents' impact on their children's career choice was negligible as parents did not help their children pursue any course they had selected from. Therefore, it was suggested that parents should educate their children and always meet the basic needs of the children, school counselors and teachers are also encouraged to provide equal attention to all students irrespective of gender on the acquisition of information about career choice.(Olaosebikan and Olusakin, 2014) found that about 50% of respondents accepted that parents would affect their choice of profession. On average, 21.5 per cent of respondents accepted that their career choice had been affected by the line of business of their parents, while 75 per cent disagreed. Approximately 30% of the respondents decided to choose family profession because of the need to help family busines. In addition, adolescents in secondary schools have been indicated to have some degree of independence when making career choices. Although the choices should be driven, it is still important that students follow the career line in which they share great passion and interest.

Education can vastly be viewed as formal, semi-formal and informal.Accordingly, education is that which empowers man to perform in a justly, skilfully and satisfactory manner to whatever capacity he/she finds him/ herself. It was further asserted that it is a process of leading and initiating people to acquire necessary skills, facts, knowledge, habits and attitudes that will make them co-exist with others as useful and productive members of the society(Ajibola, et al., 2017).

In this study, it interests the researcher to investigate who motivates or influences students to make choice of programmes during application process. This originates from the quest to find answers to how they enjoy or regret their programme of study in college. It can be recall vividly that we have different programme desires in the teaching profession, such as Early Childhood Education (ECE), Primary Education (PE) and Junior High option (Home Economics, Mathematics, Languages etc). Often, nothing attracted students on some programmes before deciding to study it. Nevertheless, some are happy and proud to read those programmes during or after; on the other hand, some also regretted after making the decision because it was not their preferred programme of choice or interest initially.

Most of the current mathematical methods for formal modeling, reasoning and computation in real life are in nature smooth, deterministic, and precise. Classical crisp mathematical methods are unable to deal with the complexity and imprecision issues. Many mathematical methods are available for modeling complex structures, such as probability theory, fuzzy set theory and mathematics of intervals. Probability theory refers only to a stable system in stochastic form. Interval mathematics isnot adaptable enough for problems with various uncertainties. In this paper, Fuzzy Max-min method of composition and Minimization of Regret is proposed to construct the decision method for student choice of programme in college using fuzzy soft matrices. In order to make this, properties of max-min composition are applied. The result is obtained based on the minimum value in the rating(Siddique, 2009).

II. SETTING OF THE STUDY

This study was conducted at St. Teresa's College of Education, Hohoe in the Volta Region. In September 2004, the college was upgraded to a diploma awarding institution under the Ghana Education Service with a 3-year Diploma in Basic Education Programme. Again, in 2018, the college was upgraded to a 4 – year Bachelor Education Programme with various options focused on basic education under the National Teaching Council (NTC). Currently the college trains averagely250 teachers annually over last decade and continues to train a significant percentage of the countries schoolteachers.

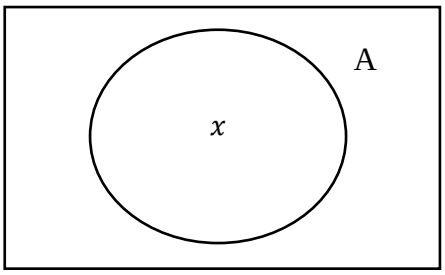
III. FUZZY LOGIC CONCEPT AND APPLICATION

It is important to realize what fuzzy logic really is before explaining the mechanisms that make Fuzzy logic work? Fuzzy logic is a superset of traditional (Boolean) logic generalized to deal with the idea of partial truth-values between "completely true" and "completely false." As its name suggests it is the logic underlying reasoning modes that are approximate rather than precise. The value of fuzzy logic derives from the fact that most human reasoning modes, and especially common-sense reasoning, are in nature approximate.

3.1 Definition

(1) *Crisp Set Theory*: Is defined as a collection of well-defined objects

If we have



X

This explain that $x \in A$ or $x \notin A$

Then the characteristics function is given as

$$\chi_A(x) = \begin{cases} 1, & iff\ x \in A \\ 0, & iff\ x \notin A \end{cases}$$

This relation is given as

$$\chi_A : x \rightarrow \{0,1\}$$

(2) Fuzzy Set

In the classical set, we have seen that membership of an object to a group is a specific concept; the object is either a member or it is not; hence membership function can take two values 1 or 0. However, a Fuzzy set is a set of elements that have differing degrees of membership in set. This concept compares with classic set because it would not be a part of the Crisp set unless its membership was complete.

This is defined as

$$\{(x, \mu_{\bar{A}}(x) | x \in X\}$$

where

$$\mu_{\bar{A}} : x \rightarrow [0,1]$$

Example 1: If $X = \{1,2,3,4,5,\dots\}$, to find the $\bar{A}$ given as $\{two\ or\ so\}$

Then we have

$$\mu_{\bar{A}}(1) = 0.5, \mu_{\bar{A}}(2) = 1, \mu_{\bar{A}}(3) = 0.5, \mu_{\bar{A}}(4) = 0, \mu_{\bar{A}}(5) = 0$$

This can be written as ordered pair

$$\bar{A} = \{(1,0.5), (2,1), (3,0.5), (4,0), (5,0), \dots\}$$

Example 2: If $\bar{A} = \{Ian\ is\ young\ ;\ young\ \in [0,80]\}$

So, if Ian is 30 years then he will be estimated as young with 0.9

If $\bar{A} = \{Ian\ is\ very\ young\ ;\ young\ \in [0,50]\}$

Again, if Ian is 30 years then he will be estimated as young with 0.5

The variation in the values expressed the rate of membership functions when using fuzzy logic model.

3.2 Max – min Fuzzy Relation Composition

Let R be a fuzzy relation in $X \times Y$, and S be a fuzzy relation in $Y \times Z$.

The Max-Min composition of A and B, $A \circ B$, is a fuzzy relation in $X \times Z$ such that

$$A \circ B \leftrightarrow \mu_{A \circ B}(x,z) = \vee \{\mu_A(x,y) \wedge \mu_B(y,z)\}$$

$$= Max. \frac{\{Min.\{\mu_A(x,y), \mu_B(y,z)\}\}}{x,z}$$

Similarly

The Max-Product composition of A and B, $A \circ B$, is a fuzzy relation in $X \times Z$ such that

$$A^{\circ}B \leftrightarrow \mu_{A^{\circ}B}(x,z) = \vee \{\mu_A(x,y)\ \mu_B(y,z)\}$$

$$= Max.\frac{\{Min.\{\mu_A(x,y)\cdot\mu_B(y,z)\}\}}{x,z}$$

Example

Let the two relations A and Bbe, respectively:

A	y_1	y_2	y_3
x_1	0.4	0.6	0
x_2	0.9	1	0.1

B	z_1	z_2
y_1	0.5	0.8
y_2	0.1	1
y_1	0	0.6

The goal is to compute $A \circ B$ using both Max-min and Max-product composition rules.

MAX-MIN Composition

$$A \circ B =$$

$$\begin{bmatrix} 0.4 & 0.6 & 0 \\ 0.9 & 1 & 0.1 \end{bmatrix} \circ \begin{bmatrix} 0.5 & 0.8 \\ 0.1 & 1 \\ 0 & 0.6 \end{bmatrix} = \begin{bmatrix} 0.4 & 0.6 \\ 0.5 & 1 \end{bmatrix}$$

$$max\{min(0.4,0.5), min(0.6,0.1), min(0,0)\}$$
$$= max\{0.4, 0.1, 0\} = 0.4$$
$$max\{min(0.4,0.8), min(0.6,1), min(0,0.6)\}$$
$$= max\{0.4, 0.6, 0\} = 0.6$$
$$max\{min(0.9,0.5), min(1,0.1), min(0.1,0)\}$$
$$= max\{0.5, 0.1, 0\} = 0.5$$
$$max\{min(0.9,0.8), min(1,1), min(0.1,0.6)\}$$
$$= max\{0.8, 1, 0.1\} = 1$$

3.3 Decision Making Using Minimization of Regret (MMR)

Assume we have a decision problem in which we have collection of alternatives $\{A_n \ldots\ldots A_n\}$ with state of nature $\{S_1 \ldots\ldots S_n\}$.C_{ij} is the payoff matrix to the decisionmaker if she selects alternative A_i and state of nature S_j. The matrix R whose componentsare r_{ij} is regret matrix. Main objective of the problem is to select the alternative which bestsatisfies the payoff to the decision maker. Ordered Weighted Average (OWA) is used to generalized the choice of the students in selecting their programme during the orientation in college.

The algorithm

Alternatives	State of Nature					
	S_1	S_2	S_3	…	…	S_m
A_1	C_{11}	C_{12}	C_{13}	…	…	C_{1m}
A_2	C_{21}	C_{22}	C_{23}	…	…	C_{2m}
⋮	⋮	⋮	⋮	⋱	⋱	⋮
⋮	⋮	⋮	⋮	⋱	⋱	⋮
A_n	C_{n1}	C_{n2}	C_{n3}	…	…	C_{nm}

For FMMR Method following steps are followed.

Step 1- Calculate the payoff matrix

Step 2- Calculate C_{ij} = Max$\{C_{ij}\}$ for each S_j

Step3 – Calculate for each pair $A_i$and S_j $r_{ij} = C_j - C_{ij}$

Step 4 – Calculate regret matrix $R_i = Max\{r_{ij}\}$ for each A_i

Step 5 – Select R_1such that $R_i = Min\{R_{ij}\}$

IV. CASE STUDY

Let institutionXYZinvestigates who influencenew students during programme selection. The management has threecourses alternativesPE (A1), ECE (A2) and HE (A3) that are offered in the institution. After reviewing the general information, the experts have given following expectedresults depending on the person who is close, support and related to the studentP1(self), P2(parent), P3(peer) andP4(college workers) that could advise students in application processes. The study also used following weighting vectors w= 0.3,0.3,0.2,0.2 based on the survey on participants.

Step 1 – Payoff Matrix

	Person of option			
Alternatives	P1	P2	P3	P4
A1	90	99	89	110
A2	68	86	118	79
A3	94	112	73	86

Step 2- Calculation of $C_{ij} = Max\{c_{ij}\}$ for each S_j

	Person of option			
Alternatives	P1	P2	P3	P4
A1	90	99	89	110
A2	68	86	118	79
A3	94	112	73	86
$C_{ij} = Max\{c_{ij}\}$	94	112	118	110

Step 3 – Calculate for each pair A_i and $S_j r_{ij} = C_j - C_{ij}$ and obtain regret matrix

For P1=94		For P3=118	
$94-90=4$ $94-68=26$ $94-94=0$		$118-89=29$ $118-118=0$ $118-73=45$	
For P2=112		For P4=110	
$112-99=13$ $112-86=26$ $112-112=0$		$110-110=0$ $110-79=31$ $110-86=24$	

	Person of Influence			
Alternatives	P1	P2	P3	P4
A1	4	13	29	0
A2	26	26	0	31
A3	0	0	45	24

Step 4 – Calculate $Ri = (r_{i1} \ldots\ldots\ldots r_{in})$ for eachAi by using formula, we calculate OWA for $A1, A2$ and $A3$

We have w= 0.3,0.3,0.2,0.2 as the weighted vector

For $A1 = (4 \times 0.3) + (13 \times 0.3) + (29 \times 0.2) + (0 \times 0.2) = 10.3$

For $A2 = (26 \times 0.3) + (26 \times 0.3) + (0 \times 0.2) + (31 \times 0.2) = 21.8$

For $A3 = (0 \times 0.3) + (0 \times 0.3) + (45 \times 0.2) + (24 \times 0.2) = 13.8$

Alternative A1 is the less influence (10.3) option of students programme selection. This means that student offering Primary Education has minimal influence on their decision when selecting their programme compared to the choice of Early Childhood Education and Home Economics students.

V. CONCLUSION

Under uncertainty the study is concerned with the issue of decision-making. Although, there are revelations about personal interest of choices and decision making among students. This study still proves that they may impose and misleading influence on student choice of programme even at the tertiary level. This was evident based on jobs after school, personal interest, past experience and individual uncertainty.

It is recommended that higher institutions if possible, should factor programme and career decision making talks into their orientation seminars for fresh student before they settle on their programme of study. By the risk of reading a programme and later regret may reduce.

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