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Research paper

A Fuzzy TOPSIS with Z-Numbers Method for Assessment on Memorandum of Understanding at University

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Abstract

Memorandum of Understanding (MOU) is the signing an agreement between university with other university. It has been known as the policy that sharing different competencies in academic between both Universities' involved. Classifying the issues on choosing the suitable university, involves a proportion of vague and uncertain cases. Fuzzy Z-numbers gives more uncertainties compared to Fuzzy Sets (FSs). They provide us with additional degree of freedom to represent the uncertainty and fuzziness in real situations. The objective of this paper is to apply a FTOPSIS with Z-numbers to handle uncertainty for the Memorandum of Understanding Case. Five criteria and three alternatives are used to evaluate the decision from the university's expert. From the result, it reveals that the FTOPSIS with Z-numbers offers us with another suitable way to handle FMCDM problems in a more intelligent and flexible way due to the fact that it uses FTOPSIS with Z-numbers.

Keywords: *FTOPSIS; MOU; Z-numbers.*

1. Introduction

Multiple-Criteria Decision Making (MCDM) is a ranking alternatives method based on experts' decisions. There are numerous different methods from MCDM with Fuzzy Sets (FSs) that have been proposed thus far [1-3] or formally known as Fuzzy MCDM (FMCDM). Such as FAHP, FVIKOR, FTOPSIS and so on. FTOPSIS was quoted as one of the most popular approaches in MCDM issues that were proposed by [4] and extended with FSs by [5]. FTOPSIS is a technique for ranking several of alternatives via aloofness measures. The basic principle is that the selected alternative should have the shortest distance from the positive ideal solution. The key advantage of the FTOPSIS is its intrinsic ability to handle intangibles, less unwieldy mathematical calculations and it is more easily comprehended in comparison with other methods. There exists a large amount of literature involving FTOPSIS theory and its application [6-10]. However, the earlier approaches lacks with the reflection on reliability of the decision pertinent information [11]. Z-numbers proposed by [12] relates to the problem of reliability of information. Z-numbers (Z) has two main parts, Z = (B, C). The first component, B, will be a restriction on the values for the uncertain real-valued variable X. The second component, C, is a measure of reliability for the first component [11]. Due to the restriction and reliability concepts, Z-numbers give room of flexibility to represent uncertainties. Therefore, the objective of this paper is to applied FTOPSIS and Z-numbers method [13] to handle uncertainty for the Memorandum of Understanding Case. Five criteria and three alternatives are used to evaluate the decision from the university's expert. The rest of this paper is prepared as the following orders; Second section discusses on Z-numbers method; Third section shows the steps of FTOPSIS with Z-numbers, Fourth section examines the real case study with the proposed FTOPSIS and Z-numbers, and the last Fifth section is the conclusion section.

2. Z-Numbers Method

A Z-number by [12] is a systematic pair of fuzzy numbers signified as $Z = (\tilde{A}, \tilde{R})$. The first module $\tilde{A}$, a fuzzy constraint on the values, is a real-valued uncertain factor X. The second module $\tilde{R}$ is an extent of fuzzy reliability for the first module.

3. The Steps of FTOPSIS with Z-Numbers

This section offered the six steps of FTOPSIS with Z-numbers to examine the ranking of the outputs. The offered steps are used to guide experts step-by-step. The indication of the offered FTOPSIS with Z-numbers steps are revealed underneath:

Step 1: Scaling the Relative of Data

In FMCDM issues, reactions from experts are primarily focused on the view of the experts concerning rating of the attributes of the issues based on the known criteria. The experts were requested to stipulate rating using seven of the new linguistic scales varying from 'Very Poor' to 'Very Good' and from 'Not Sure' to 'Very Confident' over the factors related with FMCDM issues. The linguistic scale of FTOPSIS with Z-numbers is used to describe the expert's measurement of each criterion and alternatives of the FMCDM problems. The linguistic scale is presented in Table 1 and Table 2.

Table 1: Linguistic scale for the ratings of the attributes and their corresponding Z-numbers with FSs[13]

Linguistic Terms	Fuzzy Set with Z-Numbers
Very Poor (VP)	(0,0,1)
Poor (P)	(0,1,3)
Medium Poor (MP)	(1,3,5)
Fair (F)	(3,5,7)
Medium Good (MG)	(5,7,9)
Good (G)	(7,9,10)
Very Good (VG)	(9,10,10)

Table 2: Linguistic scale for fuzzy reliability and their corresponding Z-numbers[13]

Linguistic Terms	Fuzzy Set with Z-Numbers
Not Sure (NS)	(0,0,1)
Quite Sure (QS)	(1,3,5)
Sure (S)	(5,7,9)
Very Confident (VC)	(9,10,10)

Step 2: Formulate a Ranked Table of FMCDM Issue

The ranked table of FMCDM issue is formulated. Data for criteria and alternatives must be known as part of a FMCDM issue.

$$Y_p = \left(\tilde{\tilde{f}}_{ij}^{p}\right)_{m\times n} = \begin{matrix} & D_1 & D_2 & D_3 & \cdots & D_n \\ f_1 & (\tilde{\tilde{f}}_{11}^{p}, r\tilde{\tilde{f}}_{11}^{p}) & (\tilde{\tilde{f}}_{12}^{p}, r\tilde{\tilde{f}}_{12}^{p}) & (\tilde{\tilde{f}}_{13}^{p}, r\tilde{\tilde{f}}_{13}^{p}) & \cdots & (\tilde{\tilde{f}}_{1n}^{p}, r\tilde{\tilde{f}}_{1n}^{p}) \\ f_2 & (\tilde{\tilde{f}}_{21}^{p}, r\tilde{\tilde{f}}_{21}^{p}) & (\tilde{\tilde{f}}_{22}^{p}, r\tilde{\tilde{f}}_{22}^{p}) & (\tilde{\tilde{f}}_{23}^{p}, r\tilde{\tilde{f}}_{23}^{p}) & \cdots & (\tilde{\tilde{f}}_{2n}^{p}, r\tilde{\tilde{f}}_{2n}^{p}) \\ f_3 & (\tilde{\tilde{f}}_{31}^{p}, r\tilde{\tilde{f}}_{31}^{p}) & (\tilde{\tilde{f}}_{32}^{p}, r\tilde{\tilde{f}}_{32}^{p}) & (\tilde{\tilde{f}}_{33}^{p}, r\tilde{\tilde{f}}_{33}^{p}) & \cdots & (\tilde{\tilde{f}}_{3n}^{p}, r\tilde{\tilde{f}}_{3n}^{p}) \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ f_m & (\tilde{\tilde{f}}_{m1}^{p}, r\tilde{\tilde{f}}_{m1}^{p}) & (\tilde{\tilde{f}}_{m2}^{p}, r\tilde{\tilde{f}}_{m2}^{p}) & (\tilde{\tilde{f}}_{m3}^{p}, r\tilde{\tilde{f}}_{m3}^{p}) & \cdots & (\tilde{\tilde{f}}_{mn}^{p}, r\tilde{\tilde{f}}_{mn}^{p}) \end{matrix}$$

where

$$r\tilde{\tilde{f}}_{ij} = \left(\frac{\tilde{\tilde{f}}_{ij}^{p}, r\tilde{\tilde{f}}_{ij}^{1} \oplus \tilde{\tilde{f}}_{ij}^{2}, r\tilde{\tilde{f}}_{ij}^{2} \oplus \tilde{\tilde{f}}_{ij}^{3}, r\tilde{\tilde{f}}_{ij}^{3} \oplus \ldots \tilde{\tilde{f}}_{ij}^{k}, r\tilde{\tilde{f}}_{ij}^{k}}{k}\right)(r\tilde{\tilde{f}}_{ij}, r\tilde{\tilde{f}}_{ij}) \quad (1)$$

is a Z-Numbers with fuzzy TOPSIS, $1 \le i \le m, 1 \le j \le n, \ 1 \le p \le k$ and k represents the number of specialist.

Step 3: Create the weighting matrix Q_p of the criteria of the experts and create the *p*th average weighting matrix $\overline{Q}$, respectively by using Table 3.

Table 3: Linguistic terms of weights for the attributes and their positive and negative[13]

Linguistic Terms	Fuzzy Set with Z-Numbers
Very Low (VL)	(0,0,0.1)
Medium Low (ML) Low (L)	(0.1,0.5,0.7) (0,0.1,0.3)
Medium (M)	(0.3,0.5,0.7)
Medium High (MH)	(0.5,0.7,0.9)
Very High (H)	(0.9,1.0,1.0)
High (VH)	(0.7,.0,9.0.1)

$$Q_p = \left(r\tilde{\tilde{Q}}_i^{p}\right)_{m\times n} = \begin{matrix} f_1 & f_2 & f_3 & \cdots & f_m \\ [r\tilde{\tilde{q}}_1^{p} & r\tilde{\tilde{q}}_2^{p} & r\tilde{\tilde{q}}_3^{p} & \cdots & r\tilde{\tilde{q}}_m^{p}] \end{matrix}$$

$$\overline{Q} = \left(r\tilde{\tilde{q}}_{\square j}\right)_{m\times n}$$

where $$\tilde{\tilde{l}}_i^{p} = \frac{r\tilde{\tilde{q}}_i^{1} \oplus r\tilde{\tilde{q}}_i^{2} \oplus r\tilde{\tilde{q}}_i^{3} \oplus \ldots\ldots\ldots r\tilde{\tilde{q}}_m^{p}}{k}, \tilde{\tilde{q}}_i \quad (2)$$

is a Z-numbers with fuzzy TOPSIS, $1 \le i \le m, 1 \le j \le n, 1 \le p \le k$ and k signifies the number of specialist.

Next, the weighted decision matrix can be obtainable as follows:

$$\overline{T}_w = \left(\tilde{\tilde{T}}_{ij}, r\tilde{\tilde{T}}_{ij}\right)_{m\times n} = \begin{matrix} & D_1 & D_2 & D_3 & \cdots & D_n \\ f_1 & \tilde{\tilde{z}}_{11}^{p}, r\tilde{\tilde{z}}_{11}^{p} & \tilde{\tilde{z}}_{12}^{p}, r\tilde{\tilde{z}}_{12}^{p} & \tilde{\tilde{z}}_{13}^{p}, r\tilde{\tilde{z}}_{13}^{p} & \cdots & \tilde{\tilde{z}}_{1n}^{p}, r\tilde{\tilde{z}}_{1n}^{p} \\ f_2 & \tilde{\tilde{z}}_{21}^{p}, r\tilde{\tilde{z}}_{21}^{p} & \tilde{\tilde{z}}_{22}^{p}, r\tilde{\tilde{z}}_{22}^{p} & \tilde{\tilde{z}}_{23}^{p}, r\tilde{\tilde{z}}_{23}^{p} & \cdots & \tilde{\tilde{z}}_{2n}^{p}, r\tilde{\tilde{z}}_{2n}^{p} \\ f_3 & \tilde{\tilde{z}}_{31}^{p}, r\tilde{\tilde{z}}_{31}^{p} & \tilde{\tilde{z}}_{32}^{p}, r\tilde{\tilde{z}}_{32}^{p} & \tilde{\tilde{z}}_{33}^{p}, r\tilde{\tilde{z}}_{33}^{p} & \cdots & \tilde{\tilde{z}}_{3n}^{p}, r\tilde{\tilde{z}}_{3n}^{p} \\ \vdots & \vdots & \vdots & \vdots & & \vdots \\ f_m & \tilde{\tilde{z}}_{m1}^{p}, r\tilde{\tilde{z}}_{m1}^{p} & \tilde{\tilde{v}}_{m2}^{p}, r\tilde{\tilde{z}}_{m2}^{p} & \tilde{\tilde{v}}_{m3}^{p}, r\tilde{\tilde{z}}_{m3}^{p} & \cdots & \tilde{\tilde{z}}_{mn}^{p} r\tilde{\tilde{z}}_{mn}^{p} \end{matrix}$$

where

$$\tilde{\tilde{t}}_{ij}, r\tilde{\tilde{t}}_{ij} = \tilde{l}_i, r\tilde{l}_i \otimes \tilde{f}_{ij}, r\tilde{f}_{ij}, 1 \le i \le m \le j \le n \quad (3)$$

Step 4: Examine the Positive and Negative Ideal Solutions and Negative

Examine the positive and negative ideal solutions respectively:

$$f^* = \{z_1^*, \ldots\ldots, z_n^*\} = \left\{(\max_j z_{ij} \,/\, i \in I'), (\min_j z_{ij} \,/\, i \in I'')\right\}, \quad (4)$$

$$f^- = \{z_1^-, \ldots\ldots, z_n^-\} = \left\{(\min_j z_{ij} \,/\, i \in I'), (\min_j z_{ij} \,/\, i \in I'')\right\} \quad (5)$$

where I' is associated with the positive attribute, and I'' is associated with the negative element.

Step 5: Compute the Distance among Each Alternative y_j and the Positive Ideal Solution q^+ as Shown as Follows:

The separation of each alternative Z-numbers with IT2FS from the PIS is given as

$$(G_j^*, rG_j^*) = \left(\sqrt{\sum_{i=1}^{n}(\check{z}_{ij} - \check{z}_i^*)^2}, \sqrt{\sum_{i=1}^{n}(r\check{z}_{ij} - \check{z}_i^*)^2}\right), j = 1, \ldots J. \quad (6)$$

Similarly, the separation of each alternative Z-numbers with IT2FS from the NIS is given as

$$(G_j^-, rG_j^-) = \left(\sqrt{\sum_{i=1}^{n}(\check{z}_{ij} - \check{z}_i^*)^2}, \sqrt{\sum_{i=1}^{n}(r\check{z}_{ij} - \check{z}_i^*)^2}\right), j = 1, \ldots J. \quad (7)$$

Step 6: Compute the Relative Degree of Closeness $C(q_j)$ of q_j with the Respect to the Positive Ideal Solution as Shown as Follows:

The relative closeness of the alternative x_i with respect to f^* is defined as

$$(C_j^*, rC_j^*) = \frac{\left(\frac{G_j^-}{G_j^* + G_j^-}, \frac{rG_j^-}{rG_j^* + rG_j^-}\right)}{2}, j = 1, \ldots. J. \quad (8)$$

A large value of closeness coefficient N_j specifies a good performance of the alternative f_i. The best alternative is the one with the greatest relative closeness to the ideal solution.

4. Numerical Examples

Suppose that UniSZA intends to sign a Memorandum of Understanding (MOU) with other university. The MOU will enhance academic pursuit for both Universities since both of the universities have different competencies and applicability. The main problem is to select the form of governance for the MOU. Various experts are involved in the decision-making process, and all have different perspectives. There are mainly three experts who are the top management of the university with three different alternatives. All the experts reflect different points of view namely Academic calendar (C1), Syllabus (C2), Financial Strength (C3), Students Exchange (C4) and Staff Exchange (C5). Hence, a model that considers various aspects into account with an analytical perspective will increase the performance of strategic decision making. This study set out three agreement of MOU as alternatives, funding (A1), educational level (A2) and policy development (A3).

Table 4: Evaluating values of the alternatives given by the decision makers with respect to different attributes

Criteria	Alternative	Experts With Their Corresponding Z-Numbers					
		D1	Z	D2	Z	D3	Z
Academic Calendar	A1	MG	S	G	VC	MG	VC
	A2	G	QS	G	QS	MG	VC
	A3	VG	S	G	QS	F	NS
Syllabus	A1	G	VC	MG	QS	F	NS
	A2	VG	QS	VG	QS	VG	QS
	A3	MG	S	G	VC	VG	QS
Financial Strength	A1	F	NS	G	S	G	S
	A2	VG	QS	VG	QS	G	S
	A3	G	S	MG	VC	VG	QS
Staff Exchange	A1	VG	QS	G	S	VG	QS
	A2	VG	QS	VG	QS	VG	QS
	A3	G	S	VG	QS	MG	VC
Students Exchange	A1	F	NS	F	S	F	NS
	A2	VG	QS	MG	VC	G	S
	A3	G	S	G	S	MG	VC

$$An = \begin{array}{c} \\ \end{array}\begin{array}{ccc} D_1 & D_2 & D_3 \end{array}$$

$$An=\begin{bmatrix} (\tilde{\tilde{f}}_{11},r\tilde{\tilde{f}}_{11}) & (\tilde{\tilde{f}}_{12},r\tilde{\tilde{f}}_{12}) & (\tilde{\tilde{f}}_{13},r\tilde{\tilde{f}}_{13}) \\ (\tilde{\tilde{f}}_{21},r\tilde{\tilde{f}}_{21}) & (\tilde{\tilde{f}}_{22},r\tilde{\tilde{f}}_{22}) & (\tilde{\tilde{f}}_{23},r\tilde{\tilde{f}}_{23}) \\ (\tilde{\tilde{f}}_{31},r\tilde{\tilde{f}}_{31}) & (\tilde{\tilde{f}}_{32},r\tilde{\tilde{f}}_{32}) & (\tilde{\tilde{f}}_{33},r\tilde{\tilde{f}}_{33}) \\ (\tilde{\tilde{f}}_{41},r\tilde{\tilde{f}}_{41}) & (\tilde{\tilde{f}}_{42},r\tilde{\tilde{f}}_{42}) & (\tilde{\tilde{f}}_{43},r\tilde{\tilde{f}}_{43}) \\ (\tilde{\tilde{f}}_{51},r\tilde{\tilde{f}}_{51}) & (\tilde{\tilde{f}}_{52},r\tilde{\tilde{f}}_{52}) & (\tilde{\tilde{f}}_{53},r\tilde{\tilde{f}}_{53}) \end{bmatrix}$$

$$A_1 = \begin{array}{c} \text{Academic Calender} \\ \text{Syllabus} \\ \text{Financial Strenth} \\ \text{Staff Exchange} \\ \text{Students Exchange} \end{array} \overset{\begin{array}{ccc} D_1 & D_2 & D_3 \end{array}}{\begin{bmatrix} MG,S & G,VC & MG,VC \\ G,VC & MG,QS & F,NS \\ F,NS & G,S & G,S \\ VG,QS & G,S & VG,QS \\ F,NS & F,S & F,NS \end{bmatrix}}$$

$$A_2 = \begin{array}{c} \text{Academic Calender} \\ \text{Syllabus} \\ \text{Financial Strenth} \\ \text{Staff Exchange} \\ \text{Students Exchange} \end{array} \overset{\begin{array}{ccc} D_1 & D_2 & D_3 \end{array}}{\begin{bmatrix} G,QS & G,QS & MG,VC \\ VG,QC & VG,QS & VG,QS \\ VG,QS & VG,QS & G,S \\ VG,QS & VG,QS & VG,QS \\ VG,QS & MG,VC & G,S \end{bmatrix}}$$

$$A_3 = \begin{array}{c} \text{Academic Calender} \\ \text{Syllabus} \\ \text{Financial Strenth} \\ \text{Staff Exchange} \\ \text{Students Exchange} \end{array} \overset{\begin{array}{ccc} D_1 & D_2 & D_3 \end{array}}{\begin{bmatrix} VG,S & G,QS & F,NS \\ MG,S & G,VC & VG,QS \\ G,S & MG,VC & VG,QS \\ G,S & VG,QS & MG,VC \\ G,S & G,S & MG,VC \end{bmatrix}}$$

Table 5: Fuzzy decision matrix

Alternative	Criteria	Fuzzy Numbers		
A1	C_1	0.5667	0.7667	0.9333
	C_2	0.5	0.7	0.8667
	C_3	0.5667	0.7667	0.9
	C_4	0.8333	0.9667	1
	C_5	0.3	0.5	0.7
A2	C_1	0.6333	0.8333	0.9667
	C_2	0.9	1	1
	C_3	0.8333	0.9666	1
	C_4	0.9	1	1
	C_5	0.7	0.8667	0.9667
A3	C_1	0.7	0.8667	0.9667
	C_2	0.7	0.8667	0.9667
	C_3	0.7	0.8667	0.9667
	C_4	0.7	0.8667	0.9667
	C_5	0.6333	0.8333	0.9667

Table 6: Fuzzy decision matrix

Alternative	Criteria	Z-Numbers		
A1	C_1	0.766667	0.9	0.966667
	C_2	0.333333	0.433333	0.533333
	C_3	0.333333	0.466667	0.633333
	C_4	0.233333	0.433333	0.633333
	C_5	0.166667	0.233333	0.366667
A2	C_1	0.366667	0.533333	0.666667
	C_2	0.1	0.3	0.5
	C_3	0.2333	0.4333	0.63333
	C_4	0.1	0.3	0.5
	C_5	0.5	0.666667	0.8
A3	C_1	0.2	0.333333	0.5
	C_2	0.5	0.666667	0.8
	C_3	0.5	0.666667	0.8
	C_4	0.5	0.666667	0.8
	C_5	0.633333	0.8	0.933333

Table 7: Weights of attributes evaluated by the experts

Attributes	Decision-makers					
	D1		D2		D3	
Academic Calendar	H	S	VH	QS	MH	VC
Syllabus	VH	QS	VH	QS	VH	QS
Financial Strength	VH	QS	H	S	H	S
Staff Exchange	VH	QS	VH	QS	VH	QS
Students Exchange	M	NS	MH	VC	MH	VC

$$\bar{Q} = \begin{bmatrix} AC & SY & FS & SE & SE \\ \tilde{\tilde{q}}_1 & \tilde{\tilde{q}}_2 & \tilde{\tilde{q}}_3 & \tilde{\tilde{q}}_4 & \tilde{\tilde{q}}_5 \end{bmatrix}$$

$\tilde{\tilde{q}}_1 = (0.70, 0.86667, 0.966667), (0.50, 0.666667, 0.80)$

$\tilde{\tilde{q}}_2 = (0.90, 1.00, 1.00), (0.1, 0.3, 0.5)$

$\tilde{\tilde{q}}_3 = (0.766667, 0.933333, 1.00), (0.366667, 0.566667, 0.766667)$

$\tilde{\tilde{q}}_4 = (0.90, 1.00, 1.00), (0.1, 0.3, 0.5)$

$\tilde{\tilde{q}}_5 = (0.433333, 0.633333, 0.833333), (0.6, 0.6667, 0.7)$

$\tilde{\tilde{q}}_1 = (0.84, 0.66)$, $\tilde{\tilde{w}}_2 = (0.97, 0.3)$ $\tilde{\tilde{q}}_3 = (0.90, 0.57)$, $\tilde{\tilde{q}}_4 = (0.96, 0.3)$, $\tilde{\tilde{q}}_5 = (0.63, 0.66)$

$\bar{Q} = (0.86, 0.50)$

Table 8: Weighted decision matrix

Alternative	Criteria	Z-Numbers		
A1	C_1	0.383333	0.6	0.773333
	C_2	0.016667	0.028889	0.042667
	C_3	0.009167	0.017111	0.027867
	C_4	0.004492	0.011122	0.019507
	C_5	0.000538	0.002293	0.001892
A2	C_1	0.183333	0.355556	0.533333
	C_2	0.005	0.02	0.04
	C_3	0.009167	0.017111	0.027867
	C_4	0.001925	0.0077	0.0154
	C_5	0.001613	0.002867	0.004128
A3	C_1	0.1	0.222222	0.4
	C_2	0.025	0.044444	0.064
	C_3	0.01375	0.024444	0.0352
	C_4	0.009625	0.017111	0.02464
	C_5	0.002043	0.00344	0.004816

Table 9: Positive and negative ideal solution

.	Positive (C^+)		Negative (C^-)	
A1	(0.162056)	(0.197219)	(0.470945)	(0.36833)
A1	(0.136759)	(0.942163)	(0.481204)	(0.000978)
A1	(0.136921)	(0.964288)	(0.503587)	(0.000384)
A1	(0.021204)	(0.976761)	(0.832315)	(0.000175)
A1	(0.465819)	(0.996854)	(0.152485)	(3.04E-06)
A2	(0.130445)	(0.433344)	(0.530445)	(0.148158)
A2	(0.012033)	(0.957342)	(0.885367)	(0.000675)
A2	(0.046654)	(0.964288)	(0.740728)	(0.000384)
A2	(0.020833)	(0.983417)	(0.854167)	(0.0001)
A2	(0.242218)	(0.994271)	(0.347403)	(9.29E-06)
A3	(0.164503)	(0.591646)	(0.45191)	(0.073128)
A3	(0.05193)	(0.913269)	(0.694152)	(0.002232)
A3	(0.084104)	(0.951746)	(0.625586)	(0.000675)
A3	(0.05193)	(0.96608)	(0.694152)	(0.000331)
A3	(0.262411)	(0.993147)	(0.334263)	(1.31E-05)

The fuzzy relative closeness of each alternative by solving the models for each TOPSIS-Z-numbers is summarised in the table 10 below.

Table 10: Closeness coefficients

	Closeness Coefficients	Final Results
A1	(0.725639) (0.08317)	0.404404
A2	(0.881326)(0.033317)	0.457321
A3	(0.819945)(0.017002)	0.418474

In conclusion, the best alternative selection is A2 and the ranking order of the alternative of selecting the issues lead to MOU at the University is given by A2 > A3 >A1.

5. Conclusion

The FTOPSIS and Z-numbers method aims at assisting top managers in governance from selection problem (explain what is Alternatives) where there are different experts and various alternatives for example; funding (A1), educational level (A2), policy development (A3), Academic Calendar (C1), Syllabus (C2), Financial Strength (C3), Staff Exchange (C4) and Students Exchange (C5). In this paper, a Z-numbers and FTOPSIS method to handle Memorandum of Understanding at the University have presented. The landscape of the issue is complicated and vague, involving different perspectives of various decisions. Five criteria with three alternatives were evaluated comprehensively by three experts from Top Management in the University. Moreover, this paper used the FTOPSIS method and Z-numbers which delivers an inclusive valuation from a group of specialists centered on the combination of experts' views and preferences. The linguistic scales of Z-numbers were used to evaluate the preferences. It is anticipated that this methods may have more prospective uses in the future.

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References

[1] Angelova, A. L., Aprahamian, M., Grekova, S. P., Hajri, A., Leuchs, B., Giese, N. A., ... & Raykov, Z. (2009). Improvement of gemcitabine-based therapy of pancreatic carcinoma by means of oncolytic parvovirus H-1PV. *Clinical Cancer Research*, *15*(2), 511-519.

[2] Ilieva, G. (2016). TOPSIS Modification with Interval Type-2 Fuzzy Numbers. *Cybernetics and Information Technologies*, *16*(2), 60-68.

[3] Radeva, I. (2013). Multi-Criteria Models for Clusters Design. *Cybernetics and Information Technologies*, *13*(1), 18-33.

[4] Hwang, C. L., & Yoon, K. (1981). Multiple attribute decision making: Methods and applications. Berlin: Springer.

[5] Chen, C. T. (2000). Extension of the TOPSIS for group decision-making under fuzzy environment. *Fuzzy Sets and Systems*, 114, 1–9.

[6] Deng, H., Yeh, C. H., & Willis, R. J. (2000). Inter-company.

[7] Wang, Y. J. (2014). A fuzzy multi-criteria decision-making model by associating technique for order preference by similarity to ideal solution with relative preference relation. *Information Sciences*, *268*, 169-184.

[8] X. Su, S. Mahadevan, W. Han & Y. Deng (2016), Combining dependent bodies of evidence, *Applied Intelligence*, 44, 634–644.

[9] Jiang, W., Xie, C., Luo, Y., & Tang, Y. (2017). Ranking Z-numbers with an improved ranking method for generalized fuzzy numbers. *Journal of Intelligent and Fuzzy Systems*, *32*(3), 1931-1943.

[10] Yaakob, A. M., Serguieva, A., & Gegov, A. (2017). FN-TOPSIS: Fuzzy networks for ranking traded equities. *IEEE Transactions on Fuzzy Systems*, *25*(2), 315-332.

[11] Yaakob, A. M., & Gegov, A. (2015). Fuzzy rule based approach with z-numbers for selection of alternatives using TOPSIS. *Proceedings of the IEEE International Conference on Fuzzy Systems, 2015*, pp. 1-8.

[12] Zadeh, L. A. (2011). A note on Z-numbers. *Information Sciences*, *181*(14), 2923-2932.

[13] Zamri, N., Ahmad, F., Rose, A. N. M., & Makhtar, M. (2016). A Fuzzy TOPSIS with Z-Numbers Approach for Evaluation on Accident at the Construction Site. *Proceedings of the International Conference on Soft Computing and Data Mining*, pp. 41-50.